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Research Article

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Differences in Maternal Mortality between Urban and Rural Areas: Analysis of Maternal Mortality based in Jinan, China in 1995-2018

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Abstract

Background: Although a large number of studies have shown that maternal mortality in rural areas is higher than that in urban areas, few reports discussed the detailed situation and the behind causes. Here, we summarized the maternal mortality from 1995 to 2018 in Jinan, a city in Eastern China, and the reason behind it was deeply discussed. It is expected to reveal the difference and it's behind reasons, thus providing a basis for policymakers to develop interventions.

Methods: Data about maternal mortality in the selected city from 1995 to 2018 were collected through the local maternal and child health care network. Maternal death age, maternal death delivery location, maternal death location, number of pregnancies, number of deliveries and maternal death causes were analyzed. The composition ratio of the above factors was compared in order to indicate the differences between rural areas and urban areas.

Result: The study showed that 75.34% of maternal deaths in urban areas occurred in tertiary hospitals, which were 2.13 times higher than those in rural areas ($p<0.05$). 16.67% of maternal deaths in rural areas delivered in primary hospitals, which were 12.17 times higher than those in urban areas ($p<0.05$). The main cause of death in rural areas was attributed to direct obstetric reasons, which were indirect obstetric reasons for urban areas ($p<0.05$). There was no difference in maternal deaths in the death age, number of births, and number of pregnancies between rural areas and urban areas ($p>0.05$).

Conclusion: Policymakers should focus on the construction of medical institutions in rural areas, the improvement of rescue capabilities in rural areas and the convenience of transport in rural areas in order to narrow the gap between rural and urban areas.

Keywords

Maternal Mortality; Maternal death delivery; Births; Pregnancies; Maternal mortality ratio; Epidemiological characteristics; Marriage law

Introduction

Maternal Mortality Ratio (MMR) is not only one of the important indicators to measure the medical level of a country or region, but also an essential factor for judging a country's economic and social development level [1]. In order to attract global attention in the aspect of maternal mortality and to ensure maternal and child safety, MMR had become the fifth in the eight Millennium Development Goals (MDG5) [2]. During the past few decades, with the increasing government investment in health care which includes providing free maternal health care, management [3] and in-hospital delivery subsidy [4,5], the MMR in china had substantially reduced. China had become one of the rare countries in the world which had achieved MDG5 [6]. Therefore, understanding the epidemiological characteristics of maternal death in China may be instructional for other similar developing countries.

Similar to other countries, there are also regional disparities in maternal deaths in China [7-9], where maternal mortality is higher in rural areas than that in urban areas. However, most of the studies only described the overall maternal mortality of them [9-11]. A detailed description and behind causes of the differences, such as death age, death location, etc., are not well documented. This information is important for policymakers to develop targeted interventions.

Jinan is located in eastern China with a population of 8 million. Terrain conditions, population distribution, and economic development level can well represent urban and rural areas. So choosing Jinan as the research site, in this paper, we will analyze the specific differences in MMR in rural and urban areas in order to provide new suggestions for government departments to develop relevant research strategies.

Methods

Subject selection

All maternal deaths were included in the study from January 1, 1995, to December 31, 2018, all of whom had a household registration in Jinan. The research subjects were divided into rural and urban. The rural areas were defined where pregnant women who were mainly engaged in agricultural production live. On the contrary, the urban areas were defined where pregnant women who did not mainly engage in agricultural production live. Finally, a total of 198 rural pregnant women and 73 urban pregnant women were included.

Determination of maternal death and causes of death

According to the World Health Organisation (WHO), during the pregnancy or within 42 days after delivery, any death caused by factors related to pregnancy and pregnancy management can be defined as maternal death. In accordance with the International Classification of Diseases and Related Health problems, 10th Revision (ICD-10) [12], the cause of maternal deaths can be classified as follows: When the primary disease and the complication co-exist, the primary disease is determined as the cause of death; When the serious disease and the mild disease co-exist, the serious disease is determined as the cause of death; when the infectious disease coexists with the non-infectious disease, the infectious disease is determined as the cause of death.

Data collection

Data were collected through a three-level maternal and child

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health network. Firstly, all hospitals where maternal deaths occurred in reported the information to the county-level maternal and child health care institutions, and the latter verified and reported the information to the municipal maternal and child health care institutions.

