Maternal Mortality:
A New Estimate for Pernambuco, Brazil

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Introduction

The death of a woman at childbirth was for a long time associated with misfortune due to the natural and risky process of childbearing, which provoked fear among women and concern among health providers. Deaths that occur during pregnancy, abortion, delivery and puerperium have become scarce events in modern society, but remain a matter of public health concern within developing countries.

Women who become pregnant in developing areas can face a risk of death after pregnancy 100 more times higher than women in developed areas, demonstrating that the differentials observed among developed and developing countries are higher than are other demographic outcomes, such as infant or perinatal mortality. Socioeconomic factors are directly related to maternal morbidity and mortality; in addition, women's inferior status, traditional beliefs, and restrictive abortion laws are important determinants of maternal mortality.

The overall maternal mortality ratio for Latin American and Caribbean countries was 190 deaths per 100,000 live births in 1995, and was associated with direct obstetric causes, complications from abortion, and HIV-AIDS. The American countries present the largest inequality in maternal mortality in the whole world; while in Canada the maternal mortality ratio in 1996 was just 4 per 100,000 live births, in Haiti it was 523 per 100,000 (PAHO, 2002).

Maternal death is a rare event even at high mortality levels, and measuring maternal mortality is difficult and complex. Indeed, reliable estimates of its magnitude are not usually available, and assessing interventions based on these unreliable estimates is problematic (WHO, 2001). In developing countries, databases are generally incomplete

or inaccurate due to both incomplete coverage of the vital registration system and misclassification of underlying causes of death. Problems in both numerator and denominator of maternal mortality ratios are responsible for unreliable maternal mortality estimates. In countries with a developed statistical system, civil registration is the main source of information about maternal deaths, but even within these regions, maternal deaths are underrecorded due to misclassifications of cause of death (Tanaka, 1999, WHO, 2001). Studies have also shown that the vital registration systems of developed countries misclassify maternal deaths, with misclassification varying from 39% in the United Kingdom to 56% in France (Bouvier-Colle, 1995; Campbell, 1999).

In Brazil, since the 1990s, different initiatives at the national and local levels have tried to create a better measurement of maternal mortality in order to control its magnitude; but up to now, there is still a gap between the maternal ratio estimated by WHO (260 per 100,000 live births for 2000) and the more recent maternal mortality ratio divulged by the Minister of Health (65 per 100,000 live births for 1998), calculated using vital statistics without any kind of adjustment (IDB – Brazil, 2001). Studies conducted in the city of São Paulo[2], which has the best vital registration system in Brazil, have shown a level of misclassification of 50% (Laurenti et al, 1987; Volochko, 1992), which is probably the lowest level of misclassification for this country.

In the North and Northeast regions, an association of women's low social status with inadequate health facilities has sustained a high prevalence of maternal mortality; this situation is worsened by the weakness of the vital registration system.

[2] The wealthiest Brazilian great-region.

There is only one study regarding maternal mortality for the State of Pernambuco. It was carried out in 1994 using the RAMOS method[3] and revealed that maternal mortality varied from 112 to 238 per 100,000 live births in the metropolitan and s*ertão* regions, respectively (Valongueiro, 1996), a level of underreporting that reached 80%. If underreporting on death certificates and misclassification of underlying causes of death are considered together, more than twice as many maternal deaths would have been identified. Eclampsias, hemorrhages and abortion (induced and spontaneous) were the most common causes of death, and more than 50% occurred during the postpartum period and in a maternity hospital. In regions where abortion is virtually prohibited[4], incomplete abortions are common and the risks of complications high; thus, death becomes its most serious complication.

This study focused on the measurement of maternal mortality and on a new estimate for Pernambuco, a northeastern state of Brazil. The Northeast is the poorest Brazilian region and represents an ideal place to conduct a study on the measurement of maternal mortality. This area concentrates a high proportion of low-income women, a large number of inadequate health facilities, and a weak vital registration system.

