

Original Article

Maternal Mortality Regionalization and Trend in Mexico (1937 - 1995)¹

SANDRA REYES FRAUSTO,* MIGUEL ANGEL LEZANA FERNANDEZ,**
MARIA DEL CARMEN GARCIA PEÑA,* and JOSE LUIS
BOBADILLA FERNANDEZ† ***

* *División de Investigación Epidemiológica y en Servicios de Salud, Coordinación de Investigación Médica, Instituto Mexicano del Seguro Social, Centro Médico Nacional Siglo XXI, México, D.F.*

** *Dirección General de Estadística e Informática, Secretaría de Salud, México, D.F.*

*** *Banco Interamericano de Desarrollo, Washington, D.C., USA*

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Abstract

Background: The objectives were to establish regions by level of maternal mortality in order to evaluate its trend from 1937 - 1995 and to analyze characteristics of cases which occurred from 1990 - 1995.

Methods: Regionalization of the country by maternal mortality level was carried out using Poisson regression. Level and mortality trends were analyzed globally and compared by regions using Poisson and linear regression. Characteristics of cases were analyzed from 1990 - 1995 using proportions and χ^2 test.

Results: Four well-differentiated and independent regions were established. Low and medium maternal mortality rate regions were found in northern and northwestern Mexico. High and very high maternal

mortality regions were found in the South and the Southeast of the country. Even when maternal mortality had descended, the speed of the descent has decreased and in the last few years, maternal mortality has increased. The quality of health care is a challenge for regions with low mortality rates, while the problem of accessibility is present in those with very high mortality rates.

Conclusion: The employment of this regionalization approach in maternal mortality analysis would be useful to determine specific problems for each region. The establishment of programs according to this analysis could contribute to decrease in maternal mortality cases in Mexico. (*Arch Med Res* 1998; 29:165)

KEY WORDS: Maternal mortality; Mortality trend; Mexico; Regionalization.

Introduction

Maternal mortality is a public health problem on a

Correspondence to:

Sandra Reyes Frausto, Bloque B de la Unidad de Congresos del Centro Médico Siglo XXI, 4° Piso, Cuauhtémoc 330, Col. Doctores, 06725 México, D.F., México. Tel: (525) 627-6900 ext. 3337; E-mail: sandrar@cim.spin.com.mx.

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†deceased

worldwide (1) scale, in spite of its absolute low frequency, due to repercussions on the family environment and on society. The level of maternal mortality has been considered as one of the most sensitive indicators of the economic and social level of countries and regions (2,3). According to the World Health Organization (WHO), 99% (4) of the 585,000 annual maternal deaths in the world take place in developing countries (5). In developed countries, the maternal mortality ratio (MMR) (number of women who died during, or as a consequence of, pregnancy divided by the number of live births in the

same locality and period) is 30, while for developing countries, the ratio is 450 per 100,000 live births (4), that is, that the risk of dying is 15 times higher in the latter. However, even in developed countries, maternal mortality is considered to be a current problem that can be avoided with effective public health and medical interventions (6). Worldwide maternal mortality has shown a downward trend. However, the speed with which the problem has decreased has differed, depending on the socioeconomic development (7) of the countries and regions. In the poorest regions with acute social and economic crises, the speed of the descent has gradually slowed, and in fact in some cases has levelled off. As some authors have pointed out, the tragedy is that the majority of maternal mortality cases are avoidable (8) due to the available resources and technology, but accessible for every woman.

Mexico has been classified by WHO as a country with high maternal mortality (9). Even when MMR has been decreased as a result of the National Program for the Health of Women included in the National Plan of Action for the Application of the World Summit for Children (10), an optimal level has not been reached (11). Maternal mortality was 54 per 100,000 live births in 1990 (without considering the level of underreporting of the maternal mortality ratio, which has been estimated to be 46%) (13,14), which was 5 - 7 times higher than in some developed countries (3,14-16). This ratio was increased during 1994 and 1995 (11), perhaps because records were improved (11) or because of women's health conditions and availability of resources made worse by economic crises.

Although maternal mortality regionalization has been recognized (11) as a need for decision making concerning the reduction of the problem through specific actions by area, these epidemiological studies have not been carried out in the Mexican population.

The objectives of this study were to establish pertinent regions according to maternal mortality level to evaluate the trend of maternal mortality (globally and by region) from 1937 - 1995 and to analyze the characteristics of the cases which occurred from 1990 - 1995 according to the established regions. Results showed regionalization strength in analyzing maternal mortality in Mexico and its utility in supporting policies and programs oriented toward high priority areas, which could contribute to decreasing maternal mortality cases in Mexico.

