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Short Communication

Shanghai rising: health improvements as measured by avoidable mortality since 2000

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Abstract

Over the past two decades, Shanghai, the largest megacity in China, has been coping with unprecedented growth of its economy and population while overcoming previous underinvestment in the health system by the central and local governments. We study the evolution of Shanghai's healthcare system by analyzing "Avoidable Mortality" (AM) – deaths amenable to public health and healthcare interventions, as previously defined in the literature. Based on analysis of mortality data, by cause of death, from the Shanghai Municipal Center for Disease Control and Prevention, we analyze trends over the period 2000–10 and compare Shanghai's experience to other mega-city regions – New York, London and Paris. Population health status attributable to public health and healthcare interventions improved dramatically for Shanghai's population with permanent residency status. The age-adjusted rate of AM, per 1,000 population, dropped from 0.72 to 0.50. The rate of decrease in age-adjusted AM in Shanghai (30%) was comparable to New York City (30%) and Paris (25%), but lower than London (42%). Shanghai's establishment of the Municipal Center for Disease Control and Prevention and its upgrading of public health and health services are likely to have contributed to the large decrease in the number and rate of avoidable deaths, which suggests that investments in public health infrastructure and increasing access to health services in megacities – both in China and worldwide – can produce significant mortality declines. Future analysis in Shanghai should investigate inequalities in avoidable deaths and the extent to which these gains have benefitted the significant population of urban migrants who do not have permanent residency status.

Keywords: Shanghai, Urban Health, Amenable Mortality

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Background

Increasing urbanization, worldwide, makes the city a strategic unit of analysis for understanding the health sector. Shanghai shares many characteristics in common with other world cities such as New York, London, Tokyo, Hong Kong and Paris (1). These cities are centers of economic growth and finance, culture and media, sophisticated transportation systems, excellence in medical care, top ranking medical schools, institutes of biomedical research, and public health infrastructure. They are also characterized by glaring inequalities (2), attracting some of the poorest as well as the wealthiest populations of their nations. For all these reasons, world cities consider themselves unique within their respective nations but can be compared to one another to explore what lessons might be learned from abroad (3).

Shanghai, the largest megacity in China, and one of the largest in the world (23.46 million inhabitants in 2011), experienced remarkable economic growth over the past three decades; and since the 1990s, the fastest economic growth of any city worldwide (4). As with other megacities in emerging industrialized nations, Shanghai has faced massive health challenges because the need for such amenities as clean drinking water, safe food and basic housing, threatened to grow faster than the city's capacity to develop its infrastructure (5). Well before megacities in the Pearl River Delta Region, Shanghai confronted unprecedented population and economic growth while trying to overcome decades of underinvestment in the health system by the central and local governments (6).

Shanghai's healthcare system – like that of other world cities – offers some of the most advanced health services while at the same time revealing challenges in assuring equitable access to healthcare. As one of forty city-regions responsible for over two-thirds of the world's economy and most of its innovation (7), it is important to study how such megacities are adapting their public health infrastructure and healthcare systems to accommodate aging populations and the growth of chronic disease. As noted by Shanghai's former Vice Mayor, Shen Xiaoming, the city's healthcare provision has far exceeded national standards (8) and, as others have documented, Shanghai is an outlier within China (4). Beyond this characteristic of world cities, an important question for urban health policy is whether the resources invested to upgrade healthcare services and the establishment of the Shanghai Municipal Center for Disease Control and Prevention have contributed to health improvements (9).

We present here an empirical analysis of Avoidable Mortality (AM) – deaths for causes amenable to healthcare interventions, in Shanghai, over the period 2000–10. It is

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designed to capture important dimensions of health system performance and represents, so far as we know, the first attempt to use this indicator with mortality data from China. We present evidence on the decline of AM for Shanghai's registered population, compare Shanghai's record with trends in some of its world city counterparts – London, New York City and Paris – and discuss the factors that may account for Shanghai's health improvements. To provide a context for this analysis, we begin by reviewing the evolution of public health and the healthcare system in Shanghai.

