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Health Improvements in BRIC Cities: Moscow, São Paulo, and Shanghai, 2000–10

Michael K. Gusmano, Victor G. Rodwin, Daniel Weisz, and Rafael Ayoub

We compare health improvements among three megacities in BRIC nations as measured by declines in amenable mortality (AM). Although there have been studies of AM in Brazil and the Russian Federation using different definitions and age cohorts, this indicator has never been used to compare these cities. During the period 2000–10, age-adjusted rates of all leading causes of AM fell in all three cities. In São Paulo, it dropped from 1.57 to 1.19 per 1,000 population. In Moscow, it fell from 2.10 to 1.40, and in Shanghai, from 0.72 to 0.54. The rate of decrease was highest in Moscow (33 percent), followed by Shanghai (30 percent), and São Paulo (24 percent). All three cities experienced large reductions in chronic cardiovascular diseases in the form of IHD and stroke, but they remain the leading causes of premature death. Our finding of the decline of AM deaths in São Paulo, Moscow, and Shanghai suggests that all three health systems made significant improvements over the 2000–10 period. It will be important to monitor this indicator as economic growth in these countries and cities has slowed considerably since 2010.

KEY WORDS: amenable mortality, health system performance, megacities

Introduction

Urban health in developing countries is worthy of increasing interest since United Nations (UN) demographers project two billion more urban dwellers by 2030 (UN, 2014) and over 90 percent of them will reside in low- and middle-income countries. Global health will increasingly depend on our capacity to improve the health of these urban populations (Sclar, Garau, & Carolini, 2005). The urban advantage hypothesis suggests that cities are engines of economic growth, opportunity, and innovation and can promote population health by focusing on social determinants, public health infrastructure, and provision of critical health-care resources. The urban penalty hypothesis, in contrast, emphasizes the convergence of high population density with the risks of infectious disease, bioterrorism, and inadequate public health infrastructure (Vlahov, Gibble, Freudenberg, & Galea, 2004). Add to these risks the growth of slums, the increase

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of intra-urban income inequalities, and Richard Horton's warning seems prescient: "... for all of its rational efficiency and benevolent intent, the city is likely to be the death of us" (Horton, 1996).

The UCL *Lancet* Commission reviews strategic interventions to "create and maintain the so-called urban advantage" (Rydin et al., 2012). Absent from the urban health literature are comparative analyses of the extent to which specific cities have produced health improvements and how they have done so. Among wealthy world cities, health systems in New York, Paris, and London have been compared, but their experience is less relevant to exploding cities in developing nations. Here, we compare health improvements among three megacities in BRIC nations—São Paulo, Moscow, and Shanghai—as measured by declines in deaths amenable to health-care interventions—premature deaths from causes for which there are effective public health and health-care interventions, otherwise known as amenable mortality (AM). Although there have been studies of AM in Brazil and the Russian Federation using different definitions and age cohorts, so far as we know, this indicator, as most commonly used among Organisation for Economic Co-operation and Development (OECD) nations, has never been used to compare these cities.

São Paulo, Moscow, and Shanghai, with their respective populations of 11.2, 11.5, and 23 million inhabitants (Table 1), have been challenged by HIV/AIDS, an influx of migrants, and demands from their wealthy populations to deliver state-of-the art health care while simultaneously confronting the effects of population aging, inadequate public health infrastructure, and glaring social inequalities. Since these cities operate within the context of national governments that proclaim a commitment to universal health coverage (UHC), comparative analysis of the progress they have achieved is timely.

The National Context for Health Improvements

Like global cities in wealthy nations, São Paulo, Moscow, and Shanghai contribute disproportionately to their nations' economic growth and have significantly higher levels of gross domestic product (GDP) per capita (Table 1). Over the 2000–10 period, they all benefited from their nations' high rates of economic growth (Table 1). Average annual rates of government health-care expenditures, per capita (in purchasing power parities [PPPs]), rose even more: by 25.4 percent in Brazil, 23.9 percent in Russia, and 37.8 percent in China. All of these cities spend far more on health care, per capita, than their nations, as a whole, and have a higher concentration of health-care resources.

