

Time Trends and Regional Disparities of Maternal Mortality Ratio: Evidences From China, 1990-2018.

Lu Chen

Chinese Academy of Medical Sciences & Peking Union Medical College Fuwai Hospital

Penghui Feng

Chinese Academy of Medical Sciences and Peking Union Medical College

Lance Shaver

The University of British Columbia

Zengwu Wang (✉ wangzengwu@foxmail.com)

National Center for Cardiovascular Disease, Fuwai Hospital, Chinese Academy of Medical Sciences and Peking Union Medical College Fuwai Hospital <https://orcid.org/0000-0003-1613-5076>

Research article

Keywords: Maternal mortality ratio, Time trend, Public health program, Regional disparity, Government health expenditure.

Posted Date: October 5th, 2020

DOI: <https://doi.org/10.21203/rs.3.rs-65566/v1>

License:  This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Version of Record: A version of this preprint was published at BMC Public Health on August 11th, 2021. See the published version at <https://doi.org/10.1186/s12889-021-11557-3>.

Abstract

Introduction China is one of the few countries to achieve Millennium Development Goal 4 and 5. This study aimed to access the levels and trends of maternal mortality ratio (MMR) in China from 1990 to 2018.

Methods Using descriptive epidemiology, we collected the data from the China Health Statistics Yearbooks and the China Statistical Yearbooks to describe changes in MMRs, hospital delivery rate, per capita GDP, policies, health expenditure indicators and per capita annual income by region from 1990 to 2018. Spearman correlation analysis was used to assess the relevance between MMR and health expenditure indicators.

Results The MMR decreased by 79.4% from 1990 to 2018 in China, and the MMR was remarkably lower in the eastern China than that in the western China. In the context of the widening gap between urban and rural wealth from 1990 to 2018, the urban-rural MMR gap narrowed. The MMR in China has always been higher in rural areas than in urban areas. After the implementation of the Two-Child policy in 2015, the urban MMR continued to decline in 2015-2018, and the rural MMR rebounded in 2017. The hospital delivery rate in China has been on the rise, with almost all pregnant women giving birth in hospital by 2018. The MMR was negatively correlated with the percentage of government health expenditure in the total health expenditure. Obstetric hemorrhage has always been the leading cause of maternal death from 1990 to 2018 in urban and rural areas.

Conclusions China has made remarkable progress in maternal survival, despite regional differences still exist. The implementation of the Two-Child policy slowed down the decline of MMR in rural areas. Chinese government should focus on the maternal health in western provinces, rural areas, and the floating population in urban areas.

Introduction

Maternal mortality ratio (MMR) is an important indicator for evaluating national medical level, which allows comparisons across time and geographic regions^[1]. Millennium Development Goal 5 was launched by members of the United Nations which aimed to reduce the MMR by three quarters between 1990 and 2015^[2]^[3]. During this period, China's MMR exceeding the requirements of Millennium Development Goal 5^[4]. Furthermore, the MMR in China has also achieved the Sustainable Development Goal set by all United Nations member states in 2015, which is to reduce the MMR to 70.0 per 100,000 live births by 2030^[5]. In the past three decades, China has implemented a number of public health programs that are beneficial to maternal health, such as the Basic Public Health Service Equalization, Maternal Mortality Reduction and Neonatal Tetanus Elimination Program, Urban Employees Basic Medical Insurance, the Five Strategies for Maternal and Newborn Safety, New Cooperative Medical Scheme, and Urban Residents Basic Medical Insurance. After the implementation of the Two-Child policy in 2015, women giving birth have been more likely to be multiparous, and more likely to be aged 35 and over, which increased the number of high risk pregnant women and brought new challenges to reduce the MMR^[6, 7]. Recently, the Chinese government proposed the 2030 Healthy China Program, which aimed to reduce the MMR to 18.0 per 100,000 birth lives by 2020 and 12.0 per 100,000 birth lives by 2030^[8]. This put forward higher requirements for reducing the MMR in China.

China is the largest developing country in the world, with a population of about one fifth of the world's total. China's economy has developed rapidly over the past 30 years and is now the second largest economy in the world^[9]. However, substantial gaps in economic development have been observed between western and eastern, as well as urban and rural areas in China, affecting healthcare resource allocation and maternal mortality^[10]. In this study, we aimed to assess long-term MMR changes in China, examining the latest urban/rural and regional disparities of MMR, exploring the influence of health economic indicators on MMR, assessing leading causes of maternal death over time.

Methods

Design and data sources

We used descriptive epidemiology and collected data from the following sources: 1) Data on MMRs, health expenditure indicators and mortality of main causes of maternal death were acquired from the China Health Statistics Yearbooks (1990-2018). 2) Data on per capita GDP and per capita annual income were acquired from the China Statistical Yearbooks (1990-2018). Above data were listed in the **Supplement**. The data of MMRs in the National Health Statistics Yearbooks were from the National Maternal Mortality Surveillance System (NMMSS). The NMMSS was established in 1989, with counties as the minimum sampling units, covering 31 provinces in mainland China, has been the most important data source for acquiring maternal death^[11]. Data collected by the NMMSS were released by the China Health Statistics Yearbook every year^[12].