Secondly, some pregnant women who died in transport or home were reported by the administrator of maternal and child health care institutions in their district.

Every year, all maternal and child health care institutions conduct on-site quality control programs and under-reporting surveys on maternal deaths information to ensure the reliability of maternal mortality data. On the one hand, quality control programs make the possibility of misreporting maternal deaths greatly reduced. On the other hand, with the improvement of medical conditions and living standards, maternal deaths outside the hospital are becoming less and less. So the data was reliable and did not become a bias.

Statistical analysis

Rate and composition ratio was used to describe the distribution of maternal deaths. Using the Mantel-Haenszel Chi-Square test, a comparative analysis of the composition of MMR between urban and rural areas was conducted. A significant difference was set at $p<0.05$.

Results

Differences in the maternal death age between rural and urban areas

The age group with the highest number of deaths in urban and rural areas also was 31-35 years old (43.43% vs. 35.62%). The age group with the lowest number of deaths in rural areas was 36-47 years old (11.62%) and in urban was 19-25 years old (15.07%). However, this difference was not statistically significant (p=0.809) (Table 1).

Differences in the composition of maternal death delivery location between rural and urban areas

Most maternal deaths in rural areas delivered in secondary hospitals (28.79%) while delivered in tertiary hospitals for urban areas (71.23%). For maternal deaths delivered in tertiary hospitals, the number of urban areas was 3.53 times than that in rural areas. On the contrary, delivered in primary hospitals, maternal deaths of rural areas were 12.17 times higher than those in urban areas. 10.61% of maternal deaths in rural areas delivered in transport, but it did not happen in urban areas (Table 2).

Differences in the composition of maternal death location between rural and urban areas

Most maternal deaths in urban areas occurred in tertiary hospitals, which was 2.13 times higher than that in rural areas (75.34% vs. 35.35%). 8.59% of maternal deaths in rural areas occurred in primary hospitals, but not in urban areas. For the proportion of the maternal death location that occurred in transit, the quantity in rural areas was 7.37 times higher than that in urban areas. As for the proportion of the maternal death location occurred in home, the number of rural areas was 5.53 times than urban areas (Table 3).

Differences in the composition of maternal deaths about the number of pregnancies and the number of deliveries between rural and urban areas

For maternal death, the difference in the number of pregnancies in rural and urban areas is small. The number of pregnancies for both is 2. Similarly, for the number of deliveries, most of maternal death had experienced two births (Tables 4 and 5).

Differences in the cause of maternal deaths between rural and urban areas

The main cause of death in rural areas can be attributed to direct obstetrics reasons (58.59%), which was indirect obstetric reasons for urban areas (54.79%). The order of obstetric hemorrhage and

Table 1: The number and proportion (%) of maternal death age between rural and urban areas during 1995-2018.

Age	Rural area	Urban area	Total
19~	47 (23.74)	11 (15.07)	58 (21.40)
26~	42 (21.21)	23 (31.51)	65 (23.99)
31~	86 (43.43)	26 (35.62)	112 (41.33)
~47	23 (11.62)	13 (17.81)	36 (12.92)
Total	198 (100.00)	73 (100.00)	271 (100.00)
χ^2=0.969; p=0.809			

Table 2: The number and proportion (%) of maternal death delivery location between rural and urban areas during 1995-2018.

Location	Rural area	Urban area	Total
Primary hospital	33 (16.67)	1 (1.37)	34 (12.55)
Secondary hospital	57 (28.79)	9 (12.33)	66 (24.35)
Tertiary hospital	40 (20.20)	52 (71.23)	92 (33.95)
In transport	21 (10.61)	0 (0.00)	21 (7.75)
Home	47 (23.74)	11 (15.07)	58 (21.40)
Total	198 (100.00)	73 (100.00)	271 (100.00)
χ^2=66.409; p=0.001			

Table 3: The number and proportion (%) of maternal death location between rural and urban areas during 1995-2018.

Location	Rural area	Urban area	Total
Primary hospital	17 (8.59)	0 (0.00)	17 (6.27)
Secondary hospital	61 (30.81)	15 (20.55)	76 (28.04)
Tertiary hospital	70 (35.35)	55 (75.34)	125 (46.13)
In transport	20 (10.10)	1 (1.37)	21 (7.75)
Home	30 (15.15)	2 (2.74)	32 (11.81)
Total	198 (100.00)	73 (100.00)	271 (100.00)
χ^2=18.071; p=0.001			

Table 4: The number and proportion (%) of pregnancies about maternal death between rural and urban areas during 1995-2018.