The evolution of Shanghai's public health and healthcare system

The establishment of the Shanghai Municipal Center for Disease Control and Prevention in 1998 was the precursor to the Chinese Center for Disease Control and Prevention, in Beijing, and to similar institutions in 28 province-level regions (10). Since then, Shanghai launched major efforts to improve its public health and healthcare delivery system. In 2000, Shanghai implemented a community health reform designed to improve access to and continuity of care for older people (11). The city also continued to improve its primary care and public health systems. Although the central government called for a minimum per capita expenditure of RMB 25 Yuan for public health initiatives in central and western China, Shanghai allocated RMB 70-80 Yuan (12). By 2001, Shanghai's government budget for disease prevention services was 6.7 times higher than the lowest spending city (Chongqing) in China (13).

Following the outbreak of SARS in 2002, Shanghai increased investment in public health services, including public health surveillance, medical research, and the expansion of the healthcare workforce. It also improved its emergency medical response capacity and chronic disease management. By 2010, Shanghai had become a leader in China's health reform. It established a basic health insurance system for employees in 1999 and expanded it to unemployed urban residents in 2007 (14). In addition, Shanghai strengthened its Center for Disease Control and Prevention, and invested significantly in the development of community-based health services – immunization, disease prevention services for women and infants, and chronic disease management (15). These services have been widely available in community health centers, medical clinics, and infirmaries.

Avoidable Mortality (AM) as a measure of health system performance

Our health status may depend on behavior and lifestyle, the environment in which we live, and our genes more than on the healthcare we receive, but for people with illness for which treatment exists, access to timely and effective healthcare is crucial. Healthcare interventions contribute relatively little to broad indicators of health status (16,17). Nevertheless, there is solid clinical evidence that some causes of premature death are amenable to such interventions. For example, maternal death can be prevented with antibiotics, safe blood transfusions, and emergency surgical care (18) and premature death due to breast cancer can be reduced through screening and early detection (19).

The concept of AM, originally developed by Rutstein and colleagues (20), grows out of the notion that an avoidable death signals evidence of health system failure. Although AM represents only one dimension of health system performance, it has been widely adopted in Europe (21) and the Organization for Economic Cooperation and Development (OECD) has begun publishing rates of AM across its member states (22). As a measure of health system performance, AM assumes that healthcare, as well as health education and screening, have made an appreciable contribution to the decline in mortality for selected diagnoses (23). Cross-national analysis of recent trends indicates that "avoidable deaths" have declined faster than other causes of mortality lending some credence to the validity of AM as an indicator for public health interventions and medical care (24,25). Moreover, analysis across states in the U.S. provides evidence that improvements in multiple dimensions of health system performance are correlated to declines in AM (26).

We rely on the definition of AM (Table 1), as previously used in the literature by Nolte and McKee (24). Their list of causes of premature death is, in turn, a modification of the work of Rutstein *et al.* (20), Tobias and Jackson (27), Mackenbach *et al.* (28), and Charlton and colleagues (29). AM assumes that healthcare can prevent premature death, under 75 years of age, from diseases amenable to a combination of different interventions, including public health prevention services, primary care, as well as selected specialized medical care services. In comparisons of national healthcare systems (30), as well as cities (31,32), AM is recognized as an important dimension of performance. Most recently, Hoffman and colleagues (33) have provided further validation for most of the causes of death noted by Nolte and McKee (24). Since mortality from these causes may also reflect socio-demographic factors, in comparison to more frequently used indicators of population health in China, based on life expectancy at birth, infant mortality or analyses of disease burden (34,35), AM captures an important dimension of health system performance.

Methods

For Shanghai, data on population and disease-specific deaths for the period 1999-2010 are from the Shanghai Municipal Center for Disease Control and Prevention. In contrast to New York City, Paris and London where mortality data include all city residents, the Shanghai data include information only for the 14.9 million registered permanent residents. We compare Shanghai to New York City, with a population of 8.0 million in 2000, to Greater London (7.3 million) and Paris, including the 3 *départements* of its first ring (6.2 million). For New York City, data on mortality are from the Bureau of Vital Statistics of the New York City Department of Health and Mental Hygiene and data on population are from the U.S. Bureau of the Census. For Greater London (the 33 boroughs to which we refer as London) data on mortality are from the Office of National Statistics. For Paris (for which we include Paris *intra-muros* and the 3 *départements* of the first ring), data on mortality are from the *Institut National de la Santé et de la Recherche Médicale* (INSERM) and data on population

are from the *Institut National de la Statistique et des Etudes Economiques* (INSEE).

