

Maternal Mortality in the informal settlements of Nairobi city: What do we know?

Abdhalah Kasiira Ziraba^{1§}, Nyovani Madise², Samuel Mills³, Catherine Kyobutungi¹ and Alex Ezeh¹

¹African Population and Health Research Center, P.O. Box 10787, 00100, Nairobi Kenya

²University of Southampton, School of Social Sciences, University of Southampton, Southampton SO17 1BJ, United Kingdom

³World Bank, The World Bank, MSN G7-701, 1818 H Street NW, Washington, DC 20433

§ Corresponding author

Email addresses:

AKZ: aziraba@aphrc.org

NM: N.J.Madise@soton.ac.uk

SM: smills@worldbank.org

CK: ckyobutungi@aphrc.org

AE: aezeh@aphrc.org

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Abstract

Background

Maternal mortality, of all health indicators, exhibits the greatest disparity between the developed and developing world with 95% of the burden being in Africa and Asia alone. With a functioning health care system, all the major causes are treatable if complications are identified early. Current estimates for MMR are as high as 1,000/100,000 live births in Kenya. Whereas about 76 percent of births are delivered by skilled birth attendants in Nairobi city, only about half of the births in the urban informal settlements are assisted by skilled health professionals. Under these circumstances, it is likely that maternal mortality situation in informal settlements will be worse than the national estimates. A major challenge in understanding maternal mortality burden in the developing world is the lack of reliable data. In this paper, we estimate the burden and identify causes of maternal mortality in two slums of Nairobi.

Methods

We use verbal autopsy data from the Nairobi Urban Health and Demographic Surveillance System and health management information data from health facilities.

Results

The MMR for the two Nairobi slums is 631 maternal deaths per 100,000 live births. The major causes of maternal death are: abortion complications, hemorrhage, sepsis, eclampsia and ruptured uterus. Only in 21% of maternal deaths did the delivery occur with assistance of a health professional. The verbal autopsy data (which covers both deaths at health facilities and at home) seems to be better at capturing abortion complications related deaths compared to health facility data. Late maternal deaths (maternal deaths between 42 days and one year of pregnancy termination) account for a large proportion (43%) of all pregnancy related deaths (up to 1 year postpartum) most of which are due to complications of HIV/AIDS.

Conclusions

The Demographic Surveillance System and verbal autopsy tool may provide the much needed data on maternal mortality and its causes in the developing world. There is urgent need to address the burden of unwanted pregnancies and unsafe abortions among the urban poor and to strengthen the integration of maternal health services in HIV programs since HIV/AIDS is becoming a major indirect cause of maternal death.

Background

Maternal mortality, of all health indicators, exhibits the greatest disparity between the developed and developing world. Of the 529,000 deaths due to pregnancy or childbirth complications that occur each year worldwide, 95% are in Africa and Asia alone ^[1]. In sub-Saharan Africa where fertility is high, the lifetime risk of dying from maternal causes is about 1 in 16 which contrasts sharply with a risk of 1 in 2,800 for women from the developed world ^[1]. Over 70% of maternal deaths in the developing countries are due to direct maternal causes such as hemorrhage, sepsis, hypertension disorders, unsafe abortion, and obstructed labor. Additionally, indirect causes such as HIV/AIDS, malaria, and anemia account for about 20 percent of maternal deaths^[2]. Given that most obstetric emergencies are often unpredictable, and that life-threatening complications occur in roughly 15 percent of all pregnancies, potentially every pregnancy is at risk of developing a complication. As such, functioning and responsive obstetric emergency services are necessary to avert maternal deaths ^[3, 4].

Maternal health indicators in Kenya have not improved significantly over the years. Although estimates from cross-sectional surveys report that maternal mortality ratio (MMR) between 1998 and 2003 was between 400 and 600 maternal deaths per 100,000 live births, the 2000 revisions of MMRs by WHO, UNICEF, and UNFPA estimated Kenya's MMR to be 1,000 maternal deaths per 100,000 live births, which is among the highest in the world^[5]. Additionally the 1998 Kenya Demographic and Health Surveys (KDHS) indicate 56% of births were delivered with assistance of skilled health professionals compared to 41% in the 2003^[6, 7]. Similarly, early childbearing remains a

significant health and social problem, leading to many clandestine abortions^[8, 9]. Nearly a quarter of Kenyan women have started childbearing by the age of 20 and this proportion is double for women living in informal urban settlements^[7, 10].