Background

After the Second World War, a dramatic decline on maternal mortality began and has continued without interruption (Loudon, 1988). Improvements in living conditions, better nutrition, advanced in medical procedures, the legalization of abortion and the

[3] The RAMOS method involves the identification and investigation of causes of death of women in reproductive ages.

[4] In Brazil terminating a pregnancy is permitted according to Brazil Federal Penal Code, Art. 128 only when is necessary to save a woman's life or when pregnancy has occurred following a rape (Ministério da Saúde, FEBRASGO, ABENFO, 2001).

increased autonomy among women are considered responsible for this decline during the 20th century (Ravidran and Berer, 1999). On the other hand, in developing countries, maternal mortality remains an important substantive problem, and its measurement a challenge.

The fact of being avoidable[5] and underreported at the same time has led some researchers to conceptualize the situation as a neglected tragedy and a silent epidemic (Rosenfield et al, 1985; Réndon et al, 1993). It has been associated with fertility levels, overall mortality levels, and also with the prevalence of female deaths among women in reproductive age. Maternal mortality rates and ratios are the most common indicators used to measure these levels. According to Maine (1999 p.p. 423), an important characteristic of maternal mortality is that women "run this risk every time they become pregnant and this risk adds up over their lifetime".

Maternal death is an outcome that includes three different stages: pregnancy, birth, and puerperium, and where each one can influence each other. Abortion represents another important direct cause of maternal death and depends on two distinct elements: the legal status of induced abortion and the level of development of a society, even though the overall number of abortions seems to have no correlation with its legal status (Hogberg, 1985).

A new epidemiological face of maternal mortality in developing countries is the HIV-AIDS. In Brazil, feminization of AIDS has increased since 1990; the sex ratio for individuals 13 years and older for 2000 was 2:1. The strong effect of being HIV positive associated with the lack of methods of diagnosis in pre-natal care in the Northeast of

[5] Maternal mortality was included in the European Concerted Action of Research on Health Services and Avoidable Deaths in the1980s because even one maternal death represents a warning about the quality of health care (Bouvier-Collier et al, 1995).

Brazil suggest that HIV-AIDS may be a new and important underlying cause of indirect maternal deaths (Berer, 1999).

Thus, the preventable nature of deaths for eclampsia and hemorrhages, the hidden condition of deaths due to illegal abortion procedures, and the non-identification of positive HIV women represent important elements in the "missing or hidden" maternal deaths.

While in developing countries, population-based studies using direct and indirect methodologies are still the most utilized, in developed countries, maternal mortality surveillance methods encompass a wide range of sources, including computerized hospital discharge data, maternal mortality review committees' reports, and medical records including autopsy reports (Mackay, Rochat, Smith and Berg, 2002).

The only national study regarding maternal mortality in Brazil was conducted in fifteen cities from different states (Rio Grande do Norte in the Northeast, Mato Grosso in the Center-West and Para in the North) using the RAMOS method (Tanaka and Mitsuiki, 1999).[6] The authors found a total maternal mortality ratio of 78 per 100,000 live births. Eclampsias, haemorrhages and abortion were the most common causes of deaths; 8.7% of these deaths had no death certificates and 47.8% were found to be misclassified, which represented a total level of underreporting of 56.5% and an adjustment factor of 2.3. This study's intent was to estimate an adjustment factor to apply to the observed maternal mortality ratio in these regions.

In order to improve the surveillance of maternal mortality, the WHO suggested the introduction of a check box on death certificates with information of the presence of

[6] A recent and yet unpublished study to estimate maternal mortality among the 27 Brazilian capitals for the first six months of 2002 (Laurenti et al) has shown a 26% decline of the maternal mortality ratio in comparison to 1998.

pregnancy (43rd Health World Organization Assembly, 1990). In Brazil, the check box for the variable moment of death was included in the Brazilian death certificate in 1995.

