Inequality in Maternal Mortality in Iran: An Ecologic Study

Parvin Tajik[1], Saharnaz Nedjat[1,2], Nozhat Emami Afshar[3], Nasrin Changizi[3], Bahareh Yazdizadeh[2], Arash Azemikhah[3], Sima Aamrolalaei[2], Reza Majdzadeh[1,2]

[1]School of Public Health, [2]Knowledge Utilization Research Center, Tehran University Medical Sciences, and [3]Department of Family Health, Ministry of Health and Medical Education, Tehran, Iran

Correspondence to:
Ass. Prof. Saharnaz Nedjat, School of Public Health, Knowledge Utilization Research Center, Tehran University of Medical sciences, Tehran, Iran. E-mail: nejatsan@tums.ac.ir

Original Article

ABSTRACT

Background: Maternal mortality (MM) is an avoidable death and there is national, international and political commitment to reduce it. The objective of this study is to examine the relation of MM to socioeconomic factors and its inequality in Iran's provinces at an ecologic level.

Methods: The overall MM from each province was considered for 3 years from 2004 to 2006. The five independent variables whose relations were studied included the literacy rate among men and women in each province, mean annual household income per capita, Gini coefficients in each province, and Human Development Index (HDI). The correlation of Maternal Mortality Ratio (MMR) to the above five variables was evaluated through Pearson's correlation coefficient (simple and weighted for each province's population) and linear regression – by considering MMR as the dependent variable and the Gini coefficient, HDI, and difference in literacy rate among men and women as the independent variables.

Results: The mean MMR in the years 2004–2006 was 24.7 in 100,000 live births. The correlation coefficients between MMR and literacy rate among women, literacy rate among men, the mean annual household income per capita, Gini coefficient and HDI were 0.82, 0.90, −0.61, 0.52 and −0.77, respectively. Based on multivariate regression, MMR was significantly associated with HDI (standardized B=−0.93) and difference in literacy rate among men and women (standardized B=−0.47). However, MMR was not significantly associated with the Gini coefficient.

Conclusion: This study shows the association between socioeconomic variables and their inequalities with MMR in Iran's provinces at an ecologic level. In addition to the other direct interventions performed to reduce MM, it seems essential to especially focus on more distal factors influencing MMR.

Keywords: Ecologic study, inequality, Iran, maternal mortality

INTRODUCTION

Every day 1600 women die of the complications of pregnancy and labor. More than 99% of these deaths take place in developing

countries, such that the mean of Maternal Mortality Ratio (MMR) in developing countries is 200/100,000, while it is 20/100,000 in developed countries. These figures show the significant difference in maternal health in developing and developed countries.[1] Inequality in Maternal Mortality (MM) is avoidable[2] and unfair;[3] hence, it can be considered inequity. Equity is one of the country's development goals, so the question here is whether the maternal death distribution at different provinces with different levels of socioeconomic development is equal or not.

MMR is one of the most important indicators of a country's development.[4] Based on World Health Organization (WHO)'s estimate, 88–98% of all maternal deaths are preventable if all women have access to maternal care and health services.[5] The literature demonstrates that MM is most strongly affected by women's access to medical care for complications of pregnancy.[6] A study conducted in Jamaica showed that the MM declined with increasing maternal education level and household income.[7] Other studies also showed that low socioeconomic backgrounds have a significant direct association with MM.[8,9]

Keeping in mind the WHO's 2000 report in which the importance of equity in heath services and estimation of health distribution indicators have been mentioned in addition to its mean indicators,[10] this study was performed to determine the relation of socioeconomic factors and inequity and MM in Iran's provinces.

METHODS

Design and setting

The ecologic study was conducted using the national data available in the "MM surveillance system," "Iran's Statistics Center" and the "Budget and Planning Organization" during 2004–2006.

Measures and measurements

Using the MM surveillance system's data, the number of mortalities in each province (28 provinces) was taken into consideration. The definition of MM was taken from the ninth edition of the International Classification of Diseases (ICD-9):[11] MM was defined as death up to 42 days after termination of pregnancy, irrespective of the duration and site of pregnancy,

resulting from any relevant cause, or as a result of care provided during it, excluding accident as a cause. This definition has been approved by the Ministry of Health and the National committee of MM reduction.[5,12,13]

The MMR shows the number of maternal deaths for every 100,000 live births resulting from complications of pregnancy and delivery.[5] To reduce data inconsistency, the total MMR of the 3-year period of 2004–2006 was considered for each province. The MMR for each province was then calculated after dividing this number by the number of live births of this period.