Definitions

Maternal death was defined as the death of a woman while being pregnant or within 42 days of pregnancy termination from any cause related to pregnancy or maternal management but not from accidental causes (ICD-10). Maternal mortality ratio was defined as the number of maternal deaths per 100,000 live births^[13]. Both definitions had remained consistent through the study period and across regions.

Statistical analysis

Analyses were conducted using Statistical Product and Service Solutions (SPSS) version 19, a two-sided $P < 0.05$ was considered statistically significant. Spearman correlation analysis was used to explore the associations between the MMRs and health expenditure indicators. We mapped the MMR and per capita GDP in each province in 2018 to observe their distribution.

Study Results

Spatial disparities of maternal mortality ratio in China

Figure 1 illustrated spatial distribution of MMR and per capita GDP by province for year 2018. There was a wide disparity in MMR between western and eastern China. The distribution of MMR was roughly consistent with the per capita GDP in China, with the provinces in the east and west were relatively developed and underdeveloped respectively (**Figure 1**). The MMRs in eastern coastal provinces, such as Tianjin, Jiangsu, Shanghai, Hebei and Guangdong, were below 10.0 per 100,000 live births in 2018. In the central provinces,

such as Hunan, Gansu, Yunnan, Hunan and Guizhou, MMRs varied between 10.0 and 24.9 per 100,000 live births in 2018. The MMRs of the western provinces of Tibet, Qinghai, and Xinjiang, were all over 25.0 per 100,000 live births in 2018. The highest observed MMR was in Tibet, which was 56.5 per 100,000 live births in 2018. There were 19 provinces where the MMR in rural areas was higher than that in urban areas in 2018, and 9 provinces where the MMR in rural areas was lower than that in urban areas (**Supplementary Table 1**).

Time trends in maternal mortality ratio in China

In this study, we were able to gather 28 years of MMR and per capita annual income data, from 1990 to 2018 (**Supplementary Table 2**). Although the per capita annual income gap between rural and urban areas grew steadily during this period, the MMR gap between them greatly decreased (**Figure 2**). The MMR in rural areas was approximately twice ($112.5/45.9=2.4$) that of the urban areas in 1990, and the difference between them ($19.9/15.5=1.2$) was very small in 2018. We observed a steadily decreasing trend in MMR, and the MMR was lower in urban areas than rural areas although the gap was decreasing gradually. The MMR decreased by 79.4% from 1990 to 2018 for the whole China, with an average annual reduction rate of 5.5%; 66.2% and 3.8% in urban areas, 82.3% and 6.0% in rural areas, respectively. The rural MMR in China fluctuated from 1990 to 2002, and showed a steadily decrease trend from 2003 to 2016.

It is noteworthy that the MMRs in rural and urban areas were almost equal in 2010, and then there was a small gap between rural and urban areas from 2010 to 2015. After the implementation of the Two-Child policy in 2015, China's overall MMR continued to decrease, and the gap of MMR between rural and urban areas widened from 2015 to 2018. The MMR in rural areas in 2017 was higher than that in 2016 (**Figure 2**). The gap between the hospital delivery rates in urban and rural areas declined gradually from 1990 to 2018. The hospital delivery rate in urban areas was 1.65 times that in rural areas in 1990, and it was almost equal in urban and rural areas by 2018 (**Figure 3**).

Correlation between MMR and health expenditure indicators in China.

Spearman correlation analysis showed that MMR negatively correlated with the total health expenditure as a percentage of GDP ($r_s=-0.912$, $P<0.05$), and with the government health expenditure as a percentage of total health expenditure ($r_s=-0.611$, $P<0.05$). There was a positive correlation between the MMR and out-of-pocket health expenditure as a percentage of total health expenditure ($r_s=0.583$, $P<0.05$). The MMR was insignificantly correlated with social health expenditure as a percentage of total health expenditure ($r_s=-0.268$, $P>0.05$) (**Table 1**).

Trends in main causes of maternal deaths of China

Compared with 1990, the mortality rates of leading causes of maternal death all decreased in 2018 in China (**Figure 4, Supplementary Table 4**). During 1990-2018, the maternal mortality caused by puerperal infection got the largest decline (95.5%), followed by obstetric hemorrhage (88.4%) and pregnancy hypertension (77.3%). Obstetric hemorrhage has always been an leading cause of maternal death from 1990 to 2018 in urban and rural areas (**Figure 4**). In 1990, the three leading causes of maternal mortality were obstetric hemorrhage (40.8%, 36.3 per 100,000 live births), pregnancy-induced hypertension (8.4%, 7.5 per 100,000 live births), and heart disease (7.4%, 6.6 per 100,000 live births) in China; In 2018, it were obstetric hemorrhage

(23.2%, 4.2 per 100,000 live births), amniotic fluid embolism (12.3%, 2.3 per 100,000 live births), and heart disease (10.0%, 1.8 per 100,000 live births) (**Figure 4**).

Discussion

MMR is a universally accepted indicator that describes population level health status and medical care provision. Our study reported a 28-year MMR time trend and the MMR regional comparisons. We found that the MMR decreased greatly in rural and urban areas during the study period in China, although disparity remains among regions and provinces.