Methods

This study used the maternal mortality definition of the World Health Organization (WHO) in the International Classification of Diseases, Injuries and Causes of Deaths (ICD 10th Revision, 1996), which defines an *early maternal death* and *later maternal death.* The terms miscarriage and abortion are sometimes understood as spontaneous and induced terminations of pregnancy, respectively. In Brazil, the term of "abortion" is used in both circumstances. This study will use pregnancy-related death rather than maternal mortality, in order to include two injury-related deaths that can not be classified as maternal deaths, according to the ICD, 10th Revision.

In this study, the definition of cases depends on the level of the study. At the first level, a case is a death of a woman of reproductive age, and as the study continues, it represents a death from maternal cause (second level), respectively. In order to go through these cases, this investigation used specific definitions directly related to the RAMOS method, such as d*eclared maternal death*, *presumable (or hidden) maternal death, and discharged maternal death. Declared maternal deaths* mean that a maternal cause of death is registered on the death certificate; *presumable (or hidden) maternal death* incorporates all female deaths aged 10 to 49 years, in which there is no maternal cause registered in the death certificate before an investigation; and *discharged maternal deaths* are all female deaths aged 10-49 years that are not considered maternal deaths after an investigation.

The fieldwork was carried out in Pernambuco from June 2003 to September 2004 using the RAMOS method. Pernambuco (see Illustrations 1 and 2) is a Northeastern state of Brazil, and its estimated population for 2003 was 8,161,028 inhabitants; the number of women aged 10-49 years was 2,681,113 representing 33% of the population. The State is organized into five political and administrative meso-regions: *Metropolitan*, *Mata*, *Agreste,* S*ertão* and *São Francisco*[7]. Each meso-region presents distinct socioeconomic characteristics, spatial distribution and different level of coverage of vital statistics and health facilities.

Regarding the system information on mortality, the level of coverage of Pernambuco in 2003 was 77%, bellow of the Brazil's level, which was 84% (Minister of Health, 2004)[8]. Regions differentiate this coverage and the Metropolitan region showed the best one. With respect to the quality of information on mortality, Pernambuco has fairly a lower proportion of unspecified causes of death (19%) of the Northeast, while the national average was 14% (SMI, 2002).

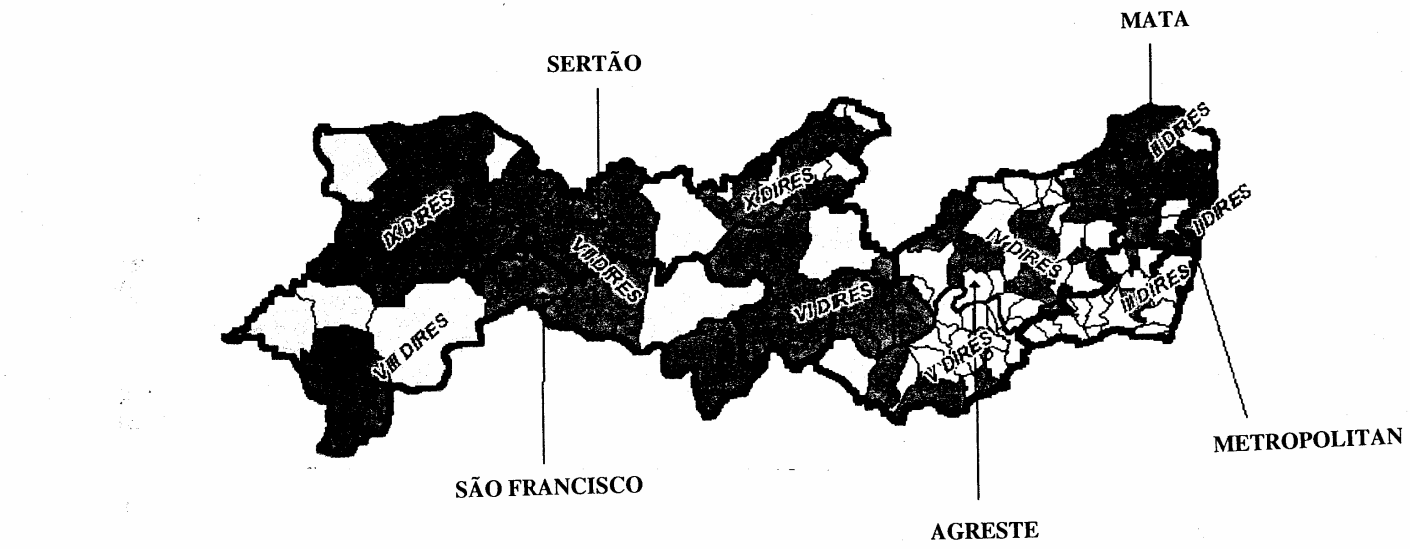
The study area was one administrative health region (GERES) of each meso-region of Pernambuco. It does not represent a probability sample, but the diversity of Pernambuco in terms of socioeconomic status, supply of health facilities and coverage, and quality of the vital statistics. Two elements were considered before defining the sample: presence/absence of a local or regional hospital (each meso-region contains health regions with different levels of obstetric care), and the prevalence of female deaths

