Determinants for High Maternal Mortality in Multiethnic Populations in Western China

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Our purpose of this study was to investigate determinants and patterns of associations with high maternal mortality in poor and multiethnic populations from the Xinjiang Uigur autonomous region of Western China. The researcher found that the maternal mortality ratio of Xinjiang was very high; almost half of the participants delivered at home without clean delivery, and nearly one-fifth of the participants had not received any medical treatment. Eighty-seven percent of maternal deaths were among ethnic minority groups. In multiethnic areas in Xinjiang, social–culture factors, lack of health resources, and low health services utilization were related to high maternal mortality.

Maternal deaths have been a long-term problem in China, especially in Western China. Some researchers have studied maternal mortality in China, but most have focused on the estimation and medical causes of maternal deaths. Few researchers have examined underlying causes of maternal
deaths, especially of maternal deaths that occurred outside of health care studies. Few studies on maternal mortality by ethnicity have been conducted by institutions in China. We have done this study to investigate the determinants and patterns of associations with high maternal mortality in poor and multiethnic populations of the Xinjiang region of Western China. We provide evidence to address the related factors leading to these maternal deaths, raise awareness about health inequality within China, and inform health policy possibly contributing to more effective strategies for further reducing maternal mortality in China.

Maternal death is still an important burden of the world; the estimated number of maternal deaths in 2005 worldwide was 535,900 (Hill et al., 2007). The most widely used measurement for maternal mortality is the maternal mortality ratio (MMR), defined as the number of maternal deaths per 100,000 live births. The main causes of maternal deaths globally have been found to be obstetric hemorrhage, pregnancy-induced hypertension (PIH), and amniotic fluid embolism (AbouZahr, 2003). The survival and well-being of mothers are not only important in their own right, but they also are central to benefiting their families (especially the babies), communities, and nations (Koblinsky, 1995; World Health Organization [WHO], 1996a, 1999). Socioeconomic, sociodemographic, cultural, health resources, and quality of care are main contributing factors to maternal mortality (Berg, Chang, Callaghan, & Whitehead, 2003; Bolam et al., 1998; Djaja & Suwandono, 2001; Forssas, Gissler, Sihvonen, & Hemminki, 1999; Gwyneth & James, 2001; Jafarey & Korejo, 1995; Nwakoby, 1994; Okolocha, Chiwuzie, Braimoh, Unuigbe, & Olumeko, 1998; Razum, Jahn, Blettner, & Reitmaier, 1999; Rush, 2000; Setel, Whiting, Hemed, & Alberti, 2000; Taguchi et al., 2003).

As in other countries the maternal deaths in China continue to contribute to the total mortality burden; the MMR was 47.7 per 100,000 live births in 2005 (routine data). Economic reforms in China began in the 1980s, and great achievements have been obtained through China’s policies of foreign trade in the 1990s. There is an imbalance in both economic and health development, however, between Eastern and Western China. In the past, the health funds were allocated proportionally all over the country by the central government, which ensured health funds in poor western areas, but now decentralization requiring local governments to invest funds has led to the slowing down of health development in the poor areas in Western China. Although China has made good improvements in overall health status within the past 15 years, an imbalance of socioeconomic development probably has caused disparities of health development between regions with different economies. The gross domestic product (GDP) in Western China was less than one quarter of that in Eastern China, while the MMR in Western China was three times higher than in Eastern China (Liang et al., 2003). Eighty percent of health resources are allocated to the cities. The rural areas of China, where 70.0% of the total
population live, are served by only 37.5% of the national technical health workers (Lee, 2004).

China is a multiethnic country. It has 55 ethnic minority groups, with a population of over 100 million (8.5% of the total). Each minority group has its own culture and customs. The Xinjiang Uigur autonomous region is one of five self-governing regions of ethnic minorities. According to the fifth population census in 2000, ethnic minority groups accounted for 59.4% of the total population in Xinjiang; its MMR (157.2 per 100,000 live births) ranked as the highest in China (48.3 per 100,000 live births) in 2004 (National Bureau of Statistics of China, 2005; Ministry of Health of China, 2006).