Methods

In order to establish maternal mortality regionalization for Mexico, a database was created with the information reported by the National Institute of Statistics, Geography and Informatics (INEGI). Variables used were the following: number of women who died due to any maternal cause; number of registered live births, and the

Table 1
States, Maternal Mortality Rate Ratio and 95% Confidence Intervals in Each Region Established by Poisson Regression Model (1937 - 1995)

Region	States	MMR Ratio	95% C.I.
Low mortality	Aguascalientes	--	--
	Baja California Sur		
	Coahuila		
	Distrito Federal Nuevo Leon		
Middle mortality	Baja California	1.24	1.22-1.26
	Campeche		
	Durango		
	Jalisco		
	Morelos		
	Nayarit		
	Sinaloa		
	Sonora Tamaulipas Tlaxcala Yucatan		
High mortality	Colima	1.51	1.49-1.53
	Chihuahua		
	Guanajuato		
	Guerrero		
	Estado de Mexico		
	Michoacan		
	Tabasco Zacatecas		
Very high mortality	Chiapas	1.89	1.86-1.92
	Hidalgo		
	Oaxaca		
	Puebla		
	Queretaro		
	Quintana Roo		
	San Luis Potosi Veracruz		

state and year in which the case occurred. The study period was from 1937 - 1995. Information was captured and recaptured directly from the INEGI records by one of the researchers (SRF). Information was processed fitting a Poisson regression model adjusted by year. The general form for the study's multiplicative model was (17):

$$\lambda_{jk} = \theta_j \Psi_k$$

The number of maternal deaths was considered to be the outcome variable and the number of live births as the multiplier. The variable state (place where cases occurred) was factorized in 32 categories and included in the model by state. Rates by state were ranged and divided into four different groups according to quartile values. Each of the four groups was defined as a region (Regions I, II, III and IV). Data were modeled (Poisson regression) again using the same outcome and multiplier variables, but with the created region variable previously factorized. Rates of MMR were obtained with