No. of pregnancies	Rural area	Urban area	Total
1	60 (30.30)	25 (34.25)	85 (31.37)
2	74 (37.37)	26 (35.62)	100 (36.90)
3	42 (21.21)	12 (16.44)	54 (19.93)
4-8	22 (11.11)	10 (13.70)	32 (11.81)
Total	198 (100.00)	73 (100.00)	271 (100.00)
χ^2=4.065; p=0.541			

Table 5: The number and proportion (%) of deliveries about maternal death between rural and urban areas during 1995-2018.

No. of deliveries	Rural area	Urban area	Total
1	21 (10.61)	9 (12.33)	30 (11.07)
2	93 (46.97)	47 (64.38)	140 (51.66)
3	80 (40.40)	16 (21.92)	96 (35.42)
4-8	4 (2.02)	1 (1.37)	5 (1.85)
Total	198 (100.00)	73 (100.00)	271 (100.00)
χ^2=8.795 **P**=0.066			

Table 6: The number and proportion (%) of maternal death cause between rural and urban areas during 1995-2018.

Causes	Rural area	Urban area	Total
Direct cause	116 (58.59)	33 (45.21)	149 (54.98)
Obstetric hemorrhage	56 (28.28)	10 (13.70)	66 (24.35)
Amniotic fluid embolism	31 (15.66)	13 (17.81)	44 (16.24)
Pregnancy-induced hypertension	22 (11.11)	6 (8.22)	28 (10.33)
Ectopic pregnancy	3 (1.52)	3 (4.11)	6 (2.21)
Puerperal infection	3 (1.52)	1 (1.37)	4 (1.48)
Pregnancy spit	1 (0.51)	0 (0.00)	1 (0.27)
Indirect cause	82 (41.41)	40 (54.79)	122 (45.02)
Heart disease	28 (14.14)	11 (15.07)	39 (14.39)
Pulmonary embolism	13 (6.57)	8 (10.96)	21 (7.75)
Sudden cardiac death	10 (5.05)	4 (5.48)	14 (5.17)
Hemorrhage	7 (3.5)	4 (5.48)	11 (4.0)
Liver disease	7 (3.54)	3 (4.11)	10 (3.69)
Pneumonia	2 (1.01)	2 (2.74)	4 (1.48)
Cancer	3 (1.52)	1 (1.37)	4 (1.48)
Others	1 (6.06)	7 (9.59)	19 (7.01)
χ^2=27.144; p=0.034			

gestational hypertension in rural areas is higher than that in urban areas. Especially, the constituent ratio of obstetric hemorrhage in rural areas was 2.06 times than that in urban areas (Table 6).

Discussion

Maternal mortality is an indicator for the country to assess the level of economic development, and for individuals is an important factor affecting family happiness. Over the years, the Chinese government has attached great importance to women's health and has continuously increased financial input. For rural areas, hospital subsidies, maternal system management, and other projects have been introduced to ensure maternal health in rural areas. The data show that the hospital delivery rate in rural areas of Jinan reached 99.98% in 2018, which was 18.75% higher than that in 1995. The maternal system management rate reached 98.21%, which was 40.01% higher than that in 1995. These changes showed that women's status has improved; medical conditions and traffic conditions have improved. However, while the economy in urban areas has been developing at a high speed, there are still some weak points in women's health care in rural areas. By 2018, there were only two tertiary medical institutions in rural areas, only one more than in 1995. The proportion of master's degrees or above in medical institutions in rural medical institutions is only 12%, which is only increased by 4 percentage points in comparison with 1995. In addition, in some remote areas, road construction has not changed much, so that the transit time has not improved much. Based on the above, we have detailed analysis of the differences in maternal mortality between rural and urban areas.

We found that most maternal deaths in rural areas occurred in secondary hospitals, while it occurred in tertiary hospitals in urban areas. The following factors may be the causes. Firstly, urban areas were rich in quality medical resources, in which the number of tertiary hospitals was higher than in rural areas. Up to now, there have been only two tertiary hospitals in the county-level medical institutions in Jinan. The little accessibility of tertiary hospitals made most rural pregnant women did not receive more services in tertiary hospitals, while urban pregnant women could. Secondly, medical personnel in rural area institutions were weaker on skills in dealing with common obstetric diseases and obstetric critical illnesses than those in urban areas. The difference in service quality was the core cause of this result [7,13]. Besides, rescue equipment [14] and blood supply [15] in rural areas were also behind that in urban areas. The combination of above factors had produced differences in the location of maternal deaths between rural and urban areas.