METHODS

Study Design and Setting

A retrospective study was carried out in 1997 among 24 counties of the Xinjiang region from the Maternal and Child Health Project (health IX project) supported by the World Bank. Because there were no individual data on maternal deaths in the study of 1997, supplementary data collection for individual information on the same deaths in 1997 (age, ethnicity, and marital status) was conducted in all these counties in 2005.

The study area was selected through the criteria established by the Ministry of Health (MOH) based on the national policy for reduction of maternal mortality in poor areas. The first criterion was that MMR (routine data) should be higher than the average of the provincial level, and the second one was that annual income per capita was under the average level of the province. There are 96 counties in Xinjiang. The counties were divided into two groups according to the first criterion: high and low MMR groups. Then 24 counties in the high MMR group with low annual income per capita were selected. At the third level, all 286 townships and about 70% of all villages (1,954) were selected in these 24 counties.

Data Collection

Uniform questionnaires were developed by the MOH and the World Bank to collect the data in 1997. The questionnaires first were prepared in Chinese, and then translated into Uigur in Xinjiang by the local investigators chosen from professional health workers in a county maternal and child health (MCH) hospital. After data collection, all questionnaires in Uigur were translated back into Chinese. The differences in translation were discussed and corrected. Because the existing data had no personal information about maternal deaths, an additional questionnaire was used to get this data in 2005.
Confidential inquiry and verbal autopsy were combined for data collection. Confidential inquiry data were collected by questionnaires to health bureau and hospitals, review of health records and documents in health facilities, all available death certificates relating to maternal deaths, and the stated principal and contributory causes of death. Verbal autopsy data were collected by a structured questionnaire to close relatives of the deceased women. The protocol advocated interviewing female respondents who had been in contact with the deceased women around the time of her death, such as mother-in-law, sister, and birth attendant. The interviews were conducted at the homes of the respondents by a trained health worker. The respondents were asked about the dead women’s general information, reproductive history, health service utilization, the process of delivery, assistance sought, and treatment. Trained health workers were responsible for filling in questionnaires according to information from health bureau and hospitals, health records, and a household interview. The investigators classified maternal deaths by the WHO ICD-9 definition.

A cascade training for the data collection was adopted. The experts from the national level trained the provincial personnel, while provincial trainers subsequently trained the personnel from the county level, and finally county trainers trained local investigators under the guidance of provincial experts.

The study established a data quality control system for consistency, integrity, and validity. After collecting original data, the investigators performed a repeat check themselves; then the investigators inspected each other’s data. The trainers at the provincial level made random inspection visits to counties to inspect the missing cases and correct errors of maternal deaths and live births. The national-level trainers performed the same random inspection as the provincial level. Finally, all the data were submitted to the MOH and rechecked at the national level.

Variables at the County Level

*Sociodemographic:* population density, proportion of ethnic minorities, proportion of women of reproductive age.
*Socioeconomic:* annual net income per capita, farmer annual income per capita, percentage of health expenditure to total government financial expenditure.
*Health resources:* skilled MCH personnel per 1,000 population, education background of MCH personnel, number of beds per 1,000 population, average number of village doctors, proportion of villages without doctors.
*Health services utilization:* hospital delivery rate, antenatal care rate, postnatal visit rate.

Variables at the Individual Level

The selected variables at the individual level are presented in Table 1.
TABLE 1 Variables at the Individual Level in Study Areas of Xinjiang

| Variable                      | Classification                                                                 |
|-------------------------------|-------------------------------------------------------------------------------|
| Age groups                    | ≤19, 20−24, 25−29, 30−34, 35−39, ≥40                                         |
| Ethnicity                     | Minority groups, Han majority                                                 |
| Marital status                | Married, unmarried                                                            |
| Gravidity                     | <3, ≥3                                                                       |
| Parity                        | <3, ≥3                                                                       |
| Antenatal care                | No ANC, ≥1                                                                   |
| Type of delivery              | Clean delivery, unclean delivery, no delivery, unknown                        |
| Nature of delivery            | Natural delivery, vaginal dystocia, Caesarean section, no delivery, unknown   |
| Place of delivery             | Medical institutions, village station, home, no delivery, unknown              |
| Place of treatment within 24  | Medical institutions, village station, home, no treatment, unknown             |
| Cause of death                | Antepartum hemorrhage, postpartum hemorrhage, PIH, internal complication, puerperal infection, other causes, unknown |
| Place of death                | Medical institutions, village station, home, other places, unknown             |

