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Maternal Mortality Re-Visited in the AIDS Era: Brazzaville, 1996

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ABSTRACT

This study provides an original method of analysing maternal mortality in Brazzaville, based on all deaths collected in the mortuaries in August 1996. During the study period, a clinical examination of all cadavers brought to Brazzaville's three mortuaries was done, and the relatives who had delivered the bodies were interviewed on signs and symptoms preceeding and the actual circumstances surrounding the deaths. A maternal mortality ratio of 652 per 100,000 was found in the age range 15 - 49 years, and the risk of death from all causes in women while pregnant, parturient or postpartum was estimated as double the baseline. The different indicators of risk of death attached to childbearing were shown to vary considerably according to age. In relative terms, the increase in all-cause risk of death was high for "early" pregnancies (estimated as nearly three fold below age 25), much more so for "late" pregnancies (nearly six fold above age 40), and much less for those pregnancies between these two age groups (less than two fold). In absolute terms, the excess risk of death associated with childbearing was maximum after (estimated at 40 per 1,000), and much lower before age 40 (5 to 6 per 1,000). In the age group most affected by AIDS (25 to 39 years), only 37% of all deaths in pregnant, parturient or postpartum women were from direct obstetric causes, versus about 60% before age 25 and 80% after age 40. The external and internal consistencies of the findings are discussed, and the public health policy implications are described. (*Afr J Reprod Health* 2000; 5

[1]:56 - 65)

KEY WORDS: Maternal mortality, HIV/AIDS, Africa

Introduction

Maternal mortality is one of the indicators of disadvantage, which best differentiates developing and developed countries, and in the past decade considerable efforts have been made worldwide to reduce its burden. Yet, proper evaluation of the impact of the safe motherhood initiative is hampered by limited and defective data, particularly in high mortality countries where death registration is notably incomplete.

To date, most estimates of maternal mortality in developing countries are based on an indirect method, the popular sisterhood technique,¹ which includes all deaths among women who are pregnant or within eight to twelve weeks following pregnancy. It is indeed generally assumed that an overwhelming majority, 80 to 95 per cent, of the deaths during pregnancy, delivery or the puerperium are related to the pregnancy be it directly or indirectly, and, therefore, that the remaining incidental deaths are not likely to influence significantly the estimated mortality level.^{1,2}

This hypothesis may, however, not be tenable in certain populations. In particular, death rates from AIDS are rising in sub-Saharan Africa, where as many as 10 per cent and as high as 40 per cent in some surveillance sites, of women attending antenatal clinics are infected with HIV.³ Generally speaking, whenever women in the reproductive age range are experiencing Important non-pregnancy related risks, the impact of childbearing on the overall mortality levels has to be quantified in order to accurately reflect the risks related to pregnancy⁴

Congo is known to be a high mortality country in which the AIDS pandemic has spread widely in the past years. In addition, in Congo the law imposes that all bodies are brought to the mortuary before they can be buried.

The purpose of this paper is to document the findings of a prospective study carried out in 1996 in the mortuaries of the capital city of Congo.^{5,6} Based on the study data, we provide here a direct estimation of maternal mortality in Brazzaville, and fully characterise the role of childbearing as a risk factor for mortality in different age groups.

Materials and Methods

Brazzaville has an estimated population of 850,000 (1996 National Census, Ministry of Planification, unpublished) and a prevalence rate of HIV-1 estimated at about 5 per cent in

the general population of childbearing age.⁷

Data Collection

From July 10 to August 9, 1996, a clinical examination of all cadavers brought to Brazzaville's three mortuaries was done, and the relatives who had delivered the bodies (93% of the cases) were interviewed on the signs and symptoms preceding and the actual circumstances surrounding the deaths. For cases that had been previously hospitalised, hospital files were assessed and medical staffs were interviewed shortly after the deaths. We estimated maternal mortality based on all deaths from direct obstetric causes in women of child-bearing age.