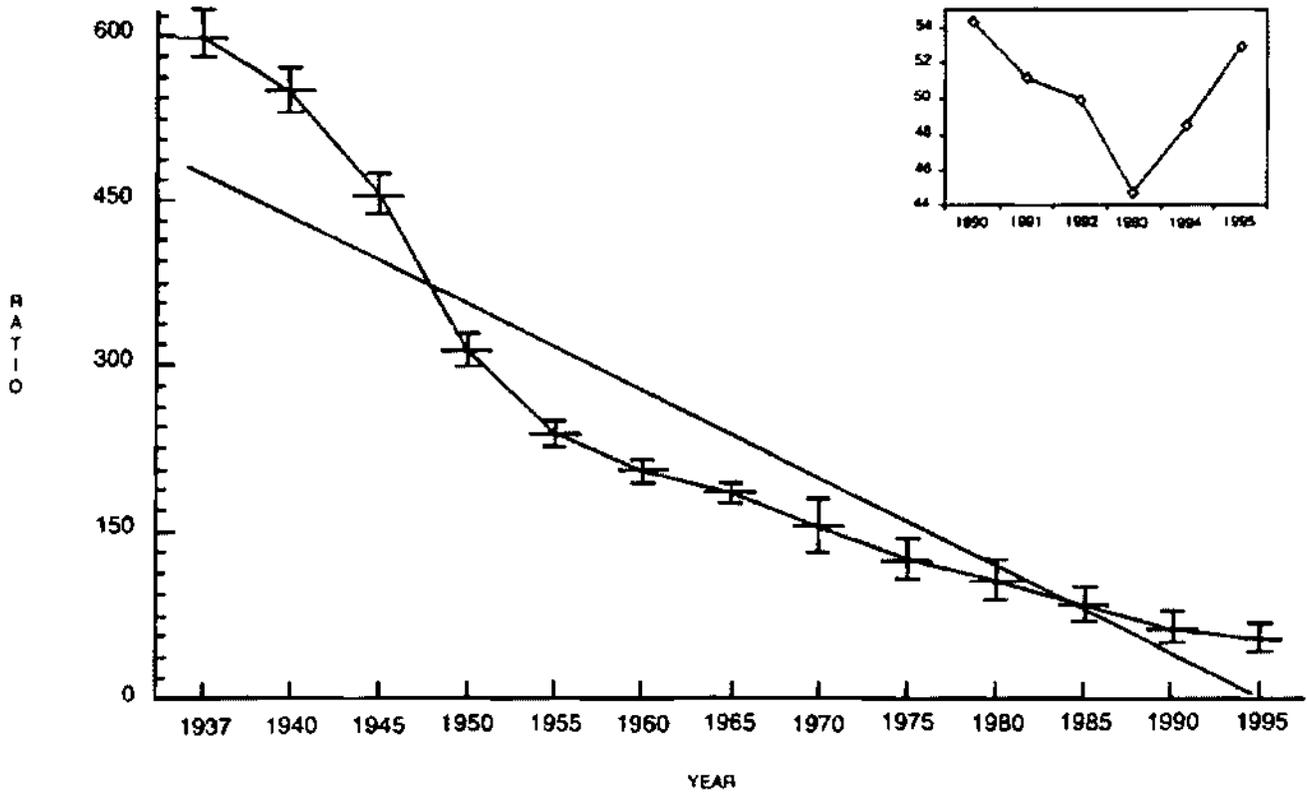


Figure 1. Maternal mortality ratio in Mexico has decreased from 1937 - 1995; however, during the last 2 years, it increased significantly. Values are expressed as average ratio (maternal mortality cases/recorded five births (100,000)) for each period including 95% confidence intervals.

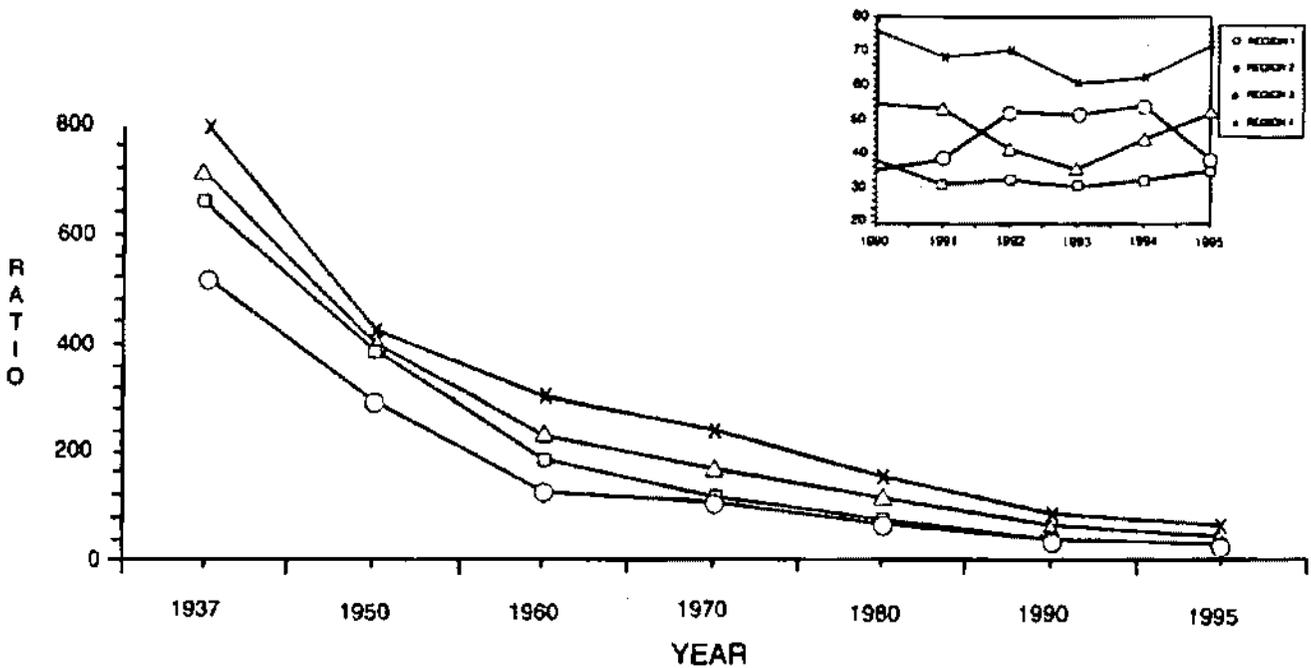


Figure 2. Maternal mortality trend by Region. Values are expressed as average ratio (maternal mortality cases/recorded live births (100,000)) for each period and Region from 1937 - 1995).