Data Analysis

The data were entered into the computer using EpiData 3.1, and were checked and edited for inconsistency and errors. All statistical analyses were performed using SPSS 13.0 Statistical Software for WINDOWS. The frequency analysis was used to obtain the descriptive statistics for individual data. Bivariate analysis for county data was used to see the correlation between MMR and independent variables. The factors associated with MMR were done by multiple linear regression analysis for county data; the stepwise procedure was selected.

RESULTS

Basic characteristics and the MMR of 24 counties of the Xinjiang region are shown in Table 2.

The county characteristics in sociodemographic, socioeconomic, health services utilization and health resources, and their bivariate correlation with MMR, are shown in Table 3. The MMR was negatively correlated with annual net income per capita and farmer annual income per capita in the study areas of Xinjiang. It was strongly correlated with the average number of village doctors in the study areas of Xinjiang.

The proportion of skilled MCH personnel to skilled health personnel was 21.6% at the county level and 14.0% at the township level in study areas of Xinjiang. The proportion of beds for gynecology and obstetrics in
TABLE 2  Basic Characteristics and MMR of Study Areas in Xinjiang in 1997

| Name of county | Number of maternal deaths | Number of live births | Area (km²) | Population | Proportion of minority (%) | MMR (per 100,000 live births) |
|----------------|---------------------------|-----------------------|------------|------------|-----------------------------|------------------------------|
| Yutian         | 19                        | 4,539                 | 39,500     | 195,745    | 98.9                        | 418.6                        |
| Pishan         | 33                        | 3,481                 | 38,920     | 190,679    | 98.6                        | 948.0                        |
| Shufu          | 26                        | 9,359                 | 4,146      | 379,121    | 98.2                        | 277.8                        |
| Yingjisha      | 19                        | 3,892                 | 3,900      | 207,000    | 98.1                        | 488.2                        |
| Aketao         | 56                        | 3,055                 | 24,176     | 157,061    | 98.0                        | 1833.1                       |
| Yupehu         | 7                         | 2,330                 | 3,327      | 121,140    | 97.5                        | 300.4                        |
| Xinhe          | 14                        | 2,645                 | 8,223      | 130,364    | 95.3                        | 529.3                        |
| Hetian         | 16                        | 5,832                 | 42,746     | 241,808    | 95.2                        | 274.3                        |
| Luntai         | 6                         | 1,242                 | 14,789     | 84,324     | 89.3                        | 483.1                        |
| Baiteng        | 18                        | 3,244                 | 15,554     | 191,400    | 87.1                        | 554.9                        |
| Maigaiti       | 18                        | 2,786                 | 15,200     | 161,907    | 85.4                        | 646.1                        |
| Tuokezun       | 8                         | 1,607                 | 17,342     | 103,814    | 83.0                        | 497.8                        |
| Nileke         | 10                        | 2,515                 | 10,053     | 140,952    | 73.6                        | 397.6                        |
| Tuoli          | 11                        | 1,584                 | 21,300     | 76,976     | 73.2                        | 694.4                        |
| Gongliu        | 14                        | 2,689                 | 4,600      | 147,612    | 69.8                        | 520.6                        |
| Buerjin        | 7                         | 958                   | 10,540     | 65,847     | 65.9                        | 730.7                        |
| Aletai         | 7                         | 1,637                 | 11,140     | 121,360    | 65.1                        | 427.6                        |
| Mulei          | 17                        | 614                   | 22,171     | 118,463    | 61.1                        | 2768.7                       |
| Emin           | 12                        | 1,694                 | 9,532      | 128,859    | 59.5                        | 708.4                        |
| Heijing        | 4                         | 1,905                 | 39,686     | 169,872    | 44.0                        | 210.0                        |
| Tacheng        | 5                         | 1,564                 | 4,352      | 131,181    | 40.4                        | 319.7                        |
| Jinghe         | 4                         | 1,158                 | 11,275     | 95,262     | 36.6                        | 345.4                        |
| Hutubi         | 4                         | 1,499                 | 9,393      | 118,906    | 34.6                        | 266.8                        |
| Manasi         | 4                         | 1,634                 | 11,067     | 126,760    | 21.3                        | 244.8                        |