Data Analysis

To compute age-specific mortality rate, we needed the age structure of Brazzaville's population in 1996. Of the last three censuses (1974, 1984 and 1996), only the first two had been published and provided the age and sex distributions of the city's population. The 1996 census established the population of Brazzaville at 850,000. The natural population growth and the migration profile in 1974 - 1984 were analysed. The migration profiles were parameterised and a one-parameter model life table was used so that the total projected population fitted the total census population. Total mortality was computed from an abridged life table based on the decennial mortality rates, which were estimated from this one-month time interval.

Practically all women residing in Brazzaville deliver in the hospitals, and those who deliver elsewhere are legally required to register the birth in a maternity hospital. In order to compute the fertility levels, we enumerated all live births in the registers of Brazzaville's five maternity units from September 1, 1995 to August 31, 1996, and recorded the ages of the mothers.

Denominator populations were expressed in woman years of observation (WY) based on the census figures and the period of observation. Considering pregnancy and postpartum as an "exposure" period, we have subdivided the total woman years of observation during the study into the time exposed and the time not exposed.

The number of pregnancies (PREG) in each age group was estimated by inflating the number of livebirths (LB) by 15 per cent to account for stillbirths, abortions and ectopic pregnancies.⁸ Denoting the age-specific fertility rates by FTTRT, we may write:

$$\text{PREG} = \text{LB} \times 1.15 = \text{FTTRT} \times \text{WY} \times 1.15$$

The duration of the exposure (i.e., maternal) period was estimated at 9 months and 42

days, that is, $\{[365 \times (9/12)] + 42\} = 315.75$ days, or equivalently, $315.75/365 = 0.87$ woman years for each pregnancy. Pregnancies that end up in fetal losses last less than 9 months, but inflating the exposure period to 9 months for those pregnancies partly makes up for the likely under-estimation of the number of early abortions. In each age group, therefore, the total number of woman years of observation (WY) was decomposed into the number of woman-years of observation in exposed women (WYe) and the number of woman years of observation in non-exposed women (WYne):

$$WY = WYe + WYne$$

and

$$WYe = PREG \times 0.87 = FTRT \times WY \times 1.15 \times 0.87$$

$$Wye = FTRT \times WY$$

During their "exposure" period, women may die either from direct obstetric or other causes. Assuming that the risk of dying from those other causes does not depend on the exposure status of the women, we derived the number of deaths from this group of non-obstetric causes during the exposed and non-exposed periods in a straightforward way.

$$Dne = DOTC \times \frac{WYne}{WY}$$

and

$$De = DDOC + DOTC \times \frac{WYe}{WY}$$

$$Dne = DOTC \times WYne$$

and

$$De = DDOC + DOTC \times WYe$$

where

DDOC is the number of deaths from direct obstetric causes

DOTC is the number of deaths from other causes

De is the number of deaths from all causes among women while exposed

Dne is the number of deaths from all causes among women while not exposed

De and Dne were divided respectively by WYe and WYne to estimate the mortality rate among exposed and non-exposed women. The maternal mortality rate was estimated as the death rate from direct obstetric causes among women of childbearing age.

Demographic and epidemiologic indicators of maternal mortality levels were derived from these baseline data, with the fertility level reflecting the prevalence of the exposure factor under study. The importance of the excess risk of death experienced by women during childbearing relative to the baseline risk in non-exposed women was measured both by the population proportional attributable risk (PPAR) and the proportional attributable risk

(PAR):

$$PPAR = 100 \times \frac{(GMRT - DR_{ne})}{GMRT}$$

$$PAR = 100 \times \frac{(DR_e - DR_{ne})}{DR_e}$$

Results

The causes of deaths in women of reproductive age are shown in [Table 1](#). Nearly half (46.6%) of those deaths are from AIDS, and an additional 11 per cent are maternal deaths. Therefore, as high as 57 per cent of deaths in the sample are related to sexuality.

The general mortality rate, maternal rate and ratio, attributable risk, relative risk, population attributable risk, and the population proportional attributable risk of maternal mortality for Brazzaville are shown in [Tables 2](#) and [3](#).

Among women of childbearing age in Brazzaville, the general mortality rate was estimated at 763 per 100,000 (95% CI 636 - 890), the maternal mortality rate at 83 per 100,000 women (95% CI 41 - 125), and the maternal mortality ratio at 652 per 100,000 live births (95% CI 322 - 982).