The independent variables whose associations with MMR were studied are as follows: 1) The illiteracy rate of each province for females 2) The illiteracy rate of each province for males, using the national consensus results in 2006. 3) Mean annual household income per capita, using the data of the "Costs and Income" project of 2005. 4) The Gini coefficients of each province, using the data of the "Costs and Income" project of 2005. The Gini coefficient is an indicator used for measuring inequality in income or wealth and its domain ranges from 0 to 1; the closer it is to 1, the higher the inequality. Conversely, the closer it is to 0, the higher the equality in distribution.[14] 5) Human Development Index (HDI), based on the data obtained from the "Budget and Planning Organization" in 2005.

The HDI assesses the average success of the provinces in the three domains of human development and summarizes the long and healthy life, which is measured through life expectancy at birth, knowledge (which is measured by the adult literacy rate and their level of education – combined gross enrolment ratio) and the extent of welfare measured by Gross Domestic Product (GDP). The upper and lower limits of this indicator are 1 and 0, and it represents greater development, the closer it is to 1.[15] These variables could be considered as the confounders for each other, while estimating their main effect was the objective of the study.

Statistical analysis

The associations between MMR and the above five variables were assessed through Pearson's correlation coefficient (simple and weighted for each province's population) and linear regression

(ENTER model). Since the level of education and income were correlated to HDI, only the three variables of difference in literacy rate among men and women, the Gini coefficient and HDI were used as independent variables. Also, the 3-year MMR was considered as the dependent variable. SPSS (version 11.5) and STATA (version 8) were used for data analysis, and type 1 error was considered 0.05.

This study has the approval of Tehran University of Medical Sciences' Ethics Committee.

RESULTS

Table 1 shows the distribution of the variables under study. The mean MMR in 2004–2006 is 24.7/100,000 live births. Illiteracy was lowest in Tehran (8.7%) and highest in Sistan Baluchestan (32.6%). The upper and lower limits of the male illiteracy rate were seen in Sistan Baluchestan (26.3%) and Tehran (6.4%), respectively, and on average, 12.5% of men are illiterate in the country. The illiteracy rate of men was lower than that of women in each province (and this held true for all the provinces). The lowest difference in literacy among men and women was seen in Tehran, where the illiteracy rate of women was only 4.7% more than that observed in men. The highest difference, on the other hand, was seen in West Azarbaijan with 15.2% difference, Ardebil (13.3%), and Kordestan (14.4%). Regarding the Gini coefficient, the lowest inequality was observed in Lorestan, Semnan, Qazvin and Qom (0.34). The highest inequality was that of Hamedan (0.48), followed by Hormozgan (0.46). When it came to the HDI, the most developed province was Tehran (0.78), followed by Esfahan and Qazvin 0.73. Also, the least developed provinces were Sistan Baluchestan (0.58), followed by Kordestan (0.63) and Ardebil

Table 1: Distribution of the study variables in 28 provinces of Iran

	Maximum	Minimum	Mean
Maternal mortality ratio	61.3	6.3	24.7
Percentage of total illiteracy	32.6	8.7	17.1
Illiteracy rate in women	38.9	11.2	21.8
Illiteracy rate in men	26.3	6.4	12.5
Gini coefficient	0.48	0.34	0.39
Human development index	0.78	0.58	0.70

(0.66). The variables under study in each province are presented in Appendix 1.

Table 2 illustrates the simple and weighted linear correlation coefficients between independent variables and MMR. The highest correlation coefficient was seen in the association between MMR and illiteracy rate in men (0.90). This is followed by the HDI which has the highest inverse correlation with MMR (-0.77). The level of significance was smaller than 0.001 in all the cases' coefficients.