[7] The state is also divided into 10 administrative health regions (GERES). Each meso-region has a different number of health regions. The metropolitan and São Francisco meso-regions contain just one health region, while Sertão meso-region has four health regions, for instance.
[8] This ratio was calculated using observed deaths from SIM and estimated deaths from the IGBE.

at reproductive age[9] that represents the female population at risk for each health region selected.

Illustration 1: Brazil – Macro-regions and States

Illustration 2:
Pernambuco – Municipalities, Health Regions (DIRES) and Meso-regions, 2001.



Health System is decentralized –municipalized

Health System is not full-decentralized -municipalized

Meso-region

DIRES

Municipalities

A set of three questionnaires (Q_1, Q_2 and Q_3) containing questions about reproductive history, pre-natal care, abortion, delivery and postpartum care, and socio-demographic characteristics was developed. These questionnaires were field tested for 64 deceased women of reproductive age outside of the study population in 2001, and the Confidential Questionnaire of Female Deaths (Q_1) was validated, after which a series of modifications were made (Valongueiro et al, 2003). These final instruments were used in sequential order. The *Confidential Questionnaire of Female Deaths* was used first because its objective was to list and classify all female deaths aged 10 to 49 years that occurred during 2003 in the meso-regions already defined. The *Confidential Questionnaire of Maternal Mortality* was the second and registered information about presumable and declared maternal deaths at hospitals or necropsy services. The *Confidential Questionnaire of Household was* used to interview relatives or others associated with the deceased women.

Trained assistants performed the data collection using the RAMOS method. This method is based on the identification of maternal deaths among female deaths of reproductive ages through records from hospital, necropsy services and home interviews

In general the death certificates were selected as soon as they arrived to the Local Epidemiology Department. Death certificates of women who died in the study area but were from other regions or other states were not included in the study.

In order to obtain the completeness of the coverage of the female deaths occurred in each meso-region studied, death certificates were sought in the public register of vital statistics and in clandestine cemeteries; deaths certificates women that lived in the meso-regions studied but occurred in other cities or even in neighbors states of Pernambuco

were also sought in the National System of Information on Mortality (SIM/DATAUS); and finally, they the live birth certificates. The fieldwork spent fifteen months long and the proportion of refuses was lesser than 0,2% for all female deaths (1,240).

The data was processed using the Epi-info program. Expects Group of the Maternal Mortality Committees of Pernambuco and Recife (GTs) composed by physicians, nurses, representatives of State and Municipal Epidemiological Secretariat, and representatives of the Obstetrician Departments and women's movement analyzed the related and maternal deaths from the five meso-regions. The conclusion of each case was obtained by consensus. Then, the final underlying causes of death were re-coded using the ICD 10^{th} Revision in order to estimate the maternal mortality ratios and the level of underreporting.