The relative risk associated with childbearing was estimated at 2.0, meaning that the risk of death from all causes in women while exposed is double that of women not exposed. The attributable risk of maternal mortality, i.e., the excess risk in exposed women compared with non-exposed was estimated in our study at 652 per 100,000 women, like the maternal mortality ratio.

The proportional attributable risk of maternal mortality is the proportion of deaths attributable to childbearing out of all deaths in pregnant and recently pregnant women: it was estimated at 48.9 per cent, which means that about half of all deaths in exposed women are pregnancy-related. The population proportional attributable risk, which reflects the proportion of maternal deaths among deaths from all causes, was estimated at 10.9 per cent.

In Brazzaville, childbearing appeared much more risky for women above age 40 (maternal per cent, which means that about half of all deaths mortality ratio of about 4000 per 100,000, based on small numbers though) than below (maternal mortality ratios of 626 per 100,000 in age group 15 - 24, and 531 in age group 25 - 39). By lengthening the data collection period (for example, from one month to two months), more precise estimates could have been obtained.

In non-exposed women, the very sharp rise in general mortality found after age 24 (with a doubling from age group 15 - 24 to age groups 25 - 39 and 40 - 49 years) is attributable to non-maternal causes of death. As illustrated in [Figure 1](#), the age group 25 to 34 years was the most affected by AIDS mortality, with an AIDS death rate of 537 per 100,000, versus 149 in the youngest age group. After age 45, the death rates from AIDS declined but conversely other causes of death rose.

Discussion

Brazzaville is an excellent setting for morgue-based studies, as burial of the dead is conditional in this city on the presentation by the family of a certificate delivered by the morgue. Once the body is buried, however, the family has less of an incentive to declare the death at the civil register, hence the lower coverage of the official mortality statistics. In addition, over one third of the deaths recorded at the civil register have no specified cause, which further reinforces the significance of morgue-based data.

Our morgue-based data collection method, as briefly presented in a previous publication,⁶ has been appreciated as an "interesting, lightweight and credible assessment of the magnitude of the maternal mortality rate"⁹. The advantages of the method may be outlined as follows:

1. Reasonable cost (about US\$10,000 for a one-month data collection in three mortuaries in Brazzaville, including training, salaries of medical personnel and in-town transportation costs) and practicality, allowing easy replication.
2. Avoidance of recall bias, as the information on cause of death is collected right after the death.
3. Good coverage of deaths related to abortions, as those are much more likely to be

declared by the families to a physician at the mortuary than to a civil registration officer.

In our data, 40 per cent of the 15 maternal deaths were related to an abortion.

The study was done over a very short period of time, covering a total of 756 deaths, among which 138 were women of childbearing age, and 15 of the 138 were maternal deaths. Given this very limited sample size, the estimates, based on our data, have poor precision and should not be taken at face value. However, our study provides an original method of analysis of maternal mortality and our results have a very good internal and external consistency, as discussed below

Magnitude of Maternal Mortality

To date, only two maternal mortality ratio estimates are mentioned in literature for Congo, one for the entire country and one for the capital city, and our direct estimate is intermediate between the two. The first estimate was provided in 1996 by a joint WHO-UNICEF study group attempting to estimate maternal mortality levels around the world.¹⁰

For countries such as the Republic of Congo, where no data were available, a simple model was used to predict values based on general fertility rates and the proportion of births that are assisted by a trained person. Based on this model, the maternal mortality ratio roughly estimated for the entire Republic of Congo in 1990 was 890 per 100,000. The second estimate was based on a retrospective study in Brazzaville of death records from the Central Hospital, one mortuary and the city districts provided for the period 1993 - 94, which yielded a maternal mortality ratio of 408 per 100,000 live births.¹¹

The figure obtained in our study is likely to be more reliable than the record-based estimate, as our data have been collected prospectively, and because we have collected exhaustive cause-of-death data based on clinical examination, hospital record and families' interview. Nonetheless, our maternal mortality ratio estimate of 652 maternal deaths per 100,000 live births is high for a capital city with good access to prenatal care and maternity hospitals.