São Paulo

São Paulo benefited from Brazil's adoption of the Unified Health System (SUS), in 1988, and the Family Health Strategy (FHS) for the poor in 1994 (Macinko & Harris, 2015). The SUS offers comprehensive health coverage, free of charge at the point of service. The FHS expands primary care to the poorest areas of the country, including poor neighborhoods in São Paulo. Together with SUS,

Table 1. Economic and Health Improvements in São Paulo, Moscow, and Shanghai

	Brazil	Russia	China
GDP per capita (in PPP)			
2000	9,139	10,462	2,907
2010	14,342	21,210	9,215
Average annual GDP/per capita growth rates[1]			
2000–10	3.70%	5.40%	9.40%
Per capita govt. expenditure on health (in PPPs)[1]			
2000	205	221	50
2010	583	751	239
Average annual increase	25.4%	23.9%	37.8%
Health expenditure as % of GDP[1]			
2000	7.2	5.4	4.6
2010	9	6.9	5
	São Paulo	Moscow	Shanghai
Population[2]			
2000	10,434,252	10,126,424 (2002)	16,407,734
2010	11,253,503	11,503,501	23,019,196
GDP per capita (in PPP)[3]			
2000	$8,542.01	$40,805 (2009)	$9,132 (2000)
2010	$22,267.44	$44,774 (2012)	$19,344 (2010)
Life expectancy at birth[4]			
2000	72.75	72.4	78.8[5]
2010	76.3	74.9	82.13
Age-adjusted total premature mortality rates			
2000	4.76/1000	6.05/1000	2.46/1000
2010	3.44/1000	4.26/1000	1.88/1000

Sources: 1. Russian Federation and China, World Bank. These figures are presented in purchasing power parities (PPPs); Brazil, Ministério da Saúde-Secretaria Executiva/Área de Economica de Saúde e E Desenvolimento−SIOPS. 2. Inst Brasileiro de Geografia e Estatistica, Russia 2010 Census, National Bureau of Statistics of China; 3. Inst Brasileiro de Geografia e Estatistica, http://www.undp.ru/documents/nhdr2011eng.pdf, National Bureau of Statistics of China; 4. [1] Instituto Brasileiro de Geografia e Estatistica, http://knoema.com/atlas/Russian-Federation/Moscow-Region/topics/Health/Heath-care/Life-expectancy-at-birth, https://lsecities.net/media/objects/articles/urbanisation-and-disease-patterns-in-shanghai/en-gb/, Shanghai Statistics Bureau; 5. Shanghai Statistical Yearbook 2011. (n.d.). Retrieved November 20, 2015, from http://www.stats-sh.gov.cn/tjnj/nje11.htm?d1=2011tjnje/E0204.htm.

the FHS resulted in enormous growth of ambulatory care facilities and massive strengthening of the primary care system (Gragnolati, Couttolenc, & Lindelow, 2012). Since there are no user fees for the services and most medications are free of charge, the program is popular and has significantly increased health-care coverage with striking effects on infant mortality (Macinko, Guanais, de Fatima, & de Souza, 2006) access to primary care (Macinko et al., 2010) and declines in AM during 1983–02 (de Abreu, César, & França, 2009).

Government health-care spending, per capita, increased significantly between 2000 and 2013. For the state of São Paulo, while the average annual rate of increase in per capita spending over the 2000–10 period (21.5 percent) was slightly lower than for Brazil as a whole (25.4 percent), the level of per capita public spending in São Paulo remained higher than for the nation over the entire period. Also, among the 26 states' capital cities, São Paulo is among the top four in per capita SUS consultations and these have increased at a higher rate (66 percent) over the 2000–10 period than for Brazil (10 percent). Since the share of population with private health insurance (43.6 percent) is higher than the national average (25 percent), and the number of private hospital beds is also higher, it is evident that the growth of health-care investments in São Paulo has been substantial by Brazilian standards (Sı́ntese de Indicacares Sociais, 2013).

Moscow

Moscow, and its surrounding region, is by far the wealthiest among the 83 administrative regions of the Russian Federation. Mean monthly household income in the Moscow region, in 2011 (47,319 rubles), is more than twice that of the average for the Federation (20,000 rubles) and the region also has the highest income inequalities (Lane, 2013). Households among the top 20 percent received 55.1 percent of citywide income and those among the bottom 20 percent received only 3.8 percent. Public expenditure on health care, per capita, in 2009, places the Moscow region among the highest and the city of Moscow as the highest spender (14,094 rubles) (Popovic et al., 2011). In addition to public spending, the level of private health-care expenditures and institutions is also among the highest in the Russian Federation. Moscow ranks among those cities with the highest number of hospital beds, physicians, and nurses in Russia.

Following the collapse of the Soviet Union, in 1991, Moscow suffered greatly. The decline in public spending on health care, which had already begun in the 1980s, accelerated during the 1990s. Along with declines in population health reflecting unprecedented levels of unemployment, hyperinflation, vagrancy, and alcoholism, there is evidence that the health system also contributed as there were increases in AM, in 1994 and during 1998–00 (Andreev, Nolte, Shkolnikov, Varavikova, & McKee, 2003). In the late 1990s, Russia's health indicators dropped to their lowest levels since the 1960s, with male life expectancy at birth falling to 58 years.