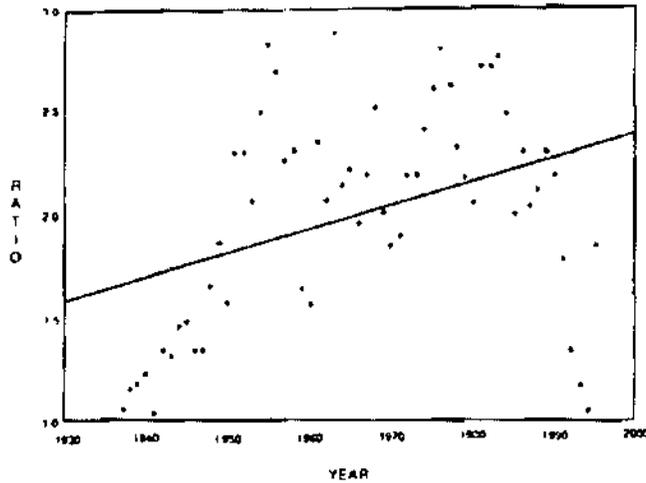


Figure 3. Maternal mortality rate (very high mortality ratio/low mortality ratio). Each point in the graphic was obtained adjusting a Poisson Regression Model by year. Every value is higher than one, meaning that each year in Region IV was higher than in Region I. In addition, the trend line is rising significantly ($p < 0.0001$), which means the gap between extreme regions is increasing.

95% confidence intervals employing the Region I ratio (lowest maternal mortality ratio region) as a reference value.

In order to evaluate the maternal mortality trend, MMR per 100,000 live births for each state and year from 1937 - 1995 were calculated (global and for each region) and plotted. Using MMR as dependent variable, year as independent variable and state as a control, a linear regression model (18) was adjusted. F-test significance < 0.05 was considered as statistically relevant.

To analyze characteristics of maternal deaths from 1990 - 1995, the death certificate databases (deaths registered by the INEGI) were used. Maternal death cases from 1990 - 1995 were extracted (ICD-9 codes 630 - 676) and registered in another database. The following variables were analyzed: size of the locality where the death occurred; woman's age; occupation; schooling; marital status; health insurance; medical care before death; place of death, and cause of death. A descriptive analysis of the information was carried out and variables were compared using χ^2 test to evaluate differences between categories by year and region.

Results

Regionalization of the country by level of maternal mortality was integrated by the following four regions (Table 1): Low MMR - Region I (Aguascalientes, Baja California Sur, Coahuila, Distrito Federal and Nuevo Leon); Middle MMR - Region II (Baja California, Campeche, Durango, Jalisco, Morelos, Nayarit, Sinaloa, Tamaulipas, Tlaxcala and Yucatan); High MMR - Region III (Colima, Chihuahua, Guanajuato, Guerrero,

Mexico, Michoacan, Tabasco and Zacatecas) and Very High MMR - Region IV (Chiapas, Hidalgo, Oaxaca, Puebla, Queretaro, Quintana Roo, San Luis Potosi and Veracruz).

The high and very high MMR were located in southern, southeastern and central areas of the country with the exception of Distrito Federal, which was included in the low MMR, and the states of Morelos, Tlaxcala, Campeche and Yucatan, which were included in the low and middle MMR regions. Using Region I as the reference, the probability of occurrence of a maternal death is 20% higher in Region II, 50% in Region III, and 90% higher in Region IV (Table 1) (95% confidence intervals).

During the study period (1937 - 1995), 169,616 maternal deaths and 107,341,026 live births were registered (LBR) in Mexico. The average MMR was 158 per 100,000 LBR for the complete period. Maternal mortality has been decreased significantly ($p < 0.05$) from 598 in 1937 to 53 per 100,000 live births in 1995 (Figure 1). The speed of descent was different but in general, the trend remained the same.

Figure 2 shows maternal mortality trend by region. There was a significant decrease in the MMR in every region. The level of maternal mortality in Region IV is higher than the rest of the regions, and the level in Region I remains lower throughout the period. The gap between Regions I and IV has increased significantly from 1937 - 1995 as shown in Figure 3 (Poisson Model $p < 0.0001$).

Characteristics of the maternal mortality cases from 1990 - 1995 were the following (Table 2): 41.5% occurred in the localities with 10,000 or more inhabitants; 14% in those with 1,000 - 9,999 inhabitants, and almost 30% in the localities with 0 - 999 inhabitants. The proportion of cases in localities with fewer than 1,000 inhabitants decreased from 1990 - 1995 ($p = 0.0037$). Statistical differences were also seen by region during the same period ($p = 0.000001$). In Region I, 88.3% of the deaths were registered in the localities with 10,000 or more inhabitants, while the figures were 51.7% in Region II, 40.2% in Region III, and 21% in Region IV.