The population proportional attributable risk represents the proportion of all deaths in the study population that are from direct obstetric causes, and as such simultaneously integrates information on the relative risk attached to childbearing, the fertility level, and the general mortality level. In our study, this indicator is relatively low (about 11%). This is most probably due to the high level of AIDS mortality in Brazzaville,⁵ and also, partly, to the use of the definition of maternal mortality based only on direct obstetric causes.

Using our data from Brazzaville, we have estimated that during the reproductive life span, one woman out of seven will die from conditions related to sexuality. This dramatically

high risk reflects the magnitude of life-threatening hazards to which women are exposed during their reproductive life. The impact of these premature deaths is multiple: years of life lost; burden of orphanhood on children, families and society; risk of perinatal transmission of HIV and increased risk of morbidity and mortality among orphans.

Age Pattern

The age distribution of the risk of death related to pregnancy and childbirth is known to be U-shaped, with probabilities of dying being highest among the younger and older mothers. The relative risk estimates attached to childbearing convey a different picture from the maternal mortality ratios, as they do integrate information on the mortality background in the population. Estimated risks in exposed women relative to non-exposed ones varied in a U-shaped fashion across the age groups. There was almost a tripling of the death rates with childbearing in the youngest women (relative risk of 2.7), almost a six fold increase above age 40 (relative risk of 5.8), while the middle age group was to some extent in a safer position as far as childbearing was concerned (relative risk of 1.6).

Within the reproductive age range, nearly 50 per cent of deaths in pregnant or recently pregnant women were from direct obstetric causes (proportional attributable risk of 48.9%), but there were large variations across age groups. In the youngest age group, where the absolute magnitude of the risk attributable to childbearing was large compared with the baseline risk in non-exposed women (63 per 100,000 versus 37) and where mortality from AIDS was much lower than in the other groups, the proportional attributable risk was estimated as 63 per cent. This percentage fell to 37 per cent in the middle age group, where childbearing was less risky ($RR = 1.6$) and AIDS mortality particularly high, and then rose up again to more than 80 per cent above age 40. For women in their forties, in spite of a high mortality from AIDS, the risk of death attached to childbearing was indeed estimated as being extremely large in both relative and absolute terms (relative risk of 5.8, attributable risk of 40 per 1,000).

The population proportional attributable risk is particularly interesting from a public health point of view, as it reflects the proportion by which the general mortality of the population would be reduced, if all deaths from direct obstetric causes were to be prevented. On this basis it appeared clearly that a public health program targeting women younger than 25 years would have a greater potential impact for reducing mortality than programs targeting older age groups (with 21% of all deaths from direct obstetric causes in women less than 25 years old versus 7 - 9% in older women). Indeed, young women combined a relatively common prevalence of childbearing and a relatively low general mortality, and, therefore, for this group childbearing would be a prominent risk factor for mortality. Conversely, at age 40 and above, even though childbearing turned out to be more "risky", the impact of these deaths at the population level was much smaller given that fertility itself was much lower.

For health policy makers, the actual number of deaths associated with childbearing is even more crucial. In terms of lives saved, the hierarchy between the age groups is bound to be different due to the age composition within the reproductive age range, as a large attributable risk applied to a small denominator population results in the same death toll than a small attributable risk applied to a large population. In addition, the earlier the age at death, the greater the number of years of life lost, and for this reason maternal health programs targeted at the younger women would also have a greater impact in terms of number of life years saved. These different dimensions of childbearing as a risk factor for mortality would need to be considered in a cost-effectiveness analysis of potential prevention programs.

HIV/AIDS and Pregnancy

In our study, deaths were considered as "maternal" when they were from direct obstetric causes, and the assumption was made that the death rate from causes other than direct obstetric causes was the same in exposed and non-exposed women. Women have long been considered as particularly vulnerable during pregnancy and postpartum, and it is generally accepted that the course of a number of diseases is aggravated by pregnancy, and even that violent deaths may be more frequent during pregnancy. On the other hand, selective factors are likely to be operating, as women who are not in good health are not as fertile as others. The net effect of those two opposite phenomena cannot be predicted with certainty.