Maternal mortality levels and underreporting estimates were calculated using the pregnancy-related deaths, and the live births are from the SINASC (National System of Information on Live Birth-Minister of Health), which presents approximately 90% of coverage for the state. The State Norm (087/95) which regulates the maternal deaths surveillance in Pernambuco and the IRB approvals and recommendations oriented all steps of the research.

Results

A total of 1,240 female deaths were identified in Pernambuco. Of these 67 (5.5%) occurred during the pregnancy or within a year of pregnancy, from which 50 were pregnancy-related deaths; among those, two injury-related deaths were included as maternal non-obstetric deaths. The remaining 48 were maternal deaths, according to the

ICD 10th Revision. Approximately 3,5% had their relation to pregnancy unknown (table 1).

Table 1

Distribution of female deaths by timing of occurrence

Pernambuco, 2003

Timing of the death	Number	%
Abortion/post-abortion	2	0.2
Pregnancy	10	0.8
At birth	3	0.2
Early puerperium (until 42 days)	26	2.1
Late puerperium (from 43 days to a year)	12	1.0
Out of those periods (after a year)	1	0.1
Out of those periods/not pregnancy related	1,141	92.0
Unknown (presumable/unconcluded)	45	3.6
Total	1,240	100.0

The most frequent place of occurrence of deaths was health institutions (85%) followed by households (13%), and 2% on way to the heath unity; the deaths at home were most common in rural areas or small municipalities in the interior of the State.

The overall pregnancy-related mortality ratio was 70 deaths per 100,000 live births, which was differentiated by meso-region. The *Metropolitan* and *São Francisco* meso-região had the highest pregnancy-related mortality ratios (81 and 82 deaths per 100,000 live births, respectively) and the *Agreste* meso-region the lowest (about 40 per 100.000 live births). The pregnancy-related ratio without external causes was 67 per 100.000 live births and it was also differentiated by region (table 2).

The system information on mortality (SIM) reported 23 pregnancy-related deaths, and the study identified 27 more, generating a severe underreporting of 117%, corresponding to an adjusted factor of 2.17. Of the total, 28 (55.6%) were identified as pregnancy-related deaths by the check box on death certificates (variables 43 and 44). Comparing with the underreporting estimated for 1994 (80%), it increased about 30%.

In addition to the underreporting, given by misclassification of maternal deaths, a general underregistration of the death certificates was calculated using the 77% level of coverage estimated for Pernambuco by the Minister of Heath (2004); and even though, the coverage varies by meso-region, the final pregnancy-related deaths can be 90 per 100.000 live births. The indirect causes predominated within the misclassified pregnancy-related deaths (44%), while for the whole group of the 50 pregnancy-related deaths predominated the direct causes (50%).

Table 2

Pregnancy-related mortality ratios by meso-regions

Pernambuco – 2003

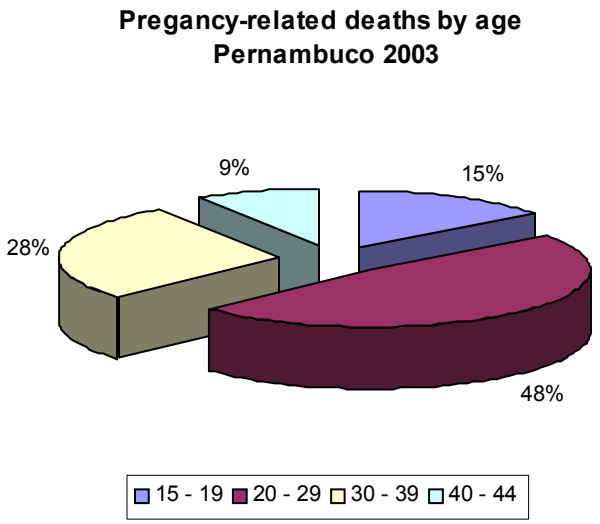
Regions	PMMR*	PRMR	Adjustment**
Metropolitan	75.4	81.4	-
Mata	68.2	68.2	-
Agreste	38.3	38.3	-
São Francisco	81.9	81.9	-
Sertão	54.6	54.6	-
All regions	**67.4**	**70.2**	**93.0**