A total of 18.6% of women were insured at the Mexican Institute of Social Security (IMSS), 3.5% by the Social Security Institute for government employees (ISSSTE), 2.4% by other social security institutions, and 75.4% were among the non-insured population. The proportion of the non-insured population increased from 1990 - 1995 ($p = 0.000001$). However, this increase was at the expense of the cases where no previous institution was indicated. Proportions at social security institutions were not modified; as the level of mortality increased (regions), the proportion from non-insured populations increased ($p = 0.000001$).

Over 60% (61.3%) of women died in a medical facility, 29% at home, 6.8% somewhere else (on the street, in public bathrooms, etc.), and for 2.8%, no place was

Table 2
Maternal Mortality Cases in Mexico From 1990 - 1995 (Relative Frequency of Different Variables by Region)

Variables	Region I (n = 1343)	Region II (n = 1189)	Region III (n = 2416)	Region IV (n = 3467)	Total (n = 8415)	P
Size of locality						
0 - 999	2.2	18.6	28.3	45.0	29.6	0.000001
1000 - 2499	2.8	9.7	15.9	18.6	14.0	
2500 - 9999	6.0	19.3	13.3	13.3	14.4	
10,000 and more	88.3	51.7	40.2	20.9	41.5	
Not established	0.7	0.9	0.1	0.3	0.4	
Social Security Inscription						
No	49.3	51.5	69.5	73.3	65.3	0.000001
IMSS	34.9	25.9	13.0	7.6	16.1	
ISSSTE	9.2	3.7	1.9	1.3	3.1	
Other	2.6	1.4	2.4	1.9	2.1	
Not established	4.0	17.5	13.2	15.9	13.4	
Place of death						
Medical unit	94.2	74.4	61.3	42.6	60.7	0.000001
Home	3.1	13.7	27.8	44.4	28.7	
Other	1.5	6.7	6.7	8.8	6.7	
Not established	1.2	5.1	4.1	4.2	3.9	
Medical care before dying						
Yes	92.6	77.9	67.9	53.2	67.2	0.000001
Not	4.5	13.5	25.9	39.6	26.4	
Not established	2.9	8.5	6.2	7.2	6.4	
Age (years)						
15 - 19	11.8	12.5	12.4	13.6	12.8	0.000023
20 - 29	47.1	44.2	40.3	38.7	41.2	
30 and more	41.0	42.9	47.0	47.6	45.7	
Not established	0.1	0.5	0.3	0.3	0.3	
Occupation						
Housework	75.4	78.0	84.4	83.7	81.9	0.000001
Other	22.8	13.1	8.9	7.7	11.2	
Not established	1.9	8.8	6.3	8.6	6.9	
Schooling						
Less than elementary school	4.5	29.3	42.5	53.8	40.8	0.000001
Elementary school	36.8	38.1	38.2	31.9	35.3	
Secondary school and above	45.5	23.5	16.3	10.7	19.7	
Not established	3.2	9.1	3.1	3.7	4.2	
Marital status						
With couple	81.6	86.6	89.0	85.2	85.9	<0.000000
Without couple	17.1	10.4	9.3	12.3	12.1	
Not established	1.3	2.9	1.7	2.2	2.0	
Cause						
Abortion	8.6	7.8	7.6	6.5	7.3	0.000001
Hemorrhage	5.5	10.3	9.9	6.8	7.9	
PDH Disease	45.8	29.3	24.5	18.7	26.2	
Sepsis	11.8	10.6	8.7	10.0	10.0	
Delivery complication						
Obstructed delivery	18.6	31.4	41.0	47.9	38.9	
Other	0.1	0.7	1.0	3.6	1.9	
	9.5	9.9	7.3	6.6	7.8	

Source: Mortality databases from INEGI.

specified. The proportion of women who died at a medical facility increased from 1991 (55.7%) - 1995 (66.6%) ($p = 0.000001$). The proportion of women who died in medical facilities was statistically different among regions. In Region I, 94.2% died in a medical facility; 74.4% in Region II; 61.3% in Region III, and 42.6% in region IV ($p = 0.000001$).

In terms of medical care, 67.2% of the women received care, and 26.4% did not receive any care. Even when in 1991 there was a decrease in the proportion of cases that received medical care, the proportion gradually increased from 61.7% in 1991 - 73.7% in 1995 ($p = 0.000001$). The proportion of women who received medical care was lower in regions III and IV than in regions I and II.

Over 81% of women were housewives, 11.2% had jobs outside their homes, and nothing was specified for the remaining cases. The proportion of housewives increased throughout the period ($p = 0.000001$), and was higher in regions III and IV than in regions I and II.