From 1990 to 2018, the decline rate of MMR in urban areas was lower than that in rural areas, which may be due to the limiting effect and the improvement of medical services in rural areas^[10]. The MMR was lower in eastern China compared to western China. Natural environment, inconvenient transportation, and weaker health services may be the reasons for the high MMRs in western provinces. It was a challenge to improve population health for western underdeveloped provinces^[14]. In 2018, China's overall MMR was lower in urban areas than in rural areas, but there were still 10 provinces in which urban areas were higher than rural areas. The reason for this phenomenon was probably due to urbanization, a large rural population entered the urban areas. The economic status, health condition and education background of floating population were generally low, and the young female floating population exhibited poor awareness of health care^[15]. We should pay more attention to the floating population, improve the service ability of the public health service system to the floating population, strengthen the behavior intervention to the floating population, and improve the health awareness and disease management compliance of the floating population^[16].

In the past three decades, the Chinese government has implemented many public health programs for maternal health care. The Basic Public Health Service Equalization project was launched by Chinese government in 2009. The goals of this project were achieving the equalization of public health services and improving the quality of life of all urban and rural residents^[17]. The Basic Public Health Service Equalization project has numerous items, one of which is improving the quality of maternal health services. Specific measures include the establishment of maternal health records, prenatal examinations and post-natal visits for rural and urban pregnant women^[18, 19]. The project also requires equal quality and quantities of maternal health services to narrow the urban-rural gap. For example, maternal health providers are all trained according to national standards and required to deliver same number of maternal services for rural and urban women^[20]. The Maternal Mortality Reduction and Neonatal Tetanus Elimination program was designed by the Chinese Ministry of Health. This program focused on increasing facility births and antenatal visits. It was implemented in 378 counties in 12 western provinces in 1999, expanding coverage to a total of 2288 counties in 22 central and western provinces from 2008. The program effectively reduced maternal mortality through the enhancement of hospital delivery, and it was nationalized to ensure free hospital delivery for all women in China in 2009^[21]. The Five Strategies for Maternal and Newborn Safety program consisted of the following components: pregnancy risk screening and assessment strategy, case-by-case management strategy, referral and treatment strategy, reporting strategy for maternal deaths and accountability strategy^[6]. The Urban Employees Basic Medical Insurance, Urban Residents Basic Medical Insurance, and New Cooperative Medical Scheme were health insurances funded by central and local governments and donated by individuals. The

Urban Employees Basic Medical Insurance was a compulsory health insurance started in 1999 for employees and employers in urban areas. However, the aged, kids, students, and urban non-employed rural residents were not included in the Urban Employees Basic Medical Insurance system. Therefore, in order to solve the problem, the Urban Residents Basic Medical Insurance scheme was established since 2007, and the scheme improved the health care of some groups and the inequality of health care^[22]. The New Cooperative Medical Scheme offered subsidies for rural residents on antenatal and postnatal services and encouraged hospital delivery, either as a prepayment or a retrospective reimbursement^[23]. The Chinese government proposed the 2030 Healthy China Program, which aimed to reduce the MMR to 12.0 per 100,000 birth lives by 2030^[8]. If the current decreasing trend continues to hold, this target seems achievable.

The gap between rural and urban MMRs decreased steadily from 1990 to 2010. It is noteworthy that the MMRs in rural and urban areas were almost equal in 2010, and then there was a small between rural and urban areas from 2010 to 2015. One reason for this phenomenon may be the implementation of the Basic Public Health Service Equalization project by Chinese government in 2009, which aimed to achieve the equalization of public health services and improve the quality of life of all urban and rural residents^[17]. The rural MMR in China fluctuated from 1990 to 2002. After the implementation of the New Cooperative Medical Scheme in 2003, the rural MMR showed a steadily decrease trend from 2003 to 2016.

After the implementation of the Two-Child policy in 2015, the pregnant women are more likely to be aged 35 and over both in urban and rural areas, which increased the number of high risk pregnant women^[6]. The gap of MMR between rural and urban areas increased after the launch of Two-Child policy. The MMR in rural areas in 2017 was higher than that in 2016, and the MMR in urban areas continued to decline. The medical conditions and educational level in the rural areas were relatively low. The implementation of the Two-child policy has brought challenges to rural maternal health.

The main diseases of maternal death in China were obstetric bleeding, puerperal infection, amniotic fluid embolism, pregnancy-induced hypertension, liver disease and heart disease^[24]. The maternal mortality rate caused by these major diseases all had declined from 1990 to 2018. The possible reasons for the decrease included the improvement of health care in poor areas. The decline in obstetric hemorrhage appeared to be an important contributing factor in the reduction in maternal deaths in China. Therefore, continuing to reduce the risk of death from obstetric hemorrhage was very important for reducing MMR. Measures to reduce the risk of obstetric hemorrhage included antenatal care, skilled delivery, emergency obstetric care, and post-partum care. The above measures worked best when combined with hospital delivery. Promoting hospital delivery was a very effective medical measure to reduce the risk of pregnancy-related diseases, especially in developing countries where many women traditionally gave birth at home^[25].

To achieve the goal of the 2030 Healthy China Program and further decrease the MMR, responsible health authorities should provide community intervention therapy, raise investments in western China and rural areas, increase the percentage of total health expenditure in GDP, heighten the percentage of government in total health expenditure, and improve the quality of obstetric care. Increasing the number of well educated and trained midwives will be an important factor in improving healthcare in the coming decades.

