

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

Authors

Abdhalah Kasiira Ziraba<sup>1</sup>, Nyovani Madise<sup>2</sup>, Samuel Mills<sup>3</sup>, Catherine Kyobutungi and Alex Ezeh<sup>1</sup>

Key words: Maternal mortality, slums, Kenya, verbal autopsy, demographic surveillance system

### **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 describe the maternal mortality experiences in two slums of Nairobi, Korogocho and Viwandani over a three year period.

#### **Methods**

We use verbal autopsy data from the demographic surveillance system and health management information data from health facilities.

#### **Results**

The MMR for the slums is 557 per 100,000 live births. From both data sources, 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 in a health facility. The verbal autopsy tool in a longitudinal setting seems to be better at capturing abortion complications compared to health facility data. Late maternal deaths (maternal related deaths after 42 days of pregnancy termination) account for a large proportion (43%) of all pregnancy related deaths most of which are due to HIV/AIDS related complications.

#### **Conclusions**

The DSS and verbal autopsy tool can 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 strengthen the integration of HIV activities in maternal health programs as HIV/AIDS is becoming a major indirect cause of maternal death.

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<sup>1</sup> African Population and Health Research Center

<sup>2</sup> University of Southampton

<sup>3</sup> World bank

## **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. In sub-Saharan Africa where fertility is quite 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<sup>(1)</sup>. Over 70% of maternal deaths in the developing world are caused by hemorrhage, sepsis, hypertension disorders, unsafe abortion, and obstructed labor. Indirectly, HIV and AIDS, malaria, and anemia account for about 20 percent of maternal deaths. Because many obstetric emergencies are often unpredictable, responsive and functioning maternal health emergency services are necessary to avert deaths<sup>(2,3)</sup>. It is estimated that life-threatening complications occur in roughly 15 percent of all pregnancies and thus, potentially every pregnancy is at risk of developing a complication. The new consensus to have every pregnant deliver with the assistance of a skilled health attendant is a major step in preventing maternal deaths that can be averted.

The maternal health situation in Kenya has 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, recent revisions of MMRs by WHO, UNICEF, and UNFPA estimated Kenya's MMR to be 1,000 per 100,000 live births, which is among the highest in the world<sup>(4)</sup>. Other maternal health indicators for Kenya have also not improved over the past two decades. According to the 1989 Kenya Demographic and Health Surveys (KDHS), about 50 percent of births were delivered with assistance of skilled health professionals but this percentage dropped to 41 in the 2003 KDHS. Similarly, early childbearing remains a significant health and social problem, leading to many clandestine abortions. 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<sup>(5,6)</sup>.

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 experience remains very limited although other indicators such as low use of health services, increasing child mortality do suggest that the urban poor are a rapidly growing marginalized group in Africa<sup>(5,7)</sup>. 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 utilization of formal health

and other social services. For example, although 76 percent of births are delivered by skilled birth attendants in the capital city, Nairobi, only about half of the births in Nairobi's slums were assisted by skilled health professionals<sup>(5)</sup>. A major challenge in trying to understand and address the maternal mortality burden in the developing world is the lack of reliable data since vital registration of deaths is often non-existent or largely incomplete. Verbal autopsies from population-based surveillance systems provide more details despite their shortcomings of recall bias and selection bias since the surveillance doesn't cover a very wide geographical<sup>(8, 9)</sup>.

In this paper, we describe the maternal mortality experiences 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 between 12 to 49 years between 2003 and 2005 in the two slum communities. We also use data from a health facility survey conducted in 2006 to assess maternal experiences as captured by the health information system in health facilities.

## **Methods**

### *Verbal Autopsies*

In 2006, we recoded verbal autopsy data collected earlier on deaths that occurred between January 01, 2003 and December 31, 2005. Verbal autopsy interviews are conducted using a questionnaire adapted from the verbal autopsy tool developed by WHO and is being used by most demographic surveillance sites affiliated to the INDEPTH Network. All deaths in the two slum communities are captured through a death registration form by a field worker. Then a detailed verbal autopsy interview is conducted by a trained team leader or supervisor within reasonable time of registering the death to respondents who consent to have the interview done. Respondents are typically members of the household who cared for the deceased prior to death or have good knowledge of the symptoms suffered and the health care that was received before death. 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 using the International Classification of Diseases version 10 (ICD10). If two or more concurred, the result was then accepted as the probable cause of death. Where agreement was not reached, the three physicians met and discussed the case in order to reach a consensus. When an agreement could not be reached, the cause of death was coded as unknown. The purpose of having the verbal autopsies recoded by a team including two obstetricians was to ensure that any maternal deaths that could have been missed by the routine coding are 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. As part of the maternal project, places where women delivered were identified in the household survey of women who had had a birth between 2003 and 2005. The study setting is an informal settlement with no proper physical planning. As such, most of the health facilities located in the slums are informal and are not regulated by the local authority. The few formal

health facilities serving this population are located outside of the demographic surveillance area.

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. We obtained information on the health facility's management, staff and their obstetric skills, availability of medical equipment and supplies, referral system and health management information system. Data on causes of deaths for 2004 and 2005 were extracted from the medical records and examined. Although the time reference for the verbal autopsies (2003-2005) and the deaths in the health facilities (2004-2005) is not the same, the data can still be compared since the causes of death would not have changed drastically between 2003 and 2004. Descriptive statistics are used to describe the maternal mortality situation in the two slums.

The two slum areas have some socio-economic and demographic differences. Viwandani, which is near an industrial area, has a highly mobile population and many of its economically active people are employed by the industrial sector. On average, a woman in Viwandani will have 3 children during her lifetime and the crude death rate is around 7 per 1000. Korogocho, on the other hand, is a long-term settlement area, and the majority of its people are engaged in petty trading. Total fertility rate is about 3.8, with crude death rate of about 11 per 1000.

## **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) and analysis is based on these. Of the 49 women for whom a verbal autopsy was not completed, 8% died within one year of having a pregnancy outcome. Out of the 293 deaths reviewed, 36.5 percent were from Viwandani and 63.5 percent 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. For comparison purposes, the general distribution of women 12-49 years in the slum population is given as seen in table 1.

**[Table 1 about here]**

In total, 51 deaths were due to a 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. Compared to the causes of death routinely derived by the DSS, there was about 62% agreement on maternal deaths. Another 10% were coded as “HIV/AIDS” in the DSS while in this project they were coded as “HIV/AIDS in pregnancy”. About 7% had been coded as “unknown” cause but were coded as “abortion complication”. Whereas women aged 20-39