Like many other health indicators, the burden of maternal mortality is heaviest among the poor. In the context of urban informal settlements, our understanding of maternal mortality remains very limited although other indicators, such as low use of health services and increasing child mortality, suggest that the urban poor are a highly vulnerable and marginalized group in Africa^[10, 11]. Rapid urbanization, fueled by high levels of rural-to-urban migration, has led to the growth of urban informal settlements (slums) in many African countries including Kenya. These slums are characterized by poor housing, lack of basic amenities such as water and sanitation, and low availability and utilization of formal health services including maternity care.

A major challenge in trying to understand and address maternal mortality burden in the developing world is the lack of reliable data since registration of deaths is often non-existent or largely incomplete. Verbal autopsies data from population-based surveillance systems provide reliable and more detailed information despite their shortcomings of recall bias and limited generalizability since surveillance systems often do not cover wide geographical areas^[12, 13].

In this paper, we estimate maternal mortality burden and causes in two slums of Nairobi, Korogocho and Viwandani, where the African Population and Health Research Center

has been conducting longitudinal demographic and health surveillance in a population of more than 55,000 individuals since 2002. We use data from verbal autopsies conducted on all female deaths aged 12-49 years between January 1, 2003 and December 31, 2005 in the two slum communities. We also use data from a health facility survey conducted in 2006 to assess maternal health experiences as captured by the health information system in health facilities for 2004 and 2005.

Methods

Verbal Autopsies

As part of the Nairobi Urban Health and Demographic Surveillance System, verbal autopsy interviews are conducted using a questionnaire adapted from the verbal autopsy tool developed by World Health Organization. All deaths in the two slum communities are captured through a death registration form by a field worker. A detailed verbal autopsy interview is then conducted by a trained interviewer within approximately 6 weeks of registering the death to respondents who consent to the interview. Respondents are typically members of the household who cared for the deceased prior to death or have good knowledge of the symptoms or events that led to death. Three physicians independently review the verbal autopsy questionnaire and assign cause of death using the International Classification of Diseases version 10 (ICD10). If two or more concur, the result is then accepted as the probable cause of death. Where agreement is not reached, the three physicians meet and discuss the case in order to reach a consensus. Where consensus is not reached, the cause of death is coded as unknown. For the maternal health project, women who died between 2003 and 2005 were identified from

the general database. Three physicians –a medical epidemiologist and two obstetricians- independently reviewed the verbal autopsy records in order to ascertain the cause of death. The purpose of having the verbal autopsies reviewed again by a team involving two obstetricians was to ensure that any maternal deaths that could have been missed by the routine DSS coding were captured.

Health Facility Survey

The health facility survey was conducted in 2006 and targeted facilities that are commonly used by women in the two slum communities for obstetric care. A total of 25 health facilities where women delivered between 2003 and 2005 were identified in the household survey which was part of a larger World Bank funded maternal health project. Some of the health facilities assessed were located in the two slums while the rest were in other parts of Nairobi.

We sought ethical approval from the Kenya Medical Research Institute (KEMRI)'s Ethical Review Committee, which is one of the Institutional Review Boards authorized to give ethical approval for research in Kenya. In addition, we obtained permission from the Ministry of Health and from the Medical Officer of Health in-charge of the Nairobi City before visiting the health facilities. Appointments were made with the respective health facilities to explain to the health personnel the details of the survey after which consent was sought to carry out the interview. Structured interviews were carried out by one clinical officer who underwent training for this exercise. Data on causes of deaths for

2004 and 2005 were extracted from the medical records and examined. Descriptive statistics are used to describe the maternal mortality situation in the two slums.

Results

During the period 2003-2005, a total of 342 women aged 12-49 years died in the two slums and verbal autopsies were completed on 293 (86 percent). Of the 49 women for whom a verbal autopsy was not completed, 4 (8%) died within one year of having a pregnancy outcome. Among the 293 deaths reviewed, 36.5% were from Viwandani and 63.5% from Korogocho slum. Since the number of deaths was small, we provide combined results for the two slums. Table 1 shows the characteristics of female deaths, distinguishing between maternal deaths (during pregnancy or within 42 days of a pregnancy outcome), late maternal death (within one year of pregnancy outcome) and other, non maternal deaths.