Our study has implications for China and other low- and middle-income countries to achieve significant reductions in maternal mortality. Our study has a limitation: data on maternal deaths in some extremely remote areas may not be registered, which may make the differences between urban and rural areas and the eastern and western regions even greater. Researchers reported discrepancies between routine data and survey data related to the number of reported livebirths, child, maternal mortality, and maternal health interventions^[26]. Other research found that coverage of most health indicators in a province were lower than in the routine data, and deaths were under-reported ^[27].

Conclusion

The reduction of MMR was more pronounced in rural regions, which, in turn, led to a narrowing urban/rural MMR gap over time, despite regional gaps remain. The service capacity of the public health service system and the skills of medical staffs need to be improved, especially in the underdeveloped western provinces and rural areas. The health awareness and disease management compliance of the floating population should be improved. The percentage of government health expenditure in the total health expenditure should be increased, and the percentage of out-of-pocket health expenditure in the total health expenditure continues to decrease. Effective referral systems should be perfected for women who are medically or socially at high risk. We believe that targeted efforts are required to further improve maternal health and promote rational distribution of resources.

Abbreviations

Maternal mortality ratio (MMR)

National Maternal Mortality Surveillance System (NMMSS)

Statistical Product and Service Solutions (SPSS)

Declarations

Ethics approval and consent to participate

Yes.

Consent for publication

Yes.

Availability of data and materials

The data used in the study were from <http://www.nhc.gov.cn/>. The public access to the database(s) is closed. We received administrative permission to access and use these.

Competing interests

The authors of this paper indicated no competing interest.

Funding

There was no funding for our study.

Authors' Contributors

Lu Chen designed the study and analyzed the data. Lu Chen, Penghui Feng, and Lance Shaver were involved in the manuscript writing. Zengwu Wang revised the manuscript. All authors have read and approved the manuscript.

Acknowledgements

We thank all the editors of China Health Statistics Yearbook and China Statistical Yearbook. We thank Min Gao for her advice on the manuscript.

References

1. Collier AY, Molina RL. **Maternal Mortality in the United States: Updates on Trends, Causes, and Solutions.** *NeoReviews* 2019; 20(10):e561-e574.
2. Chen Y, Jin GZ. **Does health insurance coverage lead to better health and educational outcomes? Evidence from rural China.** *Journal of health economics* 2012; 31(1):1-14.
3. **Countdown to 2015. A decade of tracking progress for maternal, newborn and child survival: the 2015 report.** http://countdown2030.org/documents/2015Report/Countdown_to_2015_final_report.pdf Geneva: United Nations International Children's Emergency Fund and World Health Organization, 2015.
4. **Global, regional, and national age-sex specific mortality for 264 causes of death, 1980-2016: a systematic analysis for the Global Burden of Disease Study 2016.** *Lancet (London, England)* 2017; 390(10100):1151-1210.
5. Meng Q, Xu L, Zhang Y, Qian J, Cai M, Xin Y, et al. **Trends in access to health services and financial protection in China between 2003 and 2011: a cross-sectional study.** *Lancet (London, England)* 2012; 379(9818):805-814.
6. Liu J, Song L, Qiu J, Jing W, Wang L, Dai Y, et al. **Reducing maternal mortality in China in the era of the two-child policy.** *BMJ global health* 2020; 5(2):e002157.
7. Li HT XM, Hellerstein S, et al. Association of China's universal two child policy with changes in births and birth related health factors: national, descriptive comparative study. *BMJ.* 2019;366:l4680. Published 2019 Aug 21. doi:10.1136/bmj.l4680.
8. **Chinese Ministry of Health. Outline of Healthy China 2030 Program.** <http://www.nhc.gov.cn/guihuaxxs/s3586s/201610/732d915f89a4443dad8364a49a08a60d.shtml>. 2016.
9. Sachs JD, McArthur JW. **The Millennium Project: a plan for meeting the Millennium Development Goals.** *Lancet (London, England)* 2005; 365(9456):347-353.