The hospitals was 29.1% at the county level and 24.1% at the township level in study areas of Xinjiang. Only five township hospitals had the ability to perform blood transfusions, which accounted for 1.9% of total township hospitals.

The study identified 339 deceased pregnant and lying-in women in 1997, aged 19 to 44 years; the mean age was 28 years. Ethnic minority groups of women accounted for 86.7% of maternal deaths in the study areas of Xinjiang. Most immediate causes of deaths in the study areas of Xinjiang were PPH (33.0%), internal complications (13.9%), PIH (13.6%), antepartum hemorrhage (9.4%), and puerperal infection (9.2%). In the study areas of Xinjiang, 58.1% of maternal deaths occurred at home and 31.6% of them occurred in the hospitals.

The health services that the two groups of deceased women used are shown in Figure 1. One group consists of 12 counties with higher proportion of ethnic minorities, and the other represents 12 counties with lower proportion of ethnic minorities.

The dependent variable (MMR) and 14 independent variables were entered to perform stepwise linear regression; the stepping method criteria were entry < .05 and removal > .10. The results showed that the determinants
**TABLE 3** Bivariate Correlation Between MMR and Each Variable

| Study counties of Xinjiang | Study areas of Xinjiang |
|----------------------------|------------------------|
| **n = 24**                 | **Pearson Correlation** |
| **Mean (minimum, maximum; SD)** | **MMR (per 100,000 live births)** | **P (1 tailed)** |
| Population density [person/km²] | 16.9 (3.6, 91.4; 20.0) | −.244 | .125 |
| % of minority groups | 73.7 (21.3, 98.9; 24.1) | .124 | .282 |
| % of women in reproductive age | 21.5 (10.7, 37.2; 7.2) | .209 | .163 |
| Annual net income per capita [CNY] | 1294.1 (406.0, 3440.0; 659.5) | −.350* | .047 |
| Farmer annual income per capita [CNY] | 453.0 (415.0, 511.0; 24.9) | −.427* | .019 |
| % of health expenditure to total financial expenditure | 6.9 (0.1, 12.5; 3.2) | −.171 | .229 |
| Average number of village doctors | 1.1 (0.3, 3.7; 0.7) | .799** | <.001 |
| % of villages with no doctor | 23.2 (0.0, 67.1; 20.7) | −.004 | .493 |
| Skilled maternal and child health personnel per 1,000 population | 0.4 (0.2, 0.9; 0.2) | −.158 | .230 |
| % of female village doctors | 40.9 (9.0, 69.5; 17.1) | −.230 | .140 |
| % of village doctors qualified to deliver | 40.6 (13.0, 87.2; 21.7) | −.015 | .471 |
| % of registered birth attendants | 37.1 (0.0, 84.8; 23.9) | .281 | .092 |
| Hospital delivery rate (%) | 35.8 (7.6, 93.9; 24.6) | .170 | .213 |
| Antenatal care rate (≥1 time; %) | 50.1 (1.3, 97.2; 39.1) | .121 | .292 |
| Postnatal visit rate (%) | 33.7 (1.7, 85.3; 30.9) | .139 | .263 |

*Correlation is significant at the .05 level (1 tailed).
**Correlation is significant at the .01 level (1 tailed).
of MMR were average number of village doctors, proportion of villages without doctors, and percent of minority groups (Table 4). All three determinants were positively associated with MMR.