*Excluding external causes;

** Adjusted according to the level of coverage of SIM (77%) estimated by the Minister of Health (2003).

The pregnancy-related deaths were concentrated among women aged 20-29 years, representing three times higher for both the younger and older groups, but it reached nine times higher for 40-44 years old (figure 3); no maternal death for women aged 45-49 years was identified. The mean age of maternal death was 28 (figure 1).

Figure 1

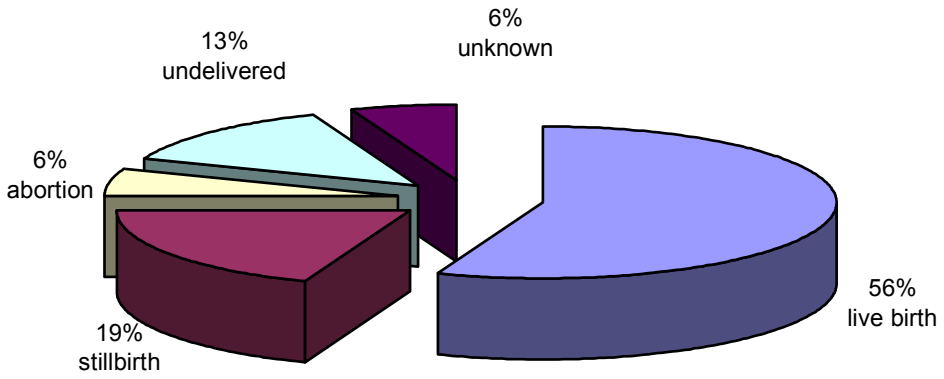


Race/color-specific pregnancy mortality ratios were higher for *parda,* and *parda* and black represented 75% of all deaths. Women who had less than 3 years of schooling represented 54% of the pregnancy-related deaths. Overall, 40% were single; 48% houseworker (without income), and 12% agricultural worker.

The figure 2 shows the most common pregnancy outcome associated with pregnancy-related death was live birth (56%), followed by stillbirth (19%), undelivered pregnancy (13.5%), and abortion (5.8%). The outcome of pregnancy was unknown for three women (5.8%).

Figure 2

Distribution of pregency-related deaths by outcomes of pregnancy - Pernambuco 2003



Regarding prenatal care, 19% not received any assistance, and 10% was unknown. Of the 71% who received it, 37% initiated during the first semester and 56% in the second ones; only 26% had the six or more number of consults.

The pregnancy-related deaths occurred most frequently among women who had one to three pregnancies (60%), but 8% occurred after 10 pregnancies: one of them occurred after twenty-three pregnancies and thirteen live births. She was 43 years old and lived in rural area.

Considering the women who had births, 95% occurred in a hospital or maternity and 5% at home; 57% were vaginal and 43% cesarean section. There was one case of abortion-related death occurred in a hospital, immediately after a dilation and curettage.

The leading causes of pregnancy-related death were pregnancy-induced hypertensions (18%), circulatory diseases (16%), and puerperal infectious (10%). Although the number of death classified as *others* have reduced after investigation, it still represented 10% (table 3). The low percentage of abortion-related death and the presence of violent deaths during the childbearing period were unexpected findings of this study. Of the six cases of violent deaths, two suicides were confirmed as injury-related during the year: one, a 21-year-old woman committed suicide in attempting to hide a pregnancy from her relatives using a well-known pesticide. The emergence care revealed the early pregnancy, which was confirmed by the autopsy; the other suicide was associated with puerperal depression in the later puerperium, both misclassified. The most common misclassified causes of death were circulatory diseases, also indirect maternal deaths.