Beginning in 2000 until 2008, as Russia's economy entered a period of strong growth, President Putin relied on budgetary surpluses to address population decline by improving care for pregnant women and newborns and developing programs to improve access and quality of care for TB, cancer, and heart disease, which accounted for a large share of the high mortality rates. In 2005, Putin announced a $4 billion program of national health-care investments to improve the delivery system (Aris, 2005). By 2006, health spending finally rose to pre-transition levels (Marquez, 2008), and continued to grow throughout the rest of the decade.

Shanghai

Throughout the 2000–10 period, Shanghai increased investments in public health and primary care and expanded health insurance for city residents. By 2010, Shanghai had become a leader in China's health reform. Long before the reform of 2009 calling for UHC and increased financing for public health, essential drugs, and an expansion of primary health-care facilities (Wang, Gusmano, & Cao, 2010), Shanghai had taken steps to counteract some of the problems created by China's market liberalization in the 1980s. After the central government reduced support for the health sector and local health organizations responded by focusing on profitable services and often ignoring public health and primary care, the Shanghai government took steps to counteract these trends. It established the first Municipal Center for Disease Control and Prevention (CDCP) in China in 1998 (Cheng, 2013) and in 2000 it implemented a community health reform to improve access continuity of care for older people (Wei, Zakus, Liang, & Sun, 2005).

Following China's creation of a basic health insurance system for salaried employees, in 1999, the Shanghai government expanded it to unemployed urban residents in 2007. By this time, it had also strengthened its CDCP and invested significantly in the development of community-based health services—immunization, disease prevention services for women and infants, and chronic disease management. These services were widely available in community health centers, medical clinics, and infirmaries. Over the 2002–07 period for which we have data, total health-care expenditures, per capita, for Shanghai were three times those for China as a whole (Yi et al., 2010).

Amenable Mortality (AM)

Health-care interventions contribute relatively little to broad indicators of health status. Nevertheless, there is solid clinical evidence that some causes of premature death are amenable to such interventions. The concept of AM assumes that public health services, as well as health education, screening, primary care, and many specialty services have made appreciable contributions to mortality decline for selected diagnoses. Cross-national analysis of AM trends indicates that these deaths have declined faster, over the past three decades, than other causes of mortality, lending further credence to the validity of AM as an indicator for the effectiveness of public health interventions, health care, and overall health system performance (HSP) (Nolte & McKee, 2008). Mortality from these causes also reflects socio-demographic factors. Yet, in comparison to more frequent analyses of population health, based on life expectancy at birth, infant mortality, or analyses of disease burden, AM captures important dimensions of HSP. In studies of HSP, AM serves as a recognized indicator of an important dimension in comparisons of nations, as well as cities (Nolte & McKee, 2008).

Data and Methods

In all three cities we examine all registered deaths. For São Paulo, data on disease-specific deaths are from the Brazilian Census and Mortality Information System; for Moscow, data are from the Russian Fertility and Mortality Database (RusFMD), maintained by the Center of Demographic Research of the New Economic School in Moscow. For Shanghai, data are from the CDCP. In contrast to São Paulo and Moscow, where mortality data include all city residents, in Shanghai, these data include information only for the 14.9 million registered permanent residents in 2010.

We rely on Nolte and McKee's definition of AM (Table 2) (Nolte & McKee, 2008). Their list of causes of premature death is, in turn, a modification of the previous efforts (Charlton, Silver, Hartley, & Holland, 1983; Mackenbach, Looman, Kunst, Habbena, & van der Maas, 1998; Rutstein et al., 1976). Hoffman and co-workers have provided further validation for most of the causes of death noted by Nolte and McKee (Hoffman et al., 2013). In measuring AM, we count only 50 percent of deaths from ischemic heart disease (IHD) (Table 3). 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 (Capewell, Beaglehole, Seddon, & McMurray, 2000). We adopt an upper age limit of 75 years for our definition since the likelihood that a condition will be

Table 2. Selected Causes of Amenable Mortality (AM), Age Group 1–74 Years

Cause of Death	ICD-10 Codes
Tuberculosis	A15-19, B90
Septicemia	A40-41
Malignancy of colon and rectum	C18-21
Malignancy of skin	C44
Malignancy of breast	C50
Malignancy of cervix and uterus	C53-55
Malignancy of testis	C62
Hodgkin's disease	C81
Leukemia	C91-95
Endocrine diseases, including diabetes mellitus	E0-69
Epilepsy	G40-41
Hypertension	I10-13
Cerebrovascular disease	I60-69
Influenza	J10-11
Pneumonia	J12-18
Ischemic heart disease (IHD)	I20-25
Peptic ulcer	K25-27
Appendicitis, abdominal hernia, and gallbladder disease	K35-38; K40- 46; K80-82
Nephritis and nephrosis	N0-7, 17-19, 25-27
Benign prostatic hyperplasia	N40
Maternal death	O00-99

Source: Nolte and McKee (2004).