### DISCUSSION

**Laggard Progress in Attaining MDGs**

The “Tracking Progress in Child Survival: Countdown to 2015” conference cosponsored by UNICEF, the WHO, and other institutions, reviewed the attainment of Millennium Development Goals (MDGs) 4 and 5 in various countries, in London in December 2005. China was listed among 60 priority countries that need to enhance their efforts to achieve the MDGs on maternal and child mortality. Although China was on track for MDGs, there is a need to enforce policies and measures to achieve further reduction in maternal and child mortality. Otherwise, the Chinese government may fail to live up to its commitment by 2015. Western regions represent 26.1% of total live births in China, but they account for 44.2% of the total number of maternal

### TABLE 4

Stepwise Regressions of the Relationship Between MMR and Selected Factors

|                                      | B (SE)            | 95% CI for B | Beta | P a Adjusted R square |
|--------------------------------------|-------------------|--------------|------|-----------------------|
| Average number of village doctors    | 849.968 (92.529)  | 654.749–1045.186 | 0.985 | <.001                 |
| Proportion of villages without doctors | 12.905 (3.343)   | 5.851–19.959  | 0.454 | .001 0.809           |
| Percent of minority groups           | 8.353 (2.655)     | 2.751–13.955  | 0.342 | .006                 |

aP < .05 was chosen as the level of significance.
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deaths in the whole country (Ministry of Health of China, 2006). Our findings may serve as a basis for the government to make effective measures against preventable cases in rural, poor western areas.

Factors Contributing to Maternal Mortality

We learned that postpartum hemorrhage (PPH) was the major cause of maternal death in Xinjiang. It also is the most prevalent cause of death in China (Ministry of Health of China, 2005). The researcher found that direct obstetric complications account for more than 50% of all maternal deaths; this is consistent with the status globally as well (AbouZahr, 2003).

Although economic factors associated with maternal mortality are widely documented (Brieger, Luchok, Eng, & Earp, 1994; Forssas et al., 1999; Li & Fottler, 1996; Taguchi et al., 2003), we argue that the influence of economic factors is complicated. When the economy develops to a certain extent, other related factors will influence maternal mortality much more. The multivariate analysis of this study showed that there was no significant relationship between economic factors and MMR in study areas of Xinjiang. One report refers to some developing countries with a low economic level, with relatively low MMR. This can be attributed to improved social status and health of women, strengthened health care and health promotion for pregnant women, and advanced service level and quality of obstetrics (Donnay, 2000). We believe that although poverty is a major underlying determinant of health, poverty eradication alone will not be the panacea for reducing maternal mortality. Economic status may be associated with other factors that in turn play a greater role (Blakely, Hales, & Woodward, 2004).

In completing this study, we learned that ethnic minorities have a lower utilization rate of health services. Aspects of the relation between ethnicity and maternal mortality have been ignored. A knowledge, attitude, and practice (KAP) study in China shows that there is still 10%–20% of women who refuse to deliver in the hospitals even if the delivery is free (World Health Organization, 2006). This suggests that aside from economic reasons, culture and beliefs are fundamental determinants for hospital delivery in rural China, especially for minority groups. The status of women is still low in some rural areas, and they have no decision-making power in the family. In general the mother-in-law or husband decides where delivery will take place (Bolam et al., 1998), and traditions often made them select the home. For example, one taboo for pregnant women from ethnic minorities in Xinjiang was that they should not be seen by strangers until 12 days after delivery (Xinjiang Cultural Exchange Association, 2006). More research on this subject is needed. It is important to know what cultural, belief, taboo, ethical, and economic factors may influence the use of health services in minority areas, so that culturally appropriate health education programs can be run effectively to promote health-seeking behavior.
Xinjiang is a vast and sparsely populated region. In pasturing areas and remote villages, it is a long trip to reach health facilities. There are still some remote villages in Xinjiang that have no public transportation with the outside world, where horses are still commonly used. Extreme weather conditions during long winters are also barriers for some pregnant women to reach a hospital in mountainous areas where the lowest temperature was about $-35^\circ$ in Xinjiang, and heavy snow could block the village for months. These difficulties restrict some women’s access to health services and make them abandon the idea of a hospital delivery (Djaja & Suwedono, 2001).