We also found that, for the maternal death location in the transit or home, the proportion of rural areas was higher than that of urban areas. First of all, it reflected the impact of transport on the maternal rescue. There were quite a few areas in Jinan located in the mountains. When intractable illness of maternal women occurred in county-level medical institutions, inconvenient transportation undoubtedly increased transit time and further increased the risk of death [16,17]. This situation was particularly prominent in the 1990s. Secondly, it was also closely related to the level of medical skills. Medical personnel in county-level medical institutions were not strict with the indications for maternal transfer. They were rushed to transport while the patient's vital signs did not reach a steady-state.

We also found that the proportion of maternal death delivery location in the home in rural areas was higher than that in urban areas. The place of birth was an important indicator of whether a pregnant woman was systematically managed. The difference in delivery location reflected the weakness of self-protection awareness in rural areas. The low self-protection awareness of pregnant women in rural areas plays an important role in the high MMR [18]. Besides, the result also showed women's low social status. Low social status often leads to poor prenatal care for pregnant women [19]. The latter was a risk factor for maternal mortality [20]. Fortunately, this situation has been greatly improved.

In addition, we found that the main cause of maternal death in rural areas was postpartum hemorrhage and gestational hypertension, while urban areas were dominated by heart disease. Postpartum hemorrhage was higher in rural areas, which could be attributing to several causes. Firstly, during dealing with postpartum hemorrhage, the skill of medical personnel in county-level medical institutions was too poor to identify the early stage of the disease. So that postpartum hemorrhage was not promptly intervened [21,22]. Secondly, blood reserves in county-level medical institutions also were insufficient. So there was not enough blood to cope with postpartum hemorrhage when postpartum hemorrhage happened [20,23]. Lastly, non-hospital delivery [24,25] and poor midwifery skills [26,27] also led to the appearance of this result.

We found pregnant women who dying from pregnancy-induced hypertension in rural areas were higher. The poor health care awareness of pregnant women in rural areas played an important role [28,29]. According to some studies, close attention to blood pressure and timely intervention can largely avoid maternal death caused by pregnancy-induced hypertension [30,31]. Precisely, care health care awareness was closely related to the attention of blood pressure.

We found there was no difference in the death age, the number of births, and the number of pregnancies of maternal deaths between rural and urban areas. In China, affected by the Marriage Law and the Late Marriage and Late Childbearing Policy, most urban and rural women are pregnant between 26-35 years old. Similarly, influenced by the one-child policy, most women can only get pregnant once and give birth once. Policies and laws had an impact on the pregnancy and childbirth of women in rural and urban areas, thus affecting the difference in the above three factors among maternal deaths.

Limitations

There were also some limitations in this study. Firstly, although the rigorous quality control program was comprehensively carried out, the omission of maternal deaths is still inevitable. Secondly, there were some deficiencies in the correctness of disease diagnosis in the past decades due to the inconsistent diagnostic criteria and the difference in diagnostic levels, especially for the amniotic fluid embolism. Based on the fact, there may be some error in the number of various diseases. Thirdly, we summarized and analyzed the occurrence of maternal deaths in Jinan in 23 years but some factors had changed over time. Based on this, we analyzed the invariant factors and the changing factors. However, the analysis may have some flaws to some extent. For example, the factors we had summarized were not comprehensive enough. This may have an impact on the conclusions of our research.

Conclusion

Policymakers should focus on the construction of Medical Institutions in rural areas, the improvement of rescue capabilities, and the promotion of transport in order to decrease maternal mortality in rural areas.

Competing Interests

The authors declare that they have no competing interests.

Author's Contributions

Lihua Zhang and Tingting Zheng participated in data analysis and wrote the manuscript. Qingyou Meng conceived the idea. Shimin Yang, Jiaxue Pan and Guoqun Wang participated in the design and implement of the study and statistical analysis. Zhongliang Li participated in data analysis and helped to draft the manuscript. All authors read and approved the final manuscript.

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