[Table 1 about here]

In total, 51 deaths were due to pregnancy or childbirth complications. Of these, 29 occurred during pregnancy or within 42 days after the end of the pregnancy, while 22 deaths occurred within one year of the pregnancy outcome. Among the 29 maternal deaths, there was a 62% agreement on cause of death being maternal in nature between the routine DSS diagnoses and the ones derived in this project. Another 10% were previously coded as “HIV/AIDS” while in this study they were coded as “HIV/AIDS in pregnancy”. About 7% had previously been coded as “unknown” cause but were re-

coded as “abortion complication”. Female residents of Viwandani and women with a higher education were less likely to die of a maternal cause though the differences were not statistically significant. Since we reviewed all deaths up to one year after delivery, we were able to identify a substantial proportion of women who died of delivery-related or pregnancy aggravated complications. Late maternal deaths constituted about 43% of all pregnancy related deaths up to a year of termination of the pregnancy and 7 % of all deaths to women of reproductive age.

In computing maternal mortality ratio, cases with no data on cause of death were assumed to have a proportionate maternal mortality experience as those for which we had information on cause of death. Based on the 29 maternal deaths and adjusting for non-response expected numbers of maternal deaths were derived as shown in table 2. For the three years a total of 5,356 live births were recorded in the demographic surveillance system, and therefore the maternal mortality ratio for this population is about 631 per 100,000 live births Table 2. This figure is higher than 414 per 100,000 recorded by the 2003 Kenya Demographic and Health Survey for Kenya as a whole. If late maternal deaths were included in this computation the mortality ratio would change drastically as follows: Deaths occurring in three months (90 days), the mortality ratio would be 830/100, 000, within 6 months the mortality ratio would be 960/100000 and up to one year the mortality ratio would be 1,110/100,000. Given the small number of maternal deaths in this study, the MMR estimates should be interpreted with caution, although this is a common limitation with maternal mortality estimates.

[Table 2 about here]

All pregnancy related deaths accounted for about 17% of all deaths among women of reproductive age group and indeed is the second most important cause of female death in this population (see Figure 1). Of all the pregnancy related deaths, 10% were maternal deaths according to the WHO definition (during pregnancy or within 42 days after pregnancy outcome).

[Figure 1 about here]

Most of the women who died of maternal causes were delivered by non-skilled health professionals. Whereas about 65% of all pregnancy outcomes over the period were delivered by a skilled birth attendant, only about 21% of women who died as a result of a maternal cause had their delivery/pregnancy termination with the help of a health professional and only 14% took place in a health facility.

[Table 3 about here]

A little over one half of all pregnancy related deaths occurred outside of a health facility. Deaths occurring after 42 days following a pregnancy outcome were more likely to occur outside of a health facility with more than two-thirds of these deaths occurring outside the health facility. Given that about 96% of all late maternal deaths sought care before death, this result suggests that the urban poor ultimately seek care in the event of a complication, but the maternity services are not in a position to influence a positive maternal outcome. While less than 2% of all pregnancy outcomes in 2003-2005 were abortions or still births, 69% of all maternal deaths and 45% of all pregnancy related deaths occurred after an abortion or still birth Table 3.

[Table 4 about here]

Table 4 shows a breakdown of the main causes of maternal deaths from the verbal autopsy data and from the medical records of health facilities. The leading causes of direct maternal deaths were generally the same from the two data sources (abortion complications, antepartum and postpartum hemorrhage, postpartum sepsis, eclampsia, and ruptured uterus). The major difference is the order of magnitude of the burden that each cause contributes. From the verbal autopsy approach, abortion complication is the leading cause of maternal death, while eclampsia is the leading cause according to the medical records from the health facilities surveyed. Results on cause of death from the health facilities records should be interpreted with caution as 47 % of medical records did not have information on cause of death and were thus excluded in this analysis. For indirect causes, we also observe some differences. HIV/AIDS/tuberculosis and anemia are the major indirect causes of maternal deaths as per the verbal autopsy data. Overall HIV/AIDS and tuberculosis accounted for 51% of all female deaths in the two slums and about 59% of all late maternal deaths. Conversely, anemia and malaria are the major indirect causes as per the medical records data. It is not clear whether the differences are due to measurement errors whereby the verbal autopsy tool over diagnoses HIV/AIDS and the health facility over diagnoses malaria. Most cases labeled as malaria in health facilities are not confirmed by laboratory investigations and thus diagnoses are mainly based on history and clinical examination. Given the low malaria transmission in Nairobi,

it is likely that those labeled as malaria might have died from other causes. On the other hand, verbal autopsy coders could also have over diagnosed HIV/AIDS especially for cases where vague signs and symptoms were reported. Further HIV/AIDS could have also been over diagnosed by the verbal autopsy codes with the coder's bias being driven by their knowledge that HIV/AIDS is prevalent and a major cause of adult deaths in this population.