10. Wang M FH, Bishwajit G, Xiang Y, Fu H, Feng Z. Evaluation of Rural Primary Health Care in Western China: A Cross-Sectional Study. *Int J Environ Res Public Health*. 2015;12(11):13843-13860. Published 2015 Oct 29. doi:10.3390/ijerph121113843.
11. Liang J ZJ, Dai L, Li X, Li M, Wang Y. Maternal mortality in China, 1996-2005. *Int J Gynaecol Obstet*. 2010;110(2):93-96. doi:10.1016/j.ijgo.2010.03.013.
12. Fang J KJRhiCitmtteL-dS--.
13. **World Health Organization. Health statistics and information systems: maternal mortality ratio. 2019. Available at: [https:// www.who.int/healthinfo/statistics/indmaternalmortality/en/](https://www.who.int/healthinfo/statistics/indmaternalmortality/en/). Accessed April 29, 2019.**
14. Du Q, Nass O, Bergsjö P, Kumar BN. **Determinants for high maternal mortality in multiethnic populations in western China.** *Health care for women international* 2009; 30(11):957-970.
15. Zhou Y WT, Fu J, Chen M, Meng Y, Luo Y. Access to reproductive health services among the female floating population of childbearing age: a cross-sectional study in Changsha, China. *BMC Health Serv Res*. 2019;19(1):540. Published 2019 Aug 1. doi:10.1186/s12913-019-4334-4.
16. Su L SL, Xu L. Review on the prevalence, risk factors and disease Management of Hypertension among floating population in China during 1990-2016. *Glob Health Res Policy*. 2018;3:24. Published 2018 Jul 23. doi:10.1186/s41256-018-0076-9.
17. Li X, Cochran C, Lu J, Shen J, Hao C, Wang Y, et al. **Understanding the shortage of village doctors in China and solutions under the policy of basic public health service equalization: evidence from Changzhou.** *The International journal of health planning and management* 2015; 30(1):E42-55.
18. Spelke B, Werner E. **The Fourth Trimester of Pregnancy: Committing to Maternal Health and Well-Being Postpartum.** *Rhode Island medical journal (2013)* 2018; 101(8):30-33.
19. Berhan Y, Berhan A. **Antenatal care as a means of increasing birth in the health facility and reducing maternal mortality: a systematic review.** *Ethiopian journal of health sciences* 2014; 24 Suppl:93-104.
20. Zhao P, Diao Y, You L, Wu S, Yang L, Liu Y. **The influence of basic public health service project on maternal health services: an interrupted time series study.** *BMC public health* 2019; 19(1):824.
21. Feng XL, Shi G, Wang Y, Xu L, Luo H, Shen J, et al. **An impact evaluation of the Safe Motherhood Program in China.** *Health economics* 2010; 19 Suppl:69-94.
22. Xian W, Xu X, Li J, Sun J, Fu H, Wu S, et al. **Health care inequality under different medical insurance schemes in a socioeconomically underdeveloped region of China: a propensity score matching analysis.** *BMC public health* 2019; 19(1):1373.
23. Long Q, Zhang Y, Raven J, Wu Z, Bogg L, Tang S, et al. **Giving birth at a health-care facility in rural China: is it affordable for the poor?** *Bulletin of the World Health Organization* 2011; 89(2):144-152.
24. **Chinese Ministry of Health. 2013 China Health Statistics Yearbook.** <http://www.nhfpc.gov.cn/htmlfiles/zwgkzt/ptjnj/year2013/index2013.html>. 2013.
25. Li X, Zhu J, Dai L, Li Q, Li W, Zeng W, et al. **Hospitalized delivery and maternal deaths from obstetric hemorrhage in China from 1996 to 2006.** *Acta obstetricia et gynecologica Scandinavica* 2011; 90(6):586-592.

26. Wang L, Wang LJ, Cai Y, Ma LM, Zhou MG. **[Analysis of under-reporting of mortality surveillance from 2006 to 2008 in China]**. *Zhonghua yu fang yi xue za zhi [Chinese journal of preventive medicine]* 2011; 45(12):1061-1064.
27. Du Q, Næss O, Bjertness E, Yang G, Wang L, Kumar BN. **Differences in reporting of maternal and child health indicators: A comparison between routine and survey data in Guizhou Province, China.** *International journal of women's health* 2012; 4:295-303.

Tables

Table 1

Spearman correlation between maternal mortality ratio and health expenditure indicators in China from 1990 to 2018.

Year	Composition of total health expenditure (%)			Total health expenditure (% GDP)
	Government health expenditure	Social health expenditure	Out-of-pocket health expenditure	
1990	25.06	39.22	35.73	3.96
1991	22.84	39.67	37.50	4.06
1992	20.84	39.34	39.81	4.03
1993	19.75	38.09	42.17	3.86
1994	19.43	36.62	43.95	3.62
1995	17.97	35.63	46.40	3.51
1996	17.04	32.32	50.64	3.77
1997	16.38	30.78	52.84	4.01
1998	16.04	29.11	54.85	4.32
1999	15.84	28.31	55.85	4.47
2000	15.47	25.55	58.98	4.57
2001	15.93	24.10	59.97	4.53
2002	15.69	26.59	57.72	4.76
2003	16.96	27.16	55.87	4.79
2004	17.04	29.32	53.64	4.69
2005	17.93	29.87	52.21	4.62
2006	18.07	32.62	49.31	4.49
2007	22.31	33.64	44.05	4.28
2008	24.73	34.85	40.42	4.55
2009	27.46	35.08	37.46	5.03
2010	28.69	36.02	35.29	4.84
2011	30.66	34.57	34.80	4.98
2012	29.99	35.67	34.34	5.20
2013	30.10	36.00	33.90	5.32
2014	29.96	38.05	31.99	5.48
2015	30.45	40.29	29.27	5.95

Year	Composition of total health expenditure (%)			Total health expenditure (% GDP)
	Government health expenditure	Social health expenditure	Out-of-pocket health expenditure	
2016	30.01	41.21	28.78	6.23
2017	28.91	42.32	28.77	6.36
2018	27.74	43.66	28.61	6.57
r_s	-0.611	-0.268	0.583	-0.912
P	0.000	0.159	0.001	0.000