Table 3

Distribution of pregnancy-related cause of deaths by all outcomes

Pernambuco – 2002

Cause of deaths	%
Pregnancy-induced hypertension (eclampsias and pre-eclampsias)	**18.0**
Diseases of circulatory system complicating the pregnancy, birth and puerperium	16.0
Puerperal infectious	10.0
Obstetric death of unspecified cause	10.0
Others	10.0
Certain infectious/parasitic diseases complicating the pregnancy, birth and puerperium	6.0
Hemorrhage	6.0
Diseases of digestive system complicating the pregnancy, birth and puerperium	6.0
Diseases of respiratory system complicating the pregnancy, birth and puerperium	6.0
Complication from anesthesia	6.0
External causes	4.0
Abortion	2.0
Neoplasms	2.0
Total	**100.0**

Discussion

The current study on maternal mortality conducted in five meso-regions of Pernambuco using the RAMOS method and based on 1,240 death certificates of women of reproductive age registered by the SIM in 2003, identified 50 pregnancy-related deaths, a prevalence of 4%. Although, this prevalence is lower for developing countries

(Royston & Armstrong, 1990), the Minister of Health works with a prevalence of 5% for whole country (Manual de Comitês de Mortalidade Materna, 2002).

In spite of limitations due to the small number of maternal deaths and potential biases produced for studying a single year, the most important finding was the high level of underreporting of pregnancy-related deaths. It accounted for 117% (from 50 pregnancy-related deaths, 23 were declared maternal deaths and 27 identified after investigation); and the Mata meso-region was two times higher comparing with the other meso-regions. The main reason for misclassify the underlying cause of death was failure of the doctors to register the recent pregnancy on the death certificate, even though 85% occurred in a health institution, and 35% had autopsy. It could explain why 44% of all obstetric indirect deaths remained no classified as maternal deaths, from which cardiovascular diseases were the leading cause.

The epidemiological transition in Brazil has shown a complex picture similar of what was described by Frenk and colleagues (1991) as the *double burden*. They postulate that in many societies, "heterogeneity in the pace of the epidemiological transition among different social strata or geographic regions produces a *protracted and polarized* transition model marked by overlap between stages" While cardiovascular diseases were the most common cause of maternal death, there were two cases re-classified as tuberculosis and one case as AIDS, both indirect deaths and not declared on the death certificates.

In addition, the proportion of unconcluded and injury-related deaths could also contribute for the underreporting. It can confirm some observations showing that the timing and distance between pregnancy outcome and death influence the way to report

the underlying pregnancy-related deaths. Later maternal deaths, for instance, are more misclassified than early maternal deaths, while maternal deaths occurred in Intensive Therapy Unity, for instance, are also more misclassified than maternal deaths occurred in the same unity care in which the woman had a birth or abortion. Some authors have demonstrated that underreporting of maternal deaths is not a problem of low-income regions, but industrialized countries have also shown the same problem with different magnitudes (Loudon, 1999, AbouZahr, 2000, Bouvier-Colle, 1995, CDC, 2003).

Although the 6% of pregnancy-related deaths ended in abortions, only one case was confirmed; the other two were re-classified as tuberculosis and unconcluded. For both, was impossible to establish a cause-effect relatiosnhip. There was also no confident information if they were spontaneous (miscarriage) or induced one.