Discussion

Maternal mortality, although a relatively rare event compared to other health events such as child mortality, has great significance because of its ramifications at the family and societal levels. Developed countries managed to reduce maternal mortality by reducing fertility and unwanted pregnancies and more importantly by effective early detection and management of obstetric complications through use of skilled birth attendants at delivery complications^[14, 15]. Current evidence and opinion suggests that this is the way to go for the developing world^[16]. With no vital registration system in most parts of Africa, generation of evidence of what works and the maternal mortality burden has been dodged by measurement problems. Evidence suggests that there are gross underestimates for maternal mortality burden with controversies on which estimates are valid. There is however consensus on the need to remove barriers to accessing professional care and make emergency obstetric care available to the majority of women at a higher risk^[1, 4, 17-19].

Results from this study concur with what is known with regard to the major causes of maternal mortality in sub-Saharan Africa^[20-26]. The difference is in the individual contribution of each cause to the overall burden of maternal mortality. For instance, abortion turns out to be the leading cause as per results from the verbal autopsy data compared to hemorrhage or eclampsia or sepsis as commonly reported from hospital based data^[27, 28]. It is important to note that whereas only 1% of pregnancy outcomes are recorded as either miscarriages or abortions in this population, abortion complications account for over 30% of all maternal deaths. It is likely that hospital-based studies miss out on clandestine abortions, where women prefer to receive treatment outside health facilities. Alternatively, given the legal restrictions of the abortion procedure, health facilities could also be deliberately not recording abortion as a cause of death especially if the abortion was induced. Another observation is the lower record of deaths attributed to HIV and AIDS in the health facilities. It is likely that health facilities do not indicate HIV/AIDS as a cause of maternal death because of the stigma and attitudes associated HIV/AIDS or due to recording style whereby only the immediate cause of death is registered leaving out co-morbidities especially the underlying causes^[29].

The relatively high estimate of maternal mortality recorded here as compared to the national estimate by KDHS 2003 could be a result of inaccurate estimates due to the small numbers of maternal deaths, although the KDHS survey also reported small numbers of maternal deaths as a limitation that have affected the estimate. The national estimate is not disaggregated by province or rural-urban residence and therefore making comparisons with the slum findings is difficult. The conventional definition that limits

maternal deaths to 42 days postpartum may underestimate the mortality burden attributable to pregnancy and child birth. This is more evident in populations affected by HIV/AIDS, malnutrition and poverty. There are increased chances that an HIV positive woman fails to heal from postpartum sepsis or anemia occasioned by the pregnancy compared to an HIV negative woman in the same circumstance. Due consideration need to be given to late maternal deaths in all estimates of burden attributable to maternal causes and service delivery plans especially in populations with generalized HIV epidemic.

The population-based approach used in this study circumvents the challenges of selection bias faced by hospital-based studies since many people do not die in hospitals and thus may not be captured by any hospital or other national registers. Findings from such surveillance are useful not only for the small locality but can inform national planning regarding the contribution of various causes to maternal mortality. The verbal autopsy approach has been widely used and has demonstrated good sensitivity and specificity as a tool and is very useful in estimating mortality in small area surveillance systems^[30-32]. It however suffers from the risk of recall bias and possible misclassification due to wrong recording and interpretation of signs and symptoms. Another limitation is that not all the female deaths were reviewed to establish the cause of death. For example, of the 49 female deaths for whom a verbal autopsy was not completed, about 8% had a pregnancy outcome within one year before their death and these could have been of a maternal nature or not. In an urban household, when death of a spouse or household head occurs, there is greater likelihood that the rest of the household relocates to their rural home. This

might happen before a verbal autopsy is conducted and this partly explains the 15% female deaths with no verbal autopsy information. Similarly, the medical records were affected by incompleteness of data with close to 50% of deaths not having a definitive diagnosis. Further, the health facilities serve as referral centers for clients beyond the city, so for comparison purposes, the populations might not be exactly similar socio-demographically and this could partly explain the differences in distribution of causes of maternal deaths in health facility data and in the population-based data.