In particular, the impact of pregnancy on the course of HIV infection, and of HIV infection on women's fertility is still being investigated. While a few studies found increased HIV progression during pregnancy,^{12,13} most authors argue that pregnancy does not accelerate disease progression among HIV-infected women.¹⁴⁻¹⁷ On the other hand, two studies have shown that fertility of HIV- positive women is lower than that of HIV-negative women in all but the youngest age group. The studies have also drawn attention to the likely underestimation of the magnitude of HIV epidemic in the population, based on surveillance confined to pregnant women.^{18,19} If the death rate from AIDS is lower among pregnant than among non-pregnant women in the age group mostly concerned by the disease, then the corresponding relative risk figure would have to be considered an over-estimation, and the proportional attributable risk as under-estimated. Assuming, for instance, that the death rate from AIDS between ages 25 and 39 years in exposed women is 80 per cent that in non-exposed, then our study results would have to be adjusted as follows: the relative risk estimate associated with childbearing in this age group would shift from 1.6 to 1.4, and the attributable risk from 5.3 to 3.6 per 1,000.

More generally, the assumption of a comparable death rate for the whole group of causes other than direct obstetric causes would hold if the lower fertility of women in poor health condition is to some extent counterbalanced by the higher lethality of diseases during

pregnancy. Whether this is the case is yet to be established. More research is needed on the relationship between pregnancy and diseases, both in terms of susceptibility/resistance of pregnant women to specific diseases and of fertility and ability of women with underlying pathology to initiate and bear a pregnancy to term.

On the other hand, in countries such as Congo, where AIDS is highly prevalent, it is becoming increasingly difficult to estimate maternal mortality independently from AIDS mortality. Indeed, HIV -positive women are more likely, when immunosuppressed, to develop obstetrical infections leading to death during pregnancy due to their immunosuppression. Should such deaths be considered as "direct obstetric deaths" or as "AIDS-related deaths"? Similarly, HIV-positive women are more likely to develop during their pregnancy or shortly after, HIV-associated diseases such as tuberculosis, pneumocystis, carini pneumonia, or cervical cancer. Should such deaths be considered as "indirect obstetric deaths" or as "AIDS-related deaths"? In our study, to avoid this overlap between AIDS mortality and maternal mortality, maternal deaths were limited to deaths from direct obstetric causes.

Conclusion

Concerning the actual outcomes of this maternal mortality study in Brazzaville, three points are noteworthy. First, we were able to make a direct and reliable estimate of maternal mortality using a data collection method that is fast, cheap and straightforward. Second, in the quasi-absence of data in this country to date, the maternal mortality ratios from direct obstetric causes which we provide are very high (652 per 100 000 live births between ages 15 and 49). Third, we estimated the proportional attributable risk associated with childbearing at 37 per cent in the age group 25 - 39, as opposed to the common belief that 80 - 95 per cent of deaths during pregnancy and the puerperium are related to the pregnancy.²

As pointed out by Stecklov,⁴ in sub-Saharan countries where AIDS mortality is on the increase, the inclusion of all deaths among women during the maternal period as done in the sisterhood method, might entail an over-estimation of maternal mortality levels. Given that the sisterhood method concerns mortality in a reference period lying 10 to 12 years before the survey, the estimates provided to date precede the spread of the AIDS epidemics in Africa. The problem now needs to be reconsidered, as the reference period has reached the time when mortality from AIDS started to become significant.

Lastly, many experts have argued that various indicators and assessment techniques were continuously needed for policy and evaluative purposes^{4,20} and the set of mortality estimates proposed here provides a very complete description of the impact of the maternal period in determining mortality levels of women. The implementation of relatively easy and short studies such as that done in Brazzaville, with collection of time

of death and cause of death data would certainly provide valuable information in order to assess mortality attributable to childbearing, and evaluate the impact of health actions. There is still a long way to go, as more than ten years after the launching of the Safe Motherhood Initiative around the world, very high maternal mortality levels are experienced by women in sub-Saharan Africa. Prenatal follow-up and access to maternity hospitals do not guarantee safe motherhood, and childbearing will continue to endanger women's lives in Africa until obstetric care and safe reproductive choices are improved.