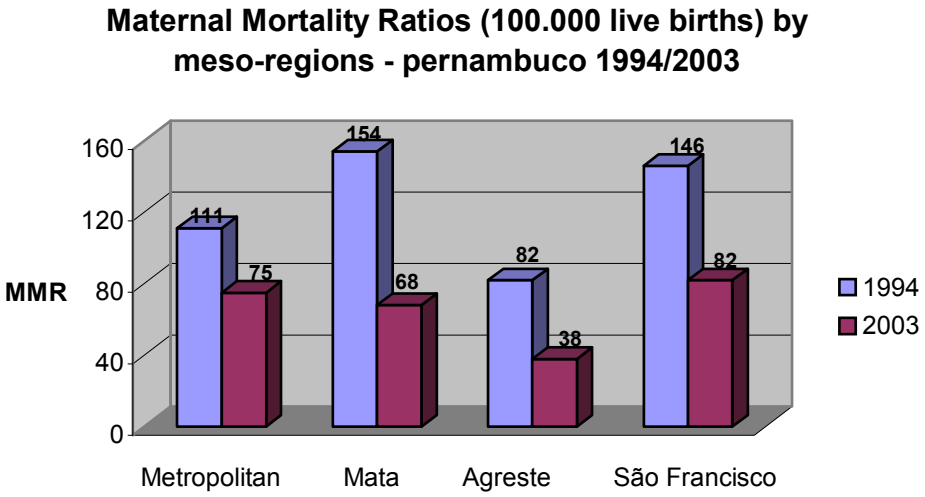
The low effectiveness of the check box (56%) on the death certificates in ascertaining pregnancy-related deaths confirms the findings of Laurenti et al (2000). They showed that among the 1,465 and 1,776 maternal deaths that occurred in the whole country in 1996 and 1997, respectively, more than 75% in 1996 and more than 62% in 1997 had *"ignored"* responses to those variables.

Although the overall pregnancy-related ratio has decreased 40% during the last decade (from 118 per 100.000 live births to 70 per 100.000 live births[10]) it still represents a high level of maternal mortality according to the WHO (2000). The decline was most important for the Mata and Agreste meso-regions, approximately 50% (figure 3). Since these two meso-regions have no especial reasons for showing these differentials (they endure expressive number low income and rural population and lack of obstetric care),

[10] It reaches 90 per 100.000 live births when adjusted by the level of coverage estimated by the Minister of Health of 77%.

and the deaths certificates SIM could explain the disparities on the decline of these indicators. Limiting the investigation to a year can also be another reason for these differentials. For instance, in the first semester of 2004 were identified the same number of regency-related deaths that were identified during the whole year of 2003.

Figure 3



Conclusion

Pregnancy-related mortality ratios continued to be higher for parda and black women, and for women with low level of education. Only 2% of the pregnancy-related deaths occurred in women with more than 12 years of schooling.

Considering the good consistency of information used in this investigation, and the RAMOS method as gold standard for estimating maternal mortality in developing

countries (WHO/UNICEF/UNFPA, 2001; Valongueiro, 2003) it is impossible to assure that all pregnancy-related deaths occurred across the meso-regions of Pernambuco were identified.

The increasing levels of underreporting was a result of the changing in the of specific-cause female deaths, which is growing up indirect deaths and aggregating injury-related deaths, overall the most misclassified causes. The inclusion of later maternal deaths and the access to medical technology that postpones the lives are also additional factors that contribute to the higher levels of the underreporting for Pernambuco.

Finally, in order to enable a comprehensive-action to reduce maternal mortality, its the magnitude should be well estimated based on all available sources of information; and even though, in Brazil, deaths associated with pregnancy are slowly being reduced, each female death of women of reproductive age must be identified and its underlying cause of death carefully reviewed in order to generate confident estimates. The physicians should be trained to improve their abilities in diagnosis and then, report better the underlying causes of death during the pregnancy, abortion and puerperium.

Pernambuco began the surveillance of maternal mortality in 1997, and is it expected to reinforce the identification pregnancy-related deaths and consequentially reduce maternal deaths in the State. In this way, the maternal mortality surveillance should embrace a wide range of available sources to identify pregnancy-related deaths, including the check box. However, it should never be used alone to confirm/discharge any pregnancy-related death.

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