Figures

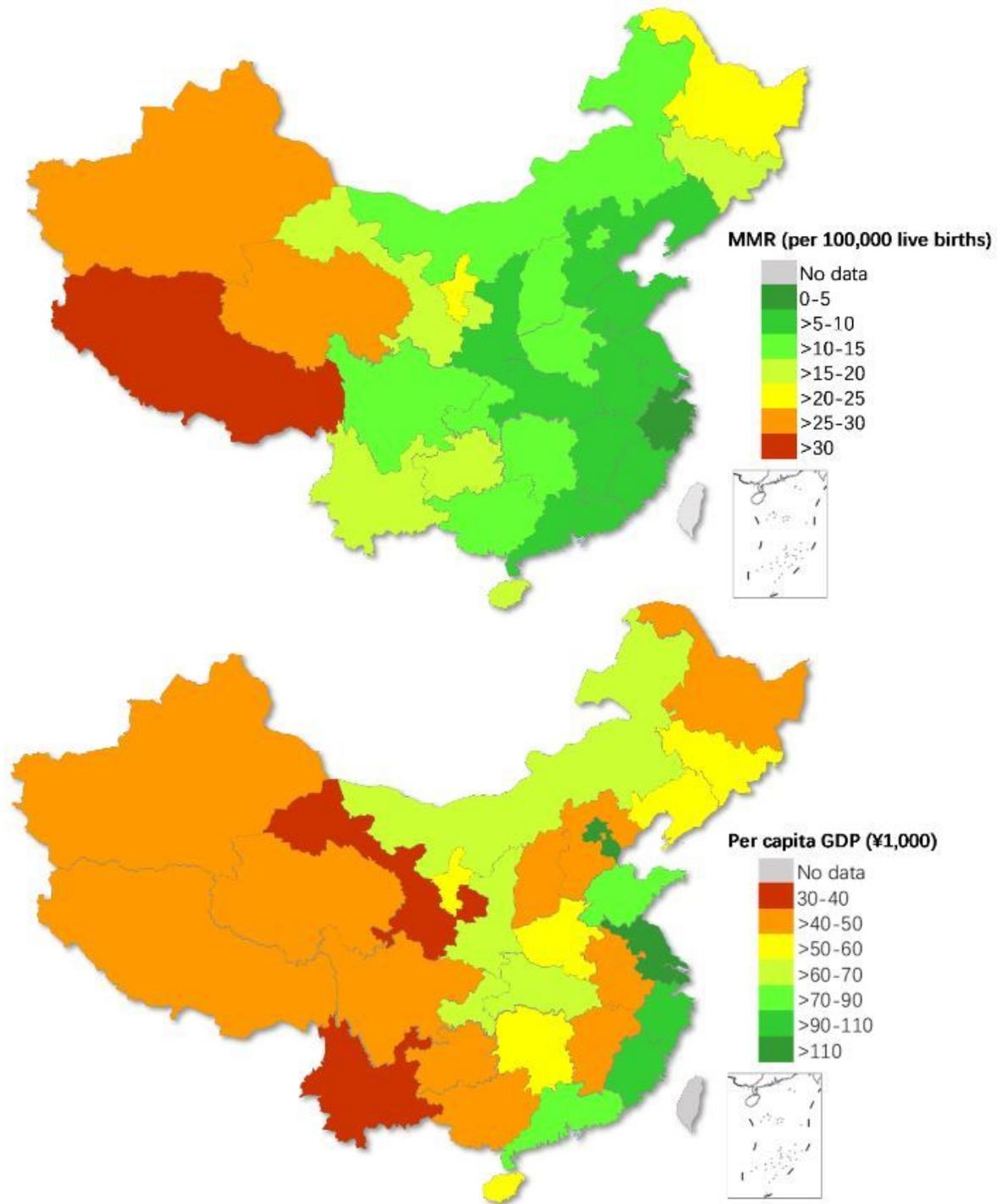


Figure 1

The maternal mortality ratio and per capita GDP in provinces of mainland China in 2018. The map in figure 1 is our own, the ArcGIS was used to create the map. Link: <https://developers.arcgis.com/> Note: The designations employed and the presentation of the material on this map do not imply the expression of any opinion whatsoever on the part of Research Square concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries. This map has been provided by the authors.