Finally, it is important to note that although most deliveries took place outside of a health facility, nearly all of them visited a health facility before death. This observation may imply poor quality or limited access to emergency obstetric care in this area. For most obstetric complications, timely access to life saving interventions is of paramount importance. This concept is being used in programs aimed at improving maternal health by targeting the removal of unnecessary delays in making the decision to seek care, in reaching a facility, and in receiving care once at the health facility^[3, 33, 34] .

Conclusions

Maternal mortality ratio for the two Nairobi city slums (Korogocho and Viwandani) is high compared to the national estimates. Abortion complications are a major cause of maternal mortality and seem to be a clandestine experience not easily detectable by the conventional health management information systems. This is more in settings, such as slum areas where the quality of record keeping and reporting below set standards. There

is need to promote programs that facilitate access to contraceptives to mitigate the occurrence of unwanted pregnancies and unsafe abortions.

Puerperal sepsis is also a major cause of maternal death and this has a bearing on the quality of maternity services such as infection control measures during delivery or caesarean section in health facilities. Also, given the fact that about 80% of maternal deaths had deliveries with a non-professional assistant, the need to use professionals as birth attendants can not be over emphasized. There is need for close supervision of both private and public maternity facilities to maintain minimum standards and provide on-the-job training to ensure quality. Most importantly there is need to ensure that all women deliver in safe hands of trained personnel.

HIV/AIDS is increasingly contributing to the burden of pregnancy related deaths. HIV/AIDS programs should take on board the plight of mothers not just children as commonly occurs in prevention of mother to child transmission of HIV (PMTCT) programs. After all, the chances of an HIV negative child to survive are equally reduced when the mother dies.

In an environment with scarcity of reliable data, different research approaches and sources of data are required to answer some of the major public health concerns. We have demonstrated this by showing that indeed verbal autopsies seem to capture abortions better than facility based records and can be a very good additional source of data for

establishing the burden of maternal mortality attributable to abortion complications especially if coded by obstetricians.

Competing interests

There are no competing interests reported by any of the authors.

Author's contributions

AKZ took lead in preparing the manuscript. He participated in data collection, data cleaning, and conducted most of the analysis.

NM conceptualized the idea of this paper; she supervised data collection and analysis and wrote sections of this paper.

SM contributed to data analysis, manuscript preparation and interpretation of findings.

CK contributed to manuscript preparation and interpretation of findings.

AE contributed to the conceptualization of the study, manuscript preparation and interpretation of findings.

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Figures

Figure 1: Percentage distribution female deaths (12-49 years old) by cause.

NUHDSS, 2003-05

Tables

Table 1: Percentage distribution of maternal, late maternal and non-maternal female deaths by socio-demographic characteristics: NUHDSS Verbal Autopsy 12-49 years old females, 2003-2005

| Characteristic | Maternal/late maternal deaths | | | Non-maternal female deaths | P value |
|------------------|-------------------------------|-------------------------|------------------------------|----------------------------|---------|
| | Total female Deaths N=293 | Maternal deaths N=29 | Late maternal Deaths N=22 | | |
| Age | | | | | |
| < 20 yrs | 4.8 | 6.9 | 18.2 | 3.3 | 0.00 |
| 20-29 yrs | 34.8 | 58.6 | 50.0 | 30.6 | |
| 30-39 yrs | 41.3 | 34.5 | 22.7 | 43.8 | |
| 40-49 yrs | 19.1 | 0.0 | 9.1 | 22.3 | |
| Residence | | | | | |
| Korogocho | 63.5 | 69.0 | 40.9 | 64.9 | 0.07 |
| Viwandani | 36.5 | 31.0 | 59.1 | 35.1 | |
| Ethnicity | | | | | |
| Kikuyu | 34.8 | 27.6 | 31.8 | 36.0 | 0.58 |
| Luo | 31.7 | 34.5 | 22.7 | 32.2 | |
| Kamba | 13.3 | 17.2 | 22.7 | 12.0 | |
| Luhya | 13.3 | 13.8 | 22.7 | 12.4 | |
| Others | 6.8 | 6.9 | 0.0 | 7.4 | |
| Education | | | | | |
| No education | 9.9 | 6.9 | 4.6 | 10.7 | 0.33 |
| Primary | 70.0 | 82.8 | 81.8 | 67.4 | |
| Secondary | 20.1 | 10.3 | 13.6 | 21.9 | |