To calculate rates of AM, we rely on Nolte and McKee's definition of causes of death (Table 1). The original Nolte and McKee definition includes codes that capture more than 80% of the deaths included in the definition that McKee used more recently in collaboration with Hoffman and colleagues (33). We adopt their more restricted definition by counting only 50% of the deaths from Ischemic Heart Disease (IHD). Although primary prevention contributes significantly to reductions in mortality from IHD, it would be inappropriate to include all IHD deaths because other factors, including genetics, diet and smoking, contribute to these deaths. Our approach is consistent with the clinical literature, which finds that a considerable proportion of deaths due to IHD are amenable to some level of public health and healthcare interventions (36).

The upper age limit adopted by our definition was set at 75 years since the likelihood that a condition will be amenable to intervention, especially in light of the high probability of serious comorbidities as well as the reliability of death certification, is lower at older age. To age-adjust these data for cohorts under 75 years of age, we employed the direct method using weights derived from the 2010 United Nations (UN) world standard population (37,38). Tables 2 and 3 show the number of deaths, the age-specific rates, and the age-adjusted rates by leading causes of death.

Table 1. Selected avoidable causes of mortality, age group 1–74

Cause of death	ICD-9 codes	ICD-10 codes
Tuberculosis	010-018,137	A15-19, B90
Septicemia	38	A40-41
Malignancy of colon and rectum	153-154	C18-21
Malignancy of skin	172-173	C44
Malignancy of breast	174-175	C50
Malignancy of cervix and uterus	179,180,182	C53-55
Malignancy of testis	186	C62
Hodgkin's disease	201	C81
Leukemia	204-208	C91-95
Endocrine diseases, including diabetes mellitus	240-279	E0-69
Epilepsy	345	G40-41
Hypertension	401-405	I10-13
Cerebrovascular disease	430-438	I60-69
Influenza	487	J10-11
Pneumonia	480-486	J12-18
Ischemic heart disease*	410-414	I20-25
Peptic ulcer	531-533	K25-27
Appendicitis, abdominal hernia and gallbladder disease	540-543; 550-553; 574.0-575.1	K35-38; K40-46; K80-82
Nephritis and nephrosis	580-589	N0-7, 17-19, 25-27
Benign prostatic hyperplasia	600	N40
Maternal death	630-676	O00-99

Source: Nolte and McKee (24)

Table 2. Leading causes of AM in Shanghai, 2000

2000	Number of deaths	Age-specific rate/1000	Age-adjusted rate/1000
Cerebrovascular disease	7530	0.57	0.36
Ischemic heart disease*	2495	0.19	0.12
Malignancy of colon and rectum	1493	0.11	0.08
Endocrine diseases, including diabetes mellitus	1299	0.10	0.06
Malignancy of breast	580	0.04	0.03
Nephritis and nephrosis	494	0.04	0.02
Leukemia	488	0.04	0.03
Hypertension	350	0.03	0.02
Tuberculosis	181	0.01	0.01
Malignancy of cervix and uterus	166	0.03	0.02

AM= Avoidable Mortality

Source: Shanghai Municipal Center for Disease Control and Prevention; calculations by authors.

*All deaths attributed to ischemic heart disease

Table 3. Leading causes of AM in Shanghai, 2010

2010	Number of deaths	Age-specific rate/1000	Age-adjusted rate/1000
Cerebrovascular disease	4753	0.34	0.20
Ischemic heart disease*	2069	0.15	0.09
Malignancy of colon and rectum	1648	0.12	0.07
Endocrine diseases, including diabetes mellitus	1410	0.10	0.06
Malignancy of breast	715	0.05	0.03
Leukemia	462	0.03	0.03
Hypertension	400	0.03	0.02
Nephritis and nephrosis	284	0.02	0.01
Malignancy of cervix and uterus	239	0.03	0.02
Pneumonia	171	0.01	0.01

AM= Avoidable Mortality

Source: Shanghai Municipal Center for Disease Control and Prevention; calculations by authors.