While 40.8% of women had not finished elementary school, 35% had, 19.7% had finished high school or a higher level, and no data were specified for 4.1%. Proportion with complete elementary school education or more increased throughout the period ($p > 0.0000$) and was higher in Region I (45.5%) than in the rest of the regions ($p = 0.000001$).

Approximately 86% of the women lived with their partners, while 12% had no partner. No significant statistical differences were observed throughout the period. In relation to causes of death, 7.3% were due to abortions, 7.9% to hemorrhages, 26% to pregnancy hypertensive disease (PHD), 10% due to sepsis, 40.8% to other complications related to the delivery, and 7.8% to other causes. No significant variation occurred in proportion due to an abortion. The proportion of cases caused by hemorrhage, PDH and other causes increased gradually. Meanwhile, the number of cases generated by sepsis and other complications related to delivery decreased ($p < 0.0000$). The proportion of cases due to abortions was greater in region I (8.6%), while the proportion of cases generated by PDH was less (18.7%) in region IV. There was no significant trend in the other causes of death.

Discussion

The use of vital statistics in the analysis of maternal mortality has been previously questioned due to problems related to the integrity of the information. However, it is the only information available in some areas. No systematic information on maternal deaths was available in Mexico before 1937. From 1937 on, there has been an improvement in the quality of registered data, which has been different and highly correlated to the economic development of the region. If the worst data

are in the poorest areas and maternal mortality is higher in those areas, according to the results of this study, the gap between regions could be greater.

There was a real need for the regionalized analysis of the problem in a country with heterogeneous characteristics such as those in Mexico. Previous classifications were tested but were not totally applicable to the study problem. This regionalization is similar but not equal to others (19) with socioeconomic components.

The risk of dying in a maternal event in region IV is almost twice that in the low-mortality region, and the gap between them has increased. This gap reflects the socioeconomic differences between the regions, and the lack of the application of the equity principle in health services delivery, which has no longer been able to differentially lessen the effect of economic crises.

The MMR in 1937 in Mexico was comparable to those of other countries such as the United States (20). However, the greatest and most important decrease in the U.S. began in the 1930s (20), while in Mexico, it occurred 20 years later with the creation of the public health institutions (IMSS, SSA - Secretariat of Health, and ISSSTE), which produced a more rapidly descending slope in post-revolutionary Mexico. At the time, greater coverage and availability of health services began to increase and without a doubt coincided with the economic growth of the country. This trend is sustained throughout the study period, with slight turns which, even when not directly corresponding to stagnation periods or economic crises, can be considered as a product of its effect in the middle term. After economic crises and adjustments in the 1980s, there was a decrease in the speed that became more pronounced in 1988 and reached its lowest level in 1990; the MMR increased in 1994, so that there is no real evidence of the benefits from strategies such as maternal mortality committees, which began to work in some institutions from 1971 on and were generalized at the national level in 1990.

The decrease in the speed of descent during the study period is a phenomenon characteristic of maternal mortality and surely of other health problems, where with a lower MMR, the effort made through different interventions has a lesser effect on the level of reduction. However, a decrease of 90% in the MMR in Italy (11) took half the time (30 years) it took in Mexico (60 years).

Current average levels still remain high in comparison to the worldwide situation. This country is still catalogued by international organizations as one of those with high maternal mortality. The average MMR is at least five times higher than that registered for the U.S. during the period of 1987 - 1990 (14), using the Epidemiologic Surveillance System. In addition, although there are states where mortality has reached national goals, there are some, such as Oaxaca, Tlaxcala and Puebla, where mortality rates are similar to those of the Mexico of 20 years ago, without considering MMR

underreporting (12,13), which is probably higher in these states.

One aspect which calls for the attention of policymakers is the increase observed in the MMR during 1994 and 1995 (an increase also seen in the U.S. from 7.2 in 1987 to 10 in 1990) (14). The improvement in only the quality of certification, registration and codification (11) cannot explain this increase. The unequal rate of increase between regions and the investment in infrastructure, training, and registration that Mexico has been unable to carry out under the current economic circumstances are arguments against that explanation. If it is accepted that maternal mortality is a sensitive socioeconomic indicator (2,3,21,22), this increase could be explained by the decrease in resources in general and of health as a product of the structural adjustment policies proposed by international organizations (23). The high and medium technology hospitals were affected by the deprivation of products and essential medications for the care of pregnant women. The poorest regions are the first to lack supplies and to have a reduced number of units for care of women, causing an increase of health needs in those states. Therefore, this analysis would only allow us to corroborate the effect of the economy and to try to alert those responsible for women's health not only to future increases but also to pertinent preventive measures. Independently of whether the increase was real or was generated by an improved registration of information, there is an immediate need to establish an epidemiological surveillance system on maternal mortality that may contribute to the improvement of the level of analysis and the trend of maternal mortality in Mexico.