Table 2: Maternal mortality estimates from verbal autopsy, in Korogocho and Viwandani settlements, Nairobi, 2003-2005

| Characteristic/Variable | Year | | | |
|----------------------------------------------------|-------|-------|-------|-----------|
| | 2003 | 2004 | 2005 | 2003-2005 |
| Maternal deaths covered in verbal autopsies | 8 | 10 | 11 | 29 |
| Female deaths covered in verbal autopsies | 117 | 102 | 74 | 293 |
| Total female deaths | 139 | 114 | 89 | 342 |
| Maternal deaths (adjusted for non-response) | 9.5 | 11.2 | 13.2 | 33.8 |
| Total live births | 1,783 | 1,882 | 1,691 | 5,356 |
| Maternal mortality ratio (per 100,000 live births) | 533 | 594 | 782 | 631 |

Table 3: Delivery and death circumstances by maternal health outcomes: NUHDSS: 2003-2005

| Characteristics | Maternal and late maternal deaths | | | | All pregnancy outcomes 2003-05 | P value |
|----------------------------------|-----------------------------------|----------------------------------------|------------------------------------------------------|--|--------------------------------|---------|
| | Total pregnancy related deaths | Maternal deaths (Death within 42 days) | Late maternal deaths (After 42 days but within 1 yr) | | | |
| | N=51 | N=29 | N=22 | | N=5,443 | |
| Delivered by health professional | | | | | | |
| Non-professional | 74.5 | 79.3 | 68.2 | | 33.7 | 0.00 |
| Professional | 25.5 | 20.7 | 31.8 | | 66.3 | |
| Place of delivery | | | | | | |
| Outside of Health facility | 88.2 | 86.2 | 90.9 | | 35.8 | 0.00 |
| Health facility | 11.8 | 13.8 | 9.1 | | 64.2 | |
| Outcome of pregnancy | | | | | | |
| Abortion/still birth | 45.1 | 69.0 | 13.6 | | 1.5 | |
| Live birth | 54.9 | 31.0 | 86.4 | | 98.5 | 0.00 |
| Place of death | | | | | | |
| Outside Health Facility | 51.0 | 37.9 | 68.2 | | | |
| Health Facility | 49.0 | 62.1 | 31.8 | | | |
| Sought care before death | | | | | | |
| No | 9.8 | 13.8 | 4.6 | | | |
| Yes | 90.2 | 86.2 | 95.5 | | | |

**Table 4: Major causes of maternal mortality using data from two different sources:
Nairobi Urban Health Demographic Surveillance System, (2003-05) and Health
Facility survey, 2006**

| Causes of maternal deaths from verbal autopsies in the surveillance area, 2003-2005 | | | Causes of maternal deaths that occurred between 2004 and 2005. Health Facility Survey 2006, | | |
|-------------------------------------------------------------------------------------|---------------|------------|---------------------------------------------------------------------------------------------|---------------|------------|
| <i>Direct maternal causes</i> | <i>Number</i> | <i>(%)</i> | <i>Direct maternal causes</i> | <i>Number</i> | <i>(%)</i> |
| Abortion related | 9 | 31.0 | Pre-eclampsia / Eclampsia | 75 | 23.7 |
| Ante/post partum hemorrhage | 4 | 13.8 | Postpartum sepsis | 43 | 13.6 |
| Postpartum sepsis | 3 | 10.3 | Ante/postpartum Hemorrhage | 33 | 10.4 |
| Pre-eclampsia/ Eclampsia | 2 | 6.9 | Abortion cause | 23 | 7.3 |
| Ruptured uterus | 1 | 3.5 | Ruptured uterus | 13 | 4.1 |
| | | | Retained placenta | 10 | 3.2 |
| | | | Prolonged labor | 5 | 1.6 |
| | | | Ectopic pregnancy | 3 | 0.9 |
| | | | Other direct | 4 | 1.3 |
| <i>Indirect maternal causes</i> | | | <i>Indirect maternal causes</i> | | |
| HIV/AIDS/TB | 4 | 13.8 | Anemia | 39 | 12.3 |
| Anemia in pregnancy | 2 | 6.9 | Malaria | 27 | 8.5 |
| Other indirect maternal causes | 4 | 13.8 | TB/HIV/AIDS | 9 | 2.8 |
| | | | Other indirect | 32 | 10.1 |
| | 29 | 100.0 | | 316 | 100.0 |

Figure 1: Percentage distribution female deaths (12-49 years old) by cause.

NUHDSS, 2003-05