*All deaths attributed to ischemic heart disease

Results

During the period 2000-10, the age-adjusted rate of AM in Shanghai dropped from 0.72 to 0.50 per 1,000 population (Figure 1). Cerebrovascular Disease (CVD) was the leading cause of AM in Shanghai from 2000 through 2010, but the age-adjusted rate of deaths due to CVD decreased from 0.36 per 1,000 to 0.20 per 1,000 during this time period (Tables 2 and 3).

Similarly, the age-adjusted rate of IHD fell from 0.12 to 0.09 per 1,000 between 2000 and 2010. Tuberculosis fell out of the top 10 causes of AM by 2010. The age-adjusted rate of AM is lower in Shanghai than in London and New York City and higher than in Paris (Figure 1). These city-level differences reflect the fact that AM is influenced by a combination of

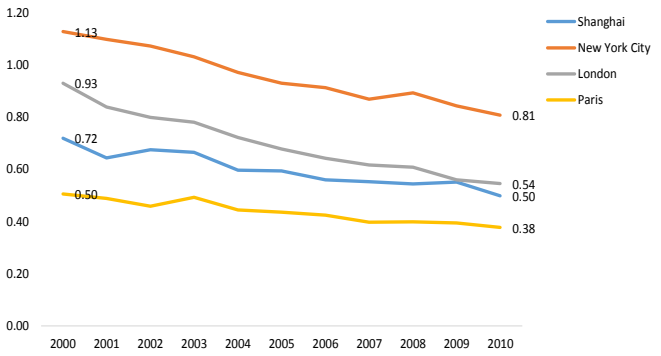

Figure 1. Avoidable mortality in London, New York, Paris and Shanghai, ages 0–74, 2000–10

population characteristics, socio-economic status and what Schoenbaum and colleagues (25) call "health-care related variables" related to health system performance. Within these cities, the rate of decrease in age-adjusted AM in Shanghai between 2000 and 2010 (30%) was comparable to decreases in New York City (30%) and Paris (25%), but less than the decrease in London (42%) (Figure 1). By 2010, the age-adjusted rate of AM in Shanghai was comparable to London.

Limitations of study

Our study has several limitations. First, the accuracy and completeness of death records may be subject to coding errors. We obtained the primary cause of mortality from death certificates, but we were unable to control for other causes of death when multiple causes applied. Second, although AM is more closely related to the healthcare system than conventional measures of population health status, e.g. life expectancy at birth, our capacity to identify the precise contribution of healthcare is limited. People who die prematurely from cancer or IHD may not have benefited from disease prevention services, or may have been engaged in risky behavior, or once they were diagnosed with IHD or cancer, did not receive appropriate medical care. Yet there is evidence from Beijing that during the period 1984–99, without improvements in healthcare, mortality from IHD would have increased much faster than it actually did (39). Finally, because data from Shanghai include only deaths among registered permanent residents, we do not know how inclusion of Shanghai's large migrant population (9.4 million in 2010) would affect Shanghai's aggregate rate of AM.

Discussion

As policy-makers strive to implement healthcare reforms, the experience of Shanghai suggests that public health infrastructure investments and improved access to medical services in megacities – both in China and worldwide – can produce significant mortality declines.

With its rapidly ageing population, urbanization and changes in diet and lifestyle, the Chinese healthcare system still faces immense challenges. Park and Cai (40) remind us that 46% of the employed population work in the informal sector and half of these employees are excluded from health insurance coverage. Recent evidence suggests that there are large socio-economic inequalities in health status within Chinese cities (41). Zhao and colleagues (42) provide evidence that migrant women in Shanghai face significant access barriers to prenatal care. Shanghai's Municipal Commission of Health and Family Planning report that in 2012, the Maternal Mortality Rate (MMR) faced by migrants was 9.8 (per 100,000 births), 2.3 times higher than that of permanent residents (4.27). Such evidence, along with the fact that the infant mortality rate for the migrant population (6.79 per 1,000 live births) was 2.5 times higher than for permanent residents (2.72) suggests that despite Shanghai's significant health improvements, particularly since 2007, the challenge of assuring equitable access to healthcare remains (43).