The proportion of women who live in places with over 10,000 inhabitants, that were medically insured by government institutions, and that died at a medical unit after having received professional assistance predominated in region I. Women living in this region had no problems in going to a clinic and asking for medical care. In a previous study, it was found that 83% of the cases had received incorrect treatment, did not have the correct surgical technique applied, and had experienced an error in diagnosis (13), a situation that has not changed drastically. Actions to be developed in this region should be directed toward improving the quality of care for women through continuous improvement groups and the Severe Maternal Complication Committees (more than maternal mortality committees), both of which should include the woman's perspective. Finally, an important point would be to educate women to detect signs and symptoms that require a special demand for prenatal (24) and natal care in medical units.

In region IV, women lived predominantly in localities with fewer than 1,000 inhabitants, had no access to social security, died at home (an amount somewhat lower than that reported in a zone with a level similar in development in Egypt in 1981-1983) (25), and with no

medical care. In addition, a large number of them were women at the extremes of their reproductive life, housewives with low or no schooling. It is clear in this region that the problem is health care accessibility generated by geographic barriers of distance or time (25). Another factor is the woman's lack of decision making (12,25), which influences her resolve to ask for help. Finally, there are the cultural barriers (26), especially seen in indigenous areas where pregnant women are exclusively cared for by midwives, and where, in some cases because of tradition, maternal death is considered to be a blessing for the families or communities (27). Due to the above, short- and middle-term strategies must be established, such as maternity waiting homes (28) for pregnant women, training of midwives, creation of obstetric care units, training of health care providers, and improvement of referral systems, etc. (8,28) Long-term strategies should also be considered, and could include education (29) of people with respect to their culture (30) (when not increasing the risk level), which allow for the improvement of the quality of life for women. Strategies such as the above can represent a challenge for the health sector in the poorest states. Palliative strategies may turn out to be more expensive in the future.

In region II, there is still a predominance of cases of women who live in localities of more than 10,000 inhabitants. However, the amount of women without social security insurance, who died at home and without medical care is greater than that seen in region I. The woman's schooling was lower than in region I, and complications during the delivery were the main causes of death. Even though the IMSS has third-level medical services in three states in the region, it has already been mentioned that only 26% of the women who died were medically insured. Although 13% of women had not received previous medical care, the most important problem is still the providing of quality health services for women who require this service.

In the high maternal mortality region, there is a combination of conditions and strategies which would have to be directed toward improving access to, opportunity for and quality of health care. Even when the challenge would seem to be greater in the states of region IV, states in region III have a double-objective priority, meaning that it is important to increase the coverage of services with diverse strategies and to provide the maximum quality standard while avoiding the improvisation of solutions.

In the analysis of the characteristics, it would have been desirable to have had available the number of registered live births categorized by different maternal characteristics such as age, schooling, and occupation, etc., to permit the analysis of the risks for each characteristic. However, no official information was available for the analysis period, so the study was unable to present a

comparison of groups by risk, this being the main limitation of the study in this aspect.

In Conclusion:

1. In countries as large as Mexico and with such heterogeneous characteristics, it is useful to carry out a regionalized analysis of the problem to instrument actions focused on particular problems.

2. Although the maternal mortality trend is descending, there are economic and social factors that not only halt the descent, but which also increase the problem of maternal mortality in Mexico.

3. As previously established, the level of maternal mortality can be an indirect indication of the quality of care (4) and of the socioeconomic level of the countries or regions (2,3,21,22), but in addition, it serves as an indicator of accessibility (26) to health services—a problem in developing countries such as Mexico where these services have not totally been resolved.