Table 3. Ten Leading Causes of Amenable Mortality, 2000 and 2010

Moscow 2000	Number of Deaths	% of Total Amenable Deaths	Moscow 2010	Number of Deaths	% of Total Amenable Deaths
IHD[a]	19777	49.3	IHD[a]	15465	48.7
Cerebrovascular disease	10213	26.3	Cerebrovascular disease	8041	25.3
Malignancy of colon and rectum	2173	5.8	Malignancy of colon and rectum	1961	6.2
Flu/pneumonia	1701	4.2	Malignancy of breast (both sexes)	1573	5.0
Malignancy of breast (both sexes)	1637	3.2	Flu/Pneumonia	1307	4.1
Tuberculosis	953	2.2	Hypertension	713	2.2
Hypertension	731	1.7	Malignancy of cervix and uterus	669	2.1
Malignancy of cervix and uterus	659	1.3	Leukemia	503	1.6
Endocrine diseases	507	1.2	Tuberculosis	500	1.6
Leukemia	507	1.2	Peptic ulcer	276	0.9
Shanghai 2000			Shanghai 2010		
Cerebrovascular disease	7530	52.4	Cerebrovascular disease	4753	38.3
IHD[a]	2495	17.4	IHD[a]	2069	16.7
Malignancy of colon and rectum	1493	1.3	Malignancy of colon and rectum	1648	13.3
Endocrine diseases	1299	9.0	Endocrine diseases	1410	11.4
Malignancy of breast (both sexes)	580	4.0	Malignancy of breast	715	5.8
Nephritis and nephrosis	494	3.4	Leukemia	462	3.7
Leukemia	488	3.4	Hypertension	400	3.2
Hypertension	350	2.4	Nephritis and nephrosis	284	2.3
Tuberculosis	181	1.3	Malignancy of cervix and uterus	239	1.9
Malignancy of cervix and uterus	166	1.2	Pneumonia	171	1.4
São Paulo 2000			São Paulo 2000		
IHD[a]	5708	23.8	Cerebrovascular disease	4752	21.0
Cerebrovascular disease	3379	20.1	Ischemic heart disease	2898	17.2
Endocrine diseases	1705	12.0	Pneumonia	1866	13.5
Pneumonia	1345	9.5	Endocrine diseases, including diabetes mellitus	1576	11.4
Hypertension	1072	7.5	Hypertension	1182	8.6
Malignancy of breast	793	5.6	Malignancy of colon and rectum	947	6.9

São Paulo 2000	Number of Deaths	% of Total Amenable Deaths	São Paulo 2000	Number of Deaths	% of Total Amenable Deaths
Malignancy of colon and rectum	686	4.8	Malignancy of breast	945	6.8
Tuberculosis	561	3.9	Malignancy of cervix and uterus	430	3.1
Malignancy of cervix and uterus	438	3.1	Leukemia	322	2.3
Leukemia	319	2.2	Tuberculosis	253	1.8

Sources: São Paulo, Brazilian Census and Mortality Information System; Moscow, Russian Fertility and Mortality Database (RusFMD), Center of Demographic Research of the New Economic School in Moscow; Shanghai, Municipal Center for Disease Control and Prevention.[a]Figures include all deaths from ischemic heart disease (IHD).

amenable to intervention, especially in light of the high probability of serious comorbidities, is lower at older age. To age-adjust these data, we employ the direct method, using weights derived from the 2010 United Nations world standard population.

Findings

During the period 2000–10, age-adjusted rates of all leading causes of AM fell in all three cities. In São Paulo, it dropped from 1.57 to 1.19 per 1,000 population. In Moscow, it fell from 2.10 to 1.40, and in Shanghai, from 0.72 to 0.54 (Figure 1). The rate of decrease was highest in Moscow (33.3 percent), followed by Shanghai (30.6 percent) and São Paulo (24.2 percent). The number of deaths amenable to health-care interventions (AM), by 10 leading causes, in 2000 and 2010 are compared in Table 3. All three cities experienced large reductions in chronic cardiovascular diseases in the form of IHD and stroke, but they remain the leading causes of premature death. São Paulo and Shanghai experienced increases in the raw number of premature deaths due to malignancies (breast and colon cancer), but these fell as a percentage of the population.