When the association of independent variables of "difference in illiteracy rate in women and men in each province, Gini coefficient and HDI" and dependent variable of 3-year MMR was assessed through multivariate linear regression, the HDI and difference in illiteracy rate in women and men in each province were still significant. Table 3 illustrates the results of this analysis. Altogether, these three variables explain 54% of the variance of the 3-year MMR ($R^2=0.54$). The effect of HDI on the 3-year MMR was negative (negative regression coefficient, B=−0.93), and the effect of difference in illiteracy rate in women and men in each province on the 3-year MMR was inverse (negative regression coefficient, B=−0.47).

DISCUSSION

In this study, we observed a significant association between MM and HDI. A rise in HDI (which itself is a combination of life expectancy, level of education and income) was associated with a significant fall in MMR. Also, since the standardized regression coefficient (B=−0.93) has been presented, this effect is stronger than the other two independent variables (Gini coefficient and difference in illiteracy rate in women and men). Also, the difference in illiteracy rate in women and men showed an independent and significant association, which against expectation is in the inverse direction. In other words, if the overall effect of "level of education of men and women in the society, life expectancy and income" which are considered as HDI in the regression equation, and inequality in income – which is represented by the Gini – are omitted, an independent rise in difference in illiteracy rate in women and men leads to a significant decline in MMR. This association was direct in the correlation between difference in

Table 2: Correlation coefficients between socioeconomic variables and maternal mortality in Iran's provinces

	Simple Pearson's correlation coefficient	Pearson's correlation coefficient weighted for each province's population
The illiteracy rate	0.41	0.86
Illiteracy rate in women	0.56	0.82
Illiteracy rate in men	0.72	0.90
Difference in illiteracy rate in women and men	0.25	0.54
Mean annual household income per capita	−0.36	−0.61
Gini coefficient	0.39	0.52
Human development index	−0.63	−0.77

Table 3: The association of three variables with MMR in 28 provinces through multivariate linear regression

	Regression coefficient (95% confidence interval)	*P*-value
Human development index	−247.6 (−368.2 to −127.1)	<0.001
Gini coefficient	51.0 (−32.1 to 134.2)	0.22
Difference in illiteracy rate in women and men	−2.1 (−4.0 to −0.2)	0.03

MMR: Maternal Mortality Ratio

level of education and MMR, such that with an increase in difference in illiteracy rate in women and men, the MMR would also rise (r=0.54). The exact explanation of this finding is not easy and requires further studies. This finding may be the effect of other confounders, the control of which may not be possible because of the ecologic nature of the data. The ecologic studies are useful for hypothesis generation. In the cross-national analysis, it was shown that indicators such as women's level of education relative to men, age at first marriage, and reproductive autonomy are a strong predictor of MM ratio among countries.[16]

In sub-Saharan Africa, the MMR in the years 1997–2006 was associated with GDP, adult literacy rate, access to an improved water source, and government expenditure on health per capita in all the countries of the region.[17] In Nigeria too, factors such as low level of education, poverty, and lack of use of health services during pregnancy have been mentioned as factors affecting MM.[18,19] According to another study conducted in Syria in 2003, the quality of maternal care is one of the determinant factors of MM such that 54% of these deaths have resulted from poor clinical skills and lack of clinical competency.[20] In our study, we have only used the available data, and these data did not include information on the quality of care provided to pregnant mothers. Although maternal care is available in all the provinces of the country, there may be differences in the quality of this care. So, we should interpret our findings with care. In a study which assessed the association between health indicators and HDI in the Arab region, high correlation between health indicators and HDI is illustrated.[21] The association between literacy rate and health indicator was assessed in another study which analyzed the HDI and World Bank data in 68 countries classified as middle- and low-income countries, in 2002 and 2003. This study has shown that if the literacy rate rises by 10%, life expectancy will be prolonged by about 1.2 years and the infant mortality rate will decrease by about 6%.[22] In another study, the association between infant and MM rates in the world and HDI was assessed; in this study, it was illustrated that HDI is a powerful predictor of infant and MM rates. It accounts for 85–92% of the variation in infant mortality rates and 82–85% of the variation in MM rates among the countries of the world. It was also shown that each component of HDI is also strongly and independently associated with infant and MM rates.[23] The other worldwide surveys also confirmed these associations.[24] Although MM is preventable, it is still taking place, and there are striking differences in its rate in different parts of the world; in Africa it is 1/26, whereas in developed countries it is 1/7300 live births.[25]

Limitations of the study

This is an ecologic study that has been conducted on the available and aggregated data. The point that should be remembered in the interpretation of these data is the possibility of ecologic bias as a result of data analysis at the aggregated level and that the effect of the confounders cannot be controlled. Therefore, in spite of the usefulness of the analyses performed, they are more of exploratory nature and are good

for hypothesis formation.[26] Also, some variables such as the quality of maternal care provided at provincial level have not been considered due to lack of data.