References

- Sachs B, Brown D, Driscoll S, Schulman E, Acker D, Ransil B, Jewett J. Maternal mortality in Massachusetts. Trends and prevention. *N Engl J Med* 1987; 316:667
- Graham W, Brass W, Snow K. Estimating maternal mortality: The Sisterhood Method. *Studies in Family Planning* 1989; 20:125.
- Parazzini F, La Vecchia C, Mezzanotte G. Maternal mortality in Italy, 1955 to 1984. *Am J Obstet Gynecol* 1988; 159:421.
- WHO. Focus: Maternal mortality. A silent tragedy. *Int J Gynecol Obstet* 1990; 31:295.
- Court C. WHO claims maternal mortality has been underestimated. *BMJ* 1996; 312:398.
- Atrash H, Alexander S, Berg C. Maternal Mortality in Developed countries: not just a concern for the past. *Obstet Gynecol* 1995; 86:700.
- Trejo-Ramírez CA. Mortalidad materna. Evolución de su estudio en México en los últimos 25 años. *Ginecol Obstet Mex* 1997; 65:317.
- Nowak R. New push to reduce maternal mortality in poor countries. *Science* 1995; 269:780.
- OPSYOMS. Plan de Acción Regional para la Reducción de la Mortalidad Materna en las Américas. *Boletín Sanit Panam* 1991; 110:448.
- UNICEF. Plan de Acción para la Aplicación de la Declaración Mundial. Cumbre Mundial a favor de la Infancia. Nueva York: 1990. p. 1.
- Comisión Nacional de Acción a favor de la Infancia. México. Programa Nacional de Acción a favor de la Infancia, 1995-2000. Evaluación 1996. México: 1997. p. 147.
- Reyes S. Mortalidad Materna en México. México: I.M.S.S.; 1994. p. 1.
- Bobadilla JL, Reyes S, Karchmer S. La magnitud y las causas de la mortalidad materna en el Distrito Federal (1988-1989). *Gac Med Mex* 1996; 132:5.
- Berg C, Atrash H, Koonin L, Tucker M. Pregnancy-related mortality in the United States, 1987-1990. *Obstet Gynecol* 1996; 88:161.
- Ministerio de Sanidad y Consumo. Indicadores de Salud. Segunda Evaluación en España del Programa Regional Europeo Salud para Todos. España: Ministerio de Sanidad y Consumo; 1994. p. 101.
- Schuiemakers N, Van-Roosmalen J, Dekker G, Van-Dongen P, Van-Geijn H. Underreporting of maternal mortality in The Netherlands. *Obstet Gynecol* 1997; 90:78.
- Breslow N, Day N. Fitting models to grouped data. In: *Statistical methods in cancer research. Vol. II. The Design and Analysis of Cohort Studies*. Breslow NE, Day NE, editors. World Health Organization. Oxford, UK.: IARC Scientific Publications No. 82.; 1993. p.123
- Hazard B. Regression. In: Hazard B. Batten editors, *Statistical Methods for Health Care Research*. U.S.A.: J.B. Lippincott Company; 1993. p. 193.
- Kunz I, Cortina M, González MA. Regionalización Socioeconómico-demográfica y de Salud en la República Mexicana: Un instrumento para la planeación e investigación en atención primaria a la salud. *Perspectivas en Salud Pública* No. 2. I.N.S.P. México: 1986. p. 1.
- Rochat R.W. Maternal mortality in the United States of America. *World Health Stat Q* 1981; 34:2.
- Louden I. Obstetric care, social class and maternal mortality. *Br Med J* 1986; 293:606.
- Brenner M. Fetal, infant, and maternal mortality during periods of economic instability. *Int J Health Serv* 1973; 3:145.
- Ruismans C. Maternal health and the World Bank. *Lancet* 1995; 346:1711.
- Martínez-González L, Reyes-Frausto S, García-Peña MC. Utilización adecuada de la Atención Prenatal en el Instituto Mexicano del Seguro Social. *Salud Pública Mex* 1996; 38:341.
- El Kady A, Saleh S, Gadalla S, Forney J, Bayoumi H. Obstetric deaths in Menoufia Governorate, Egypt. *Br J Obstet Gynaecol* 1989; 96:9.
- Thaddeus S, Maine D. Too far to walk: Maternal mortality in context. U.S.A.: Columbia University Center for Population and Family Health; 1990. p. 1.
- León N. La Obstetricia en México. Notas bibliográficas, étnicas, históricas, documentarias y críticas de los orígenes históricos hasta el año 1910. Parte I. México: Tip. de la Vda. de F. Díaz de León; 1910. p.3.
- Figa-Talamanca I. Maternal Mortality and the problem of accessibility to obstetric care: the strategy of Maternity Waiting Homes. *Soc Sci Med* 1996; 42:1381.
- Oosterbaan MM, Da-Costa MV. Guinea-Bissau: What women know about the risks-an anthropological study. *World-Health-Stat-Q* 1995; 48:39.
- Elu MC. Mexico: maternal deaths, fertility patterns, and social cost-an anthropological study. *World-Health-Stat-Q* 1995; 48:47.