Studying rates of AM does not allow us to evaluate specific public health interventions, but they are a useful indicator for aggregate assessment of a health system's overall performance. Our analysis of changes in these rates, in Shanghai, over the past decade suggests that public health and healthcare interventions have contributed to a large decrease in the number and rate of avoidable deaths. Future analysis should investigate neighborhood-level inequalities in rates of AM and the extent to which the improvements in Shanghai's health system have reached the 41% of its population (9.6 million) who are migrants and have no permanent residency status (44). Recent improvements suggest that this challenge is recognized, but in spite of efforts to expand health insurance coverage for migrants, there is evidence that most are not eligible for benefits (45,46). Our finding on the steep decline of AM among Shanghai's registered population suggests that Shanghai has indeed made significant health system improvements over the 2000-10 period. While Shanghai's substantial investment in public health raises critical questions about regional equity within China, the decrease in AM we have found suggests that Shanghai's urban health infrastructure and healthcare services, coupled with health reform at the national level has probably contributed to these health improvements.

Conclusion

Our finding on the steep decline of AM among Shanghai's registered population suggests that Shanghai has indeed made significant health system improvements over the 2000–10 period.

This accomplishment, as well as the enormous challenges associated with changes in lifestyle, population ageing and migration, reflect improvements in the broader social determinants of health. Yet it is hard to believe that Shanghai's investments in its public health and the healthcare system did not also play an important role. For example, the substantial decrease in CVD and IHD, between 2000 and 2010, probably reflects the healthcare system improvements noted earlier, particularly those related to the expansion of primary care, emergency care, and ICU services. Although there are widespread concerns about increases in the rate of Non-Communicable Disease (NCD) across China, our findings indicate that age-adjusted death rates associated with many types of NCD have either decreased or remained stable in Shanghai between 2000 and 2010. Further investments in public health, changes

in lifestyle and environment associated with urbanization may prevent additional premature deaths associated with NCD. In addition, current policies to rationalize the spatial distribution of hospitals, implement a massive IT system and begin the process of integrating hospital and primary care, may sustain these improvements (8).

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Ethical issues

Not applicable.

Competing interests

Authors declare that they have no competing interests.

Authors' contributions

All authors contributed to the design of the research. CW, LL, DW, and MKG conducted the data analysis. MKG and VGR drafted the first version of the manuscript. All authors contributed to subsequent and final drafts of the paper and approved its final version.