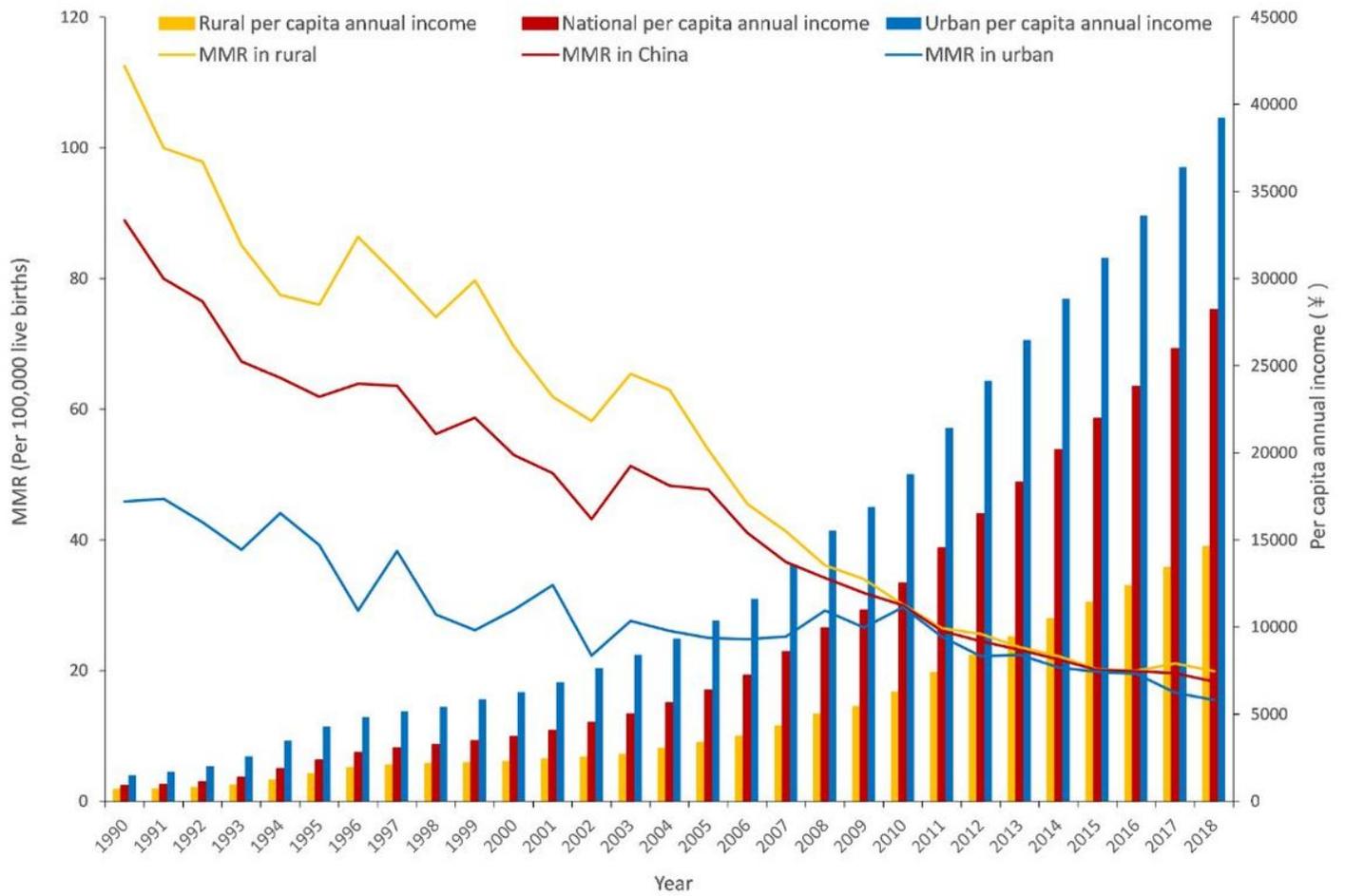


Figure 2

Maternal mortality and per capita annual income in China from 1990 to 2018.