CONCLUSIONS

The Millennium Development Goals call for a 75% reduction in MM by 2015, although it is important to focus on the direct determinants of MM such as bleeding, eclampsia, etc., but focusing on more distal determinants such as level of education and economic status can also be effective in reducing MMR. Even though the association between inequality in income and MM in each province was not significant upon adjusting for other variables in our study, the adults' level of education and MM were significantly associated in each province. Considering the fact that our study was an ecologic one, we recommend approval of the above findings upon conduction of studies at individual level. The provinces that had a lower HDI were at more risk of MM, so steps should be taken to reduce this index in these provinces.

REFERENCES

1. Poor countries still failing to meet maternal and child mortality goals. Pract Midwife 2008;11:10.
2. Adashi EY. Global maternal mortality: An unspeakable yet avoidable human tragedy. Medscape J Med 2009;11:22.
3. Barbara S. Equity in health. Can Med Assoc J 2000;162:346.
4. Hill K, Thomas K, Abou Zahr C, Walker N, Say L, Inoue M, *et al*. Estimates of maternal mortality worldwide between 1990 and 2005: An assessment of available data. Lancet 2007;370:1311-9.
5. Maternal mortality ratio (per 100 000 live births) [database on the Internet] 2004. Available from: http://www.who.int/healthinfo/statistics/indmaternalmortality/en/index.html. [Last accessed on 2011 Sep 04].
6. Maine D. How do socioeconomic factors affect disparities in maternal mortality? J Am Med Women Assoc 2001;56:189.
7. Golding J, Ashley D, McCaw-Binns A, Keeling JW,

Appendix 1: Independent variables of the study by provinces

Province	Illiteracy-women	Illiteracy-men	Gini	HDI	Province	Illiteracy-women	Illiteracy-men	Gini	HDI
Ardebil	24.43	12.29	0.44	0.66	Kermanshah	21.2	11.84	0.36	0.68
Bushehr	15.92	8.82	0.36	0.72	Khorasan	17.27	10.05	0.42	0.7
Chahrmahal Bakhtiari	20.97	10.89	0.38	0.69	Khusestan	18.8	10.7	0.41	0.71
Eastern Azarbaiijan	22.45	11.9	0.39	0.69	Kohgiluie Buierahmad	21.76	11.54	0.39	0.67
Fars	15.26	9.2	0.35	0.73	Kordestan	27.41	14.23	0.36	0.63
Gazvin	16.95	9.47	0.35	0.73	Lorestan	21.76	12.82	0.34	0.67
Ghom	16.22	8.89	0.35	0.71	Markazi	19.32	10.65	0.39	0.71
Gilan	19.92	11.56	0.41	0.73	Mazandaran	17.63	10.22	0.37	0.73
Golestan	21.18	11.24	0.45	0.7	Semnan	13.37	8.09	0.35	0.72
Hamadan	20.73	11.47	0.48	0.68	Sistan Baluchestan	32.77	22.01	0.43	0.58
Hormozgan	19.21	12.57	0.46	0.69	Tehran	10.23	5.9	0.35	0.78
Ilam	20.73	12.41	0.37	0.69	Western Azarbaiijan	27.15	13.4	0.38	0.66
Isfahan	14.51	8.62	0.39	0.75	Yazd	13.82	8.456	0.38	0.72
Kerman	18.16	13.05	0.44	0.69	Zanjan	21.89	12.02	0.36	0.68

HDI: Human Development Index

Shenton T. Maternal mortality in Jamaica. Socioeconomic factors. Acta Obstet Gynecol Scand 1989;68:581.

8. Urassa E, Lindmark G, Nystrom L. Maternal mortality in Dar es Salaam, Tanzania: Socio-economic, obstetric history and accessibility of health care factors. Afr J Health Sci 1995;2:242.