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References

1. Gusmano MK, Rodwin VG, Weisz D. *Health Care in World Cities: New York, Paris, and London*. Baltimore: Johns Hopkins University Press; 2010.
2. Fainstein S. Inequality in global city-regions. In: Scott AJ, editor. *Global City-Regions: Trends, Theory, Policy*. New York: Oxford University Press; 2002.
3. Rodwin VG, Gusmano MK. *Growing Older in World Cities: New York, London, Paris and Tokyo.* Nashville: Vanderbilt University Press; 2006.
4. Chen X. *Shanghai Rising: State Power and Local Transformations in a Global Megacity*. Minneapolis, MN: University of Minnesota Press; 2009.
5. Krämer A, Khan MH, Kraas F. *Health in Megacities and Urban Areas*. New York: Springer Publishing; 2007.
6. Fabre G, Rodwin VG. Public health and medical care for the world's factory: China's Pearl River Delta Region. *BMC Med* 2011; 9: 110. doi: 10.1186/1741-7015-9-110
7. Khanna P. When cities rule the world. McKinsey & Company; 2011 [updated February 2011; cited 2014 Dec 12]. Available from: http://www.mckinsey.com/insights/urbanization/when_cities_rule_the_world
8. Cheng TM. Explaining Shanghai's health care reforms, successes, and challenges. *Health Aff (Millwood)* 2013; 32: 2199-204. doi: 10.1377/hlthaff.2013.1136
9. Peng J, Zhang SN, Lu W, Chen AT. Public health in China: The Shanghai CDC perspective. *Am J Public Health* 2003; 93: 1991-3. doi: 10.2105/AJPH.93.12.1991
10. On improving the city's community health services: research report. Shanghai Municipal Health Bureau; 2010.
11. Wei X, Zakus D, Liang H, Sun X. The Shanghai case: A qualitative evaluation of community health reform in response to the challenge of population ageing. *Int J Health Plann Manage* 2005; 20: 269-86.
12. Tang S. Public Health Programs in China: Has Reform Improved Equity and Effectiveness? China Health Policy Report. Duke Global Health Institute; 2013.
13. Claeson M, Wang H, Hu S. *A Critical Review of Public Health in China*. Washington, DC: World Bank; 2004.
14. Li Z, Jiale H, Lin L, Shenglan T, Jin M. On residents' satisfaction with community health services after health care system reform in Shanghai, China. *BMC Public Health* 2012; 12: S9. doi: 10.1186/1471-2458-12-s1-s9
15. Shanghai Municipal Health Bureau. On improving the city's community health services: research report; 2010.
16. Preston SH, Ho J. Low life expectancy in the United States: Is the health care system at fault? PSC Working Paper Series; 2009.
17. Schroeder S. We can do better: Improving health for the American people. *N Engl J Med* 2007; 357: 1221-8. doi: 10.1056/nejmsa073350
18. Rosenfield A, Maine D. Maternal mortality – a neglected tragedy: Where is the M in MCH? *Lancet* 1985; 326: 83-5. doi: 10.1016/s0140-6736(85)90188-6
19. Peto J, Gilham C, Fletcher O, Matthews FE. The cervical cancer epidemic that screening has prevented in the UK. *Lancet* 2004; 364: 249-56. doi: 10.1016/s0140-6736(04)16674-9
20. Rutstein DD, Berenberg W, Chalmers TC, Child CG, Fishman AP, Perrin EB. Measuring the quality of health care. *N Engl J Med* 1976; 294: 582-8.
21. Holland W. *European Community Atlas of Avoidable Death*. Oxford: Oxford University Press; 1993. p. 1985-9.
22. Gay J, Paris V, Devaux M, de Looper M. Mortality amenable to health care in 31 OECD countries: Estimates and methodological issues. OECD Health Working Papers, OECD Publishing, No. 55; 2011. doi: 10.1787/5kgj35f9f8s2-en
23. Nolte E, McKee M. *Does health care save lives? Avoidable mortality revisited*. London: Nuffield Provincial Hospitals Trust; 2004.
24. Nolte E, McKee M. Measuring the health status of nations: updating an earlier analysis. *Health Aff (Millwood)* 2008; 27: 58-71. doi: 10.1377/hlthaff.27.1.58
25. Niti M, Ng TP. Temporal trends and ethnic variations in amenable mortality in Singapore 1965-1974: The impact of health care in transition. *Int J Epidemiol* 2001; 30: 966-73. doi: 10.1093/ije/30.5.966
26. Schoenbaum S, Schoen D, Nicholson J, Cantor J. Mortality amenable to health care in the United States: The roles of demographics and health systems performance. J Public Health Policy 2011; 32: 407-29. doi: 10.1787/eco_surveys-hun-2012-graph46-en
27. Tobias M, Jackson G. Avoidable mortality in New Zealand, 1981-97. *Aust N Z J Public Health* 2001; 25: 12-20. doi: 10.1111/j.1467-842X.2001.tb00543.x
28. Mackenbach JP, Looman AL, Kunst JD, Habbena I, van der Maas PJ. Post-1950 mortality trends and medical care: Gains in life expectancy due to declines in mortality from conditions amenable to medical intervention in the Netherlands. *Soc Sci Med* 1998; 27: 889-94. doi: 10.1016/0277-9536(88)90278-x
29. Charlton J, Silver R, Hartley R, Holland W. Geographical variation in mortality from conditions amenable to medical intervention in England and Wales. *Lancet* 1983; 321: 691-6. doi: 10.1016/s0140-6736(83)91981-5
30. Nolte E, McKee M. In amenable mortality--deaths avoidable through health care--progress in the US lags that of three European countries. *Health Aff (Millwood)* 2012; 31: 2114-22. doi: 10.1377/hlthaff.2011.0851
31. Chau PH, Woo J, Chan KC, Weisz D, Gusmano MK. Avoidable mortality pattern in a Chinese population—Hong Kong, China. *Eur J Public Health* 2010; 21: 215-20. doi: 10.1093/eurpub/ckq020
32. Weisz D, Gusmano MK, Rodwin VG, Neuberg LG. Population