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Rates per 100,000 women-year

Figure 1 Maternal Mortality Rates and Mortality Rates from AIDS by age groups

Table 1 **Number and Percentage of Deaths among 138 Women aged 15 to 49 years, classified according to 14 Cause of Death Groups, Brazzaville, June 10–July 9, 1996**

Cause of death	Number	Percentage
AIDS	64	46.4
Maternal mortality	15	10.9
Injuries, homicide and suicide	11	8.0
Infectious diseases	8	5.8
Diseases of the respiratory system	8	5.8
Other non infectious diseases	6	4.3
Cardiovascular diseases	5	3.6
Indeterminate	5	3.6
Diseases of the digestive system	5	3.6
Malaria	4	2.9
Cancer	3	2.2
Diseases of the liver	2	1.4
Anaemia	2	1.4
Total	138	100

Table 2 Calculation of the Age-Specific Death Rates of Women when exposed to a Maternal period and when not exposed, Brazzaville, June 10–July 9, 1996

	Years			Total
	15–24	25–39	40–49	
Number of women-months (<i>WM</i>) ^a	7371	8297	2420	18088
Number of deaths/month (<i>D</i>) ^b	34	82	22	138
Number of deaths from direct obstetric causes (<i>DDOC</i>) ^c	7	6	2	15
Number of deaths from causes other than direct obstetric causes (<i>DOTC</i>)	27	76	20	123
Number of live births/month (<i>LB</i>) ^d	1119	1131	50	2300
Fertility rates per 1,000 (<i>FTRT</i> = $LB \times 1000 / WM$)	151.8	136.3	20.7	127.2
Number of pregnancies/month (<i>PREG</i> = $LB \times 1.15$)	1286.9	1300.7	57.5	2645
Number of women-months of exposure (<i>WMe</i> = $PREG \times 0.87$)	1119.6	1131.6	50.0	2301.2
Number of women-months without exposure (<i>WMne</i> = $WM - WMe$)	6251.4	7165.4	2370.0	15786.9
Number of deaths from causes other than direct obstetric causes among exposed women/month [<i>DOTCe</i> = $DOTC \times (WMe / WM)$]	4.1	10.4	0.4	15.7
Total number of deaths among exposed women/month (<i>De</i> = $DDOCe + DOTCe$)	11.1	16.4	2.4	30.7
Number of deaths among non-exposed women/month (<i>Dne</i> = $DOTC - DOTCe$)	22.9	65.6	19.6	107.4
Death rate among exposed women per 100,000 (<i>DRe</i> = $100,000 \times (De / WMe)$)	992	1446	4824	1332
Death rate among non-exposed women per 100,000 [<i>DRne</i> = $100,000 \times (Dne / WMne)$]	366	916	826	680

^aBased on the 1974 and 1984 census figures by age and sex; the 1996 census total population count for Brazzaville; and the migration profiles and natural growth between 1974 and 1984. ^bBased on all bodies handled in Brazzaville's mortuaries during the study period. ^cAccording to the ICD-9 definition. ^dBased on all live births recorded in Brazzaville's five maternity units during the period September 1, 1995 to August 31, 1996.

Table 3 Measures of Risk of Dying Associated with the Maternal Period, Brazzaville, June 10–July 9, 1996

Age groups	Years			Total
	15-24	25-39	40-49	
Age-specific death rate (<i>per 100,000</i>) $GMRT = 100,000 \times (D/WM)$	461	988	909	763
Maternal mortality rate (<i>per 100,000</i>) $MMRT = 100,000 \times DDOC/WM$	95	72	83	83
Maternal mortality ratio and attributable risk (<i>both per 100,000</i>) $MMRO = 100,000 \times DDOC/LB$ $AR = DR_e - DR_{ne}$	626	531	3998	652
Relative risk $RR = DR_e / DR_{ne}$	2.7	1.6	5.8	2.0
Population proportional attributable risk (%) $PAR = 100(GMRT - DR_{ne})/GMRT$	20.6	7.3	9.1	10.9
Proportional attributable risk $PAR(\%) = 100(DR_e - DR_{ne})/DR_e$	63.1	36.7	82.9	48.9