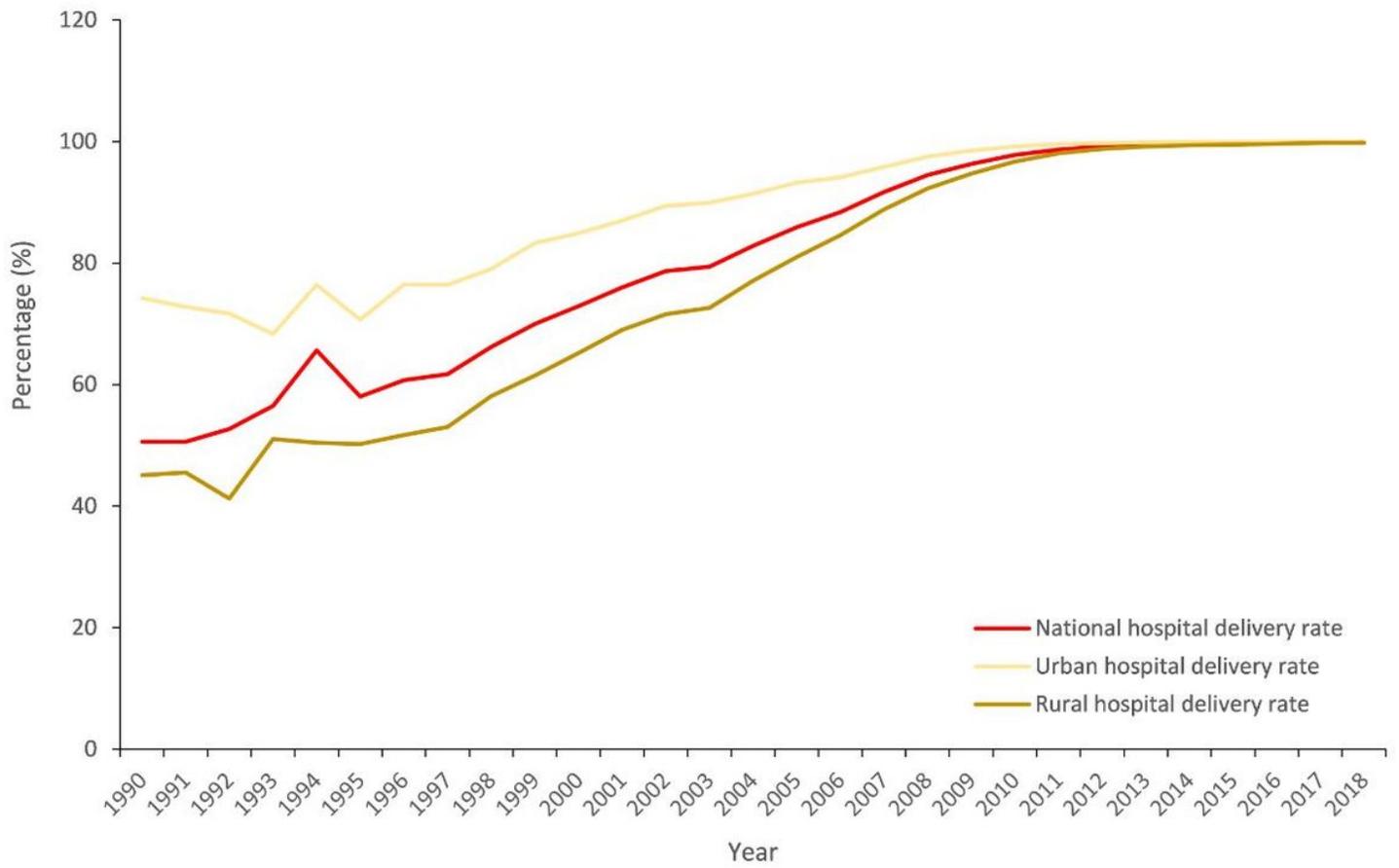


Figure 3

Hospital delivery rate in China from 1990 to 2018.

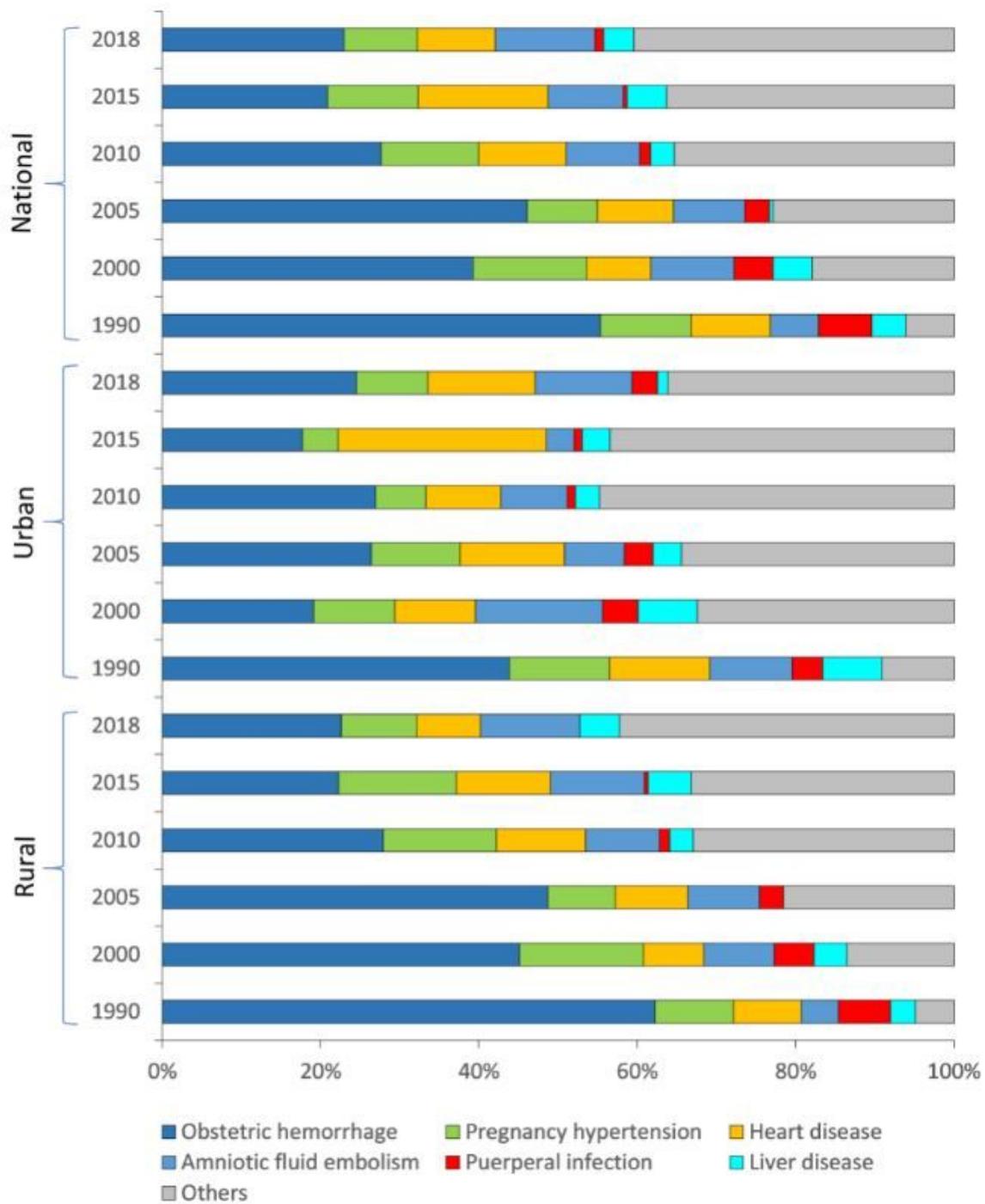


Figure 4

Trends in main causes of maternal deaths of China from 1990 to 2018.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- [Supplementarymaterials.docx](#)

- [Supplement.docx](#)