health and the health system: a comparative analysis of avoidable mortality in three nations and their world cities. *Eur J Public Health* 2008; 18: 166-72. doi: 10.1093/eurpub/ckm084

33. Hoffman R, Plug I, Khoshaba B, McKee M, Mackenbach JP, AMIEHS working group. Amenable mortality revisited: the AMIEHS study. *Gaceta Sanitaria* 2013; 27: 199-206. doi: 10.1016/j.gaceta.2012.08.004
34. Liu Y, Rao K, Wu J, Gakidou E. China's health system performance. *Lancet* 2008; 372: 1914-23. doi: 10.1016/s0140-6736(08)61362-8
35. Kraemer A, Fisscher F, Plass D, Pinheiro P, Ling L, Sang Y, *et al*. Burden of disease in China: Contrasting disease burden patterns of the general and the migrant workers populations. Working Paper 2014-11. United Nations Research Institute for Social Development; 2014.
36. Capewell S, Beaglehole R, Seddon M, McMurrey JJ. Explanation for the decline in coronary heart disease mortality in Auckland, New Zealand between 1982 and 1993. *Circulation* 2000; 102: 1511-6. doi: 10.1161/01.cir.102.13.1511
37. Klein RJ, Schoenborn CA. Age-adjustment using the 2000 projected U.S. population. Health People 2010 Statistical Notes No. 20; 2001.
38. World Population Estimates [Internet]. United Nations; 2013. [cited 2014 August 26]. Available from: http://esa.un.org/wpp/Excel-Data/population.htm
39. Critchley J, Liu J, Zhao D, Wei W, Capewell S. Explaining the increase in coronary heart disease mortality in Beijing between 1984 and 1999. *Circulation* 2004; 110: 1236-44. doi: 10.1161/01.cir.0000140668.91896.ae
40. Park A, Cai F. The informalization of the Chinese labor market. In: Kuruvilla S, Lee CK, Gallagher M, editors. *From Iron Rice Bowl to Informalization: Markets, State and Workers in a Changing China*. Ithaca: Cornell University Press; 2011.
41. Yang W, Kanavos P. The less healthy urban population: income-related health inequality in China. *BMC Public Health* 2012; 12: 1-15. doi: 10.1186/1471-2458-12-804
42. Zhao Q, Huang ZJ, Yang S, Pan J, Smith B, Xu B. The utilization of antenatal care among rural-to-urban migrant women in Shanghai: a hospital-based cross-sectional study. *BMC Public Health* 2012; 12: 1012. doi: 10.1186/1471-2458-12-1012
43. Shanghai Municipal Health and Family Planning Commission [internet]. 2006. [cited 2014 October 22]. Available from: http://www.shanghai.gov.cn/shanghai/node27118/n31193/n31212/index.html
44. Nivard J. Shanghai's point redemption scheme for residence permit [internet]. Urbachina; 2013. [updated 2013 July 25]. Available from: http://urbachina.hypotheses.org/5999
45. Shao Xi. Study finds migrant workers excluded from insurance coverage. Caixin Online [serial on the internet]. [updated 2014 October 13; cited 2014 October 22]. Available from: http://english.caixin.com/2014-10-13/100737927.html
46. Zhao Y, Kang B, Liu Y, Li Y, Shi G, Shen T, *et al*. Health insurance coverage and its impact on medical cost: observations from the floating population in China. *PLOS One* 2014; 9: e111555. doi: 10.1371/journal.pone.0111555