In most rural areas, village doctors undertake basic health care and management for pregnant women and women in delivery, such as antenatal care, postnatal visits and home delivery. There is still a large proportion of pregnant women and their families who elect to give birth at home. In this situation, village doctors and registered birth attendants are essential in rural areas. They play an important role for the bottom of three-tier health care network. Because of the low level of technology and medical equipment, however, village doctors and birth attendants are likely to miss the opportunity to save the woman’s during home delivery. On the other hand, because of cost and long held traditions and customs, village doctors generally deliver rural pregnant women’s babies (Wang, Guo, & Zhang, 2000).

The findings suggest that although safe motherhood is a high priority program in many countries including China, most deliveries still occur at home and are attended by traditional and nonregistered birth attendants. Sri Lanka, D.P.R. Korea and Thailand have successfully addressed these issues, thereby substantially decreasing maternal mortality (Fernando, Jayatilleka, & Karunaratna, 2003; Rai & Dali, 2002).

Study Limitations

This study adopted a combination of confidential inquiry and verbal autopsy. The reliability and validity of verbal autopsy for identifying maternal deaths, however, has not been established (WHO, 2004). It has been criticized for possibly misclassifying maternal deaths, particularly those occurring early in pregnancy and indirect causes of maternal death (Høj, Stensballe, & Aaby, 1999; Sloan, Langer, Hernandez, Romero, & Winikoff, 2001). The misclassification will cause overestimation or underestimation of MMR.

The study is retrospective. Within the health care facilities there were medical records to review. But outside the health system, the data were collected entirely from the families of the deceased women. Although maternal death is an unforgettable event, a time interval of 1 to 2 years possibly produced recall bias. It might cause some information bias such as reproductive history.

The study areas were not sampled completely at random for practical reasons, because this would have involved dramatic increases in cost with
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uncertain benefits. The study counties were poor areas in the province. Therefore, representation of the entire province needs to be considered (Fink, 1995).

In this study we aimed to analyze factors related to maternal mortality in each county as a whole. Due to lack of vital registration providing individual-level controls, when making inferences this must be kept in mind. That means the individual level of maternal deaths is not compared with individuals of the same reproductive age in the same county. When reporting area-level associations, we always have to keep in mind the potential for ecological fallacy, where associations found at a higher level does not necessarily correspond with similar associations at an individual level (Piantadosi, Byar, & Green, 1998; Rothman & Greenland, 1998).

CONCLUSIONS

Our data provide evidence that low health services utilization of minority women is related to high maternal mortality in multiethnic areas in Xinjiang. China is making great efforts to increase the hospital delivery rate and to develop baby-friendly hospitals, and has made progress throughout the country. Our study results, however, showed a picture that there existed inequality of progress; there are still many laggard counties in China. These results suggest that the government should greatly advocate for and improve hospital delivery, especially in poor areas of China, and establish the maximum price for regular delivery and caesarean section, allowing more pregnant women the opportunity of hospital delivery. Screening for high-risk pregnancy can be used as a strategy to promote hospital-based delivery in areas with a very low hospital delivery rate. This may be a long-term process, however, so it is equally important to create the conditions for hygienic home delivery during this period, especially in remote rural areas of Xinjiang. Women should be encouraged to use the clean home delivery kit in each case of home delivery to reduce the risk of maternal and neonatal infection (Royston & Armstrong, 1989; WHO, 1987, 1996b).

A higher risk of maternal death in medical institutions indicated that the quality of health services was not satisfactory. Health institutions should improve their quality of obstetric services and decrease the maternal deaths occurring in the hospitals, so that pregnant women can receive safe hospital delivery. Antenatal check-ups and postnatal visits can detect health problems in time, allowing pregnant women to receive timely treatment to survive the process of giving birth (Midhet, Becker, & Berendes, 1998). Attending antenatal care would help tackle the problem of PPH (Morrison et al., 2005).

In Xinjiang, it is important to encourage minority women to improve their self health care consciousness and protect themselves from social and
cultural factors. Use health education to disseminate health information and behavior to the target population, and mobilize individual, family, and community participation to use interpersonal communication to pay more attention to maternal health (Fathalla, 2001). More research regarding maternal mortality of ethnic minorities in multiethnic areas is needed.

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