

# Differences in maternal mortality between urban and rural areas: Analysis of Maternal Mortality based in Jinan, China in 1995- 2018

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## Research article

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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 about the detailed situation and the behind causes. Here, we summarized the maternal mortality from 1995 to 2018 in Jinan and the reason behind it was deeply discussed. It is expected to reveal the difference and its behind reasons, thus providing a basis for policy makers 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 above factors were compared in order to indicate the differences between rural areas and urban areas. **Results:** The study showed that 75.34% of maternal deaths in urban areas occurred in tertiary hospitals, which were 2.13 times higher than that 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 that in urban areas ( $P < 0.05$ ). The main cause of death in rural areas were attributed to direct obstetrics reasons, which were indirect obstetric reasons for urban areas ( $P < 0.05$ ). There was no difference of maternal deaths in the death age, number of births, and number of pregnancies between rural areas and urban areas. ( $P > 0.05$ ) **Conclusion:** Policy makers 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. **Key words:** Maternal Mortality; Differences between urban and rural areas; China

## Background

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<sup>[1]</sup>. 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)<sup>[2]</sup>. During the past few decades, with the increasing government investment in health care which includes providing free maternal health care, management<sup>[3]</sup>and in-hospital delivery subsidy<sup>[4, 5]</sup>, the MMR in china had substantially reduced. China had become one of the rare countries in the world which had achieved MDG5<sup>[6]</sup>. 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<sup>[7-9]</sup>, where maternal mortality is higher in rural areas than that in urban areas. However, most of studies only described the overall maternal mortality of them<sup>[9-11]</sup>. A detailed description and behind causes of the differences, such as death age, death location, etc., is not well documented. This information is important for policy makers 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 on 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 according to the household registration category. A total of 198 rural pregnant women and 73 urban pregnant women were included.

### *Determination of the Maternal Death and Causes of Death*

According to 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 the maternal death. In accordance with the International Classification of Diseases and Related Health problems, 10th Revision (ICD-10)<sup>[12]</sup>, 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 health network. 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. 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.

### *Statistical Analysis*

Rate and composition ratio were 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. Significant difference was set at  $p < 0.05$ .

## Results

### *Differences of the maternal death age between rural and urban areas*

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

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

	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)

$\chi^2=0.969$   $P=0.809$

***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 quantity 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 that in urban areas. 10.61% of maternal deaths in rural areas delivered in transport, but not in urban areas.(Table 2)

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

	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)

$$\chi^2=66.409 \quad P=0.001$$

***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 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 quantity of rural areas was 5.53 times than urban areas. (Table 3)

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

	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)

$$\chi^2=18.071 \quad P=0.001$$

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

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

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

	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)

$$\chi^2=4.065 \text{ P}=0.541$$

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

	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)

$$\chi^2=8.795 \text{ P}=0.066$$

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

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)

$$\chi^2=27.144 \quad P=0.034$$

## Discussion

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 skill in dealing with common obstetric diseases and obstetric critical illnesses than that in urban areas. The difference in service quality was the core cause of this result<sup>[7, 13]</sup>. Besides, rescue equipment<sup>[14]</sup> and blood supply<sup>[15]</sup> 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 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<sup>[16, 17]</sup>. 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 whether a pregnant woman was systematically managed. The difference of delivery location reflected the weakness about self-protection awareness in rural areas. The low self-protection awareness of pregnant women in rural areas play an important role in the high MMR<sup>[18]</sup>. Besides, the result also showed the women's low social status. Low social status often leads to poor prenatal care for pregnant women<sup>[19]</sup>. The latter was a risk factor for maternal mortality<sup>[20]</sup>. Fortunately, this situation has been greatly improved.

In addition, we found that the main cause of maternal death in rural areas were postpartum hemorrhage and gestational hypertension, while urban areas were dominated by heart disease. Postpartum hemorrhage were higher in rural areas, which could be attribute to several causes. Firstly, during dealing with postpartum hemorrhage, the skill of medical personnel in county-level medical institutions were too poor to identify the early stage of the disease. So that postpartum hemorrhage was not promptly intervened<sup>[21, 22]</sup>. 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<sup>[23, 24]</sup>. Lastly, non-hospital delivery<sup>[25] [26]</sup> and poor midwifery skills<sup>[27, 28]</sup> 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<sup>[29, 30]</sup>. According to some studies, close attention to blood pressure and timely intervention can largely avoid maternal death caused by pregnancy-induced hypertension<sup>[31, 32]</sup>. Precisely, the care health care awareness was closely related to 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.

There were also some limitations in this study. Firstly, although the rigorous quality control program were comprehensively carried out, the omission of maternal deaths is still inevitable under the intervention of the assessment about government work efficiency. Secondly, there was a certain deficiency in the correctness of disease diagnosis in the past decades, especially for the amniotic fluid embolism. Based on the fact, there may be some error in the number of various diseases.

## **Conclusion**

Policy makers 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 the maternal mortality in the rural areas.

## **Abbreviations**

MMR: maternal mortality

## **Declarations**

### **Ethics approval and consent to participate**

Ethics committee of Jinan maternal and child care hospital has approved the study.

### **Consent for publication**

We are consenting for publication.

### **Availability of data and material**

The raw data was not applicable because the data about maternal mortality was secret in most cases. However, the reader can cite the data in the table when the manuscript is published.

### **Competing interests**

The authors declare that they have no competing interests.

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## Authors' Contributions

ZL,TZ participated in data analysis and wrote the manuscript. QM conceived the idea. SY,JP participated in the design and implement of the study and statistical analysis. GW,LZ participated in data analysis and helped to draft the manuscript. All authors read and approved the final manuscript.

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