9. Taguchi N, Kawabata M, Maekawa M, Maruo T, Aditiawarman, Dewata L. Influence of socio-economic background and antenatal care programmes on maternal mortality in Surabaya, Indonesia. Trop Med Int Health 2003;8:847-52.

10. WHO. The world health report 2000 - Health systems: Improving performance, 2000.

11. International Classification of Diseases (ICD) [database on the Internet] 2000. Available from: http://www.who.int/classifications/icd/en/index.html. [Last accessed on 2011 Sep 04].

12. Ministry of Health and Medical Education, Maternal Health Office, Maternal Mortality National Surveillance System, 2007.

13. Azemikhah A, Amirkhani MA, Jalilvand P, Emami Afshar N, Radpooyan L, Changizi N. Maternal mortality surveillance system in Iran. Iran J Public Health 2009;38(Suppl 1):90-2.

14. Wikipedia. Gini coefficient. 2009; Available from: http://en.wikipedia.org/wiki/Gini_coefficient. [Last accessed on 2011 Sep 04].

15. Wikipedia. Human Development Index. 2010; Available from: http://en.wikipedia.org/wiki/Human_Development_Index. [Last accessed on 2011 Sep 04].

16. Shen C, Williamson JB. Maternal mortality, women's status, and economic dependency in less developed countries: A cross-national analysis. Soc Sci Med 1999;49:197-214.

17. Alvarez JL, Gil R, Hernandez V, Gil A. Factors associated with maternal mortality in Sub-Saharan Africa: An ecological study. BMC Public Health 2009;9:462.

18. Abe E, Omo-Aghoja LO. Maternal mortality at the Central Hospital, Benin City Nigeria: A ten year review. Afr J Reprod Health 2008;12:17-26.

19. Aboyeji AP, Ijaiya MA, Fawole AA. Maternal mortality in a Nigerian teaching hospital - a continuing tragedy. Trop Doct 2007;37:83-5.

20. Bashour H, Abdulsalam A, Jabr A, Cheikha S, Tabbaa M, Lahham M, *et al*. Maternal mortality in Syria: Causes, contributing factors and preventability. Trop Med Int Health 2009;14:1122-7.

21. Boutayeb A, Serghini M. Health indicators and human development in the Arab region. Int J Health Geogr 2006;5:61.

22. Furukawa M. Factor analysis of attributive determinants for life expectancy and infant mortality rate with recipient country data in consideration of socioeconomic environment. Nippon Eiseigaku Zasshi 2005;60:335-44.

23. Lee KS, Park SC, Khoshnood B, Hsieh HL, Mittendorf R. Human development index as a predictor of infant and maternal mortality rates. J Pediatr 1997;131:430-3.

24. McAlister C, Baskett TF. Female education and maternal mortality: A worldwide survey. J Obstet Gynaecol Can 2006;28:983-90.

25. Anderson FW. Maternal mortality: An enduring epidemic. Clin Obstet Gynecol 2009;52:214-23.

26. Kennete J, Rothman SG, Lash TL. Modern Epidemiology. 3rd ed. Philadelphia: Lippincott Williams and Wilkins; 2008.

Author Help: Reference checking facility

The manuscript system (www.journalonweb.com) allows the authors to check and verify the accuracy and style of references. The tool checks the references with PubMed as per a predefined style. Authors are encouraged to use this facility, before submitting articles to the journal.

- The style as well as bibliographic elements should be 100% accurate, to help get the references verified from the system. Even a single spelling error or addition of issue number/month of publication will lead to an error when verifying the reference.
- Example of a correct style
  Sheahan P, O'leary G, Lee G, Fitzgibbon J. Cystic cervical metastases: Incidence and diagnosis using fine needle aspiration biopsy. Otolaryngol Head Neck Surg 2002;127:294-8.
- Only the references from journals indexed in PubMed will be checked.
- Enter each reference in new line, without a serial number.
- Add up to a maximum of 15 references at a time.
- If the reference is correct for its bibliographic elements and punctuations, it will be shown as CORRECT and a link to the correct article in PubMed will be given.
- If any of the bibliographic elements are missing, incorrect or extra (such as issue number), it will be shown as INCORRECT and link to possible articles in PubMed will be given.