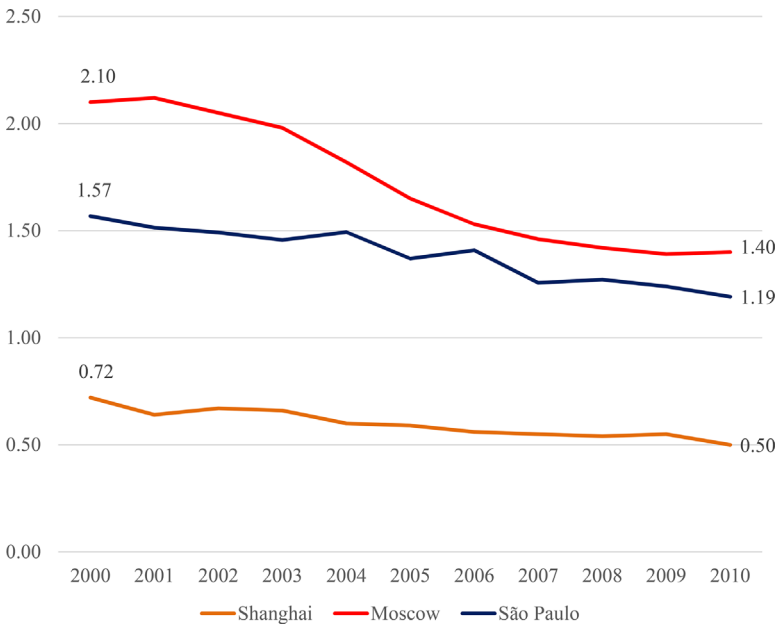

Figure 1. Age-Adjusted Amenable Mortality.
Sources: Calculations by authors; São Paulo data are from the Brazilian Census and Mortality Information System; Moscow data are from the Russian Fertility and Mortality Database (RusFMD), maintained by the Center of Demographic Research of the New Economic School in Moscow; Shanghai data are from the Shanghai Municipal Center for Disease Control and Prevention.

Limitations

We obtained the primary cause of mortality from death certificates, but are unable to control for other causes of death when multiple causes applied. Since data from Shanghai include only deaths among registered permanent residents, we do not know how inclusion of the unregistered migrant population would affect the city's aggregate rate. Although AM is more closely related to the health-care system than conventional measures of population health status, such as life expectancy at birth, we cannot make causal claims on the appropriate mix of services to achieve health improvements. For example, since people who died prematurely from IHD or cancer may not have benefited from disease-prevention services, may have been engaged in risky behavior, or may not have received appropriate medical care once they were diagnosed, we suggest that the experience of these cities warrants further in-depth study.

Discussion

Analysis of AM rates is a useful indicator for an important dimension of HSP. Our finding of their steep decline in São Paulo, Moscow, and Shanghai suggests that all three health systems made significant improvements over the 2000–10 period. The decreases in AM we document suggest that their enhancements of urban health infrastructure and health-care services, coupled with health reform at the national level, contributed to these health improvements and warrant in-depth study to suggest lessons for exploding megacities in developing nations.

Despite these health improvements in São Paulo, Moscow, and Shanghai, their health-care systems face formidable challenges. Our findings highlight the importance of efforts to expand chronic disease management. There are also gaps in health-care resources and health status among the wealthiest and poorest neighborhoods of São Paulo (Pessoto et al., 2007). In Moscow, current efforts to reduce health-care spending threaten to reduce the health-care workforce (Demirijian, 2014). Recent evidence reveals large socioeconomic inequalities in health status within Chinese cities (Yang & Kanavos, 2012). In Shanghai, it is not known whether health system improvements have reached unregistered migrants without permanent residency status. Future analysis should investigate neighborhood-level inequalities in rates of AM among all three cities.

Beyond the problem of inequalities, these BRIC cities face challenges because the rapid economic growth they experienced over 2000–10 has slowed considerably. They now face increases in unemployment, poverty, and greater pressure on their public-health and health-care budgets. If, as we have suggested, the decreases in AM reflect a combination of improvements in economic performance and greater investments in health care, these gains are now at risk. It will be important to monitor the extent to which these nations and cities can maintain their commitments to UHC and the health gains they achieved over the 2000–10 period.

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Notes

Conflicts of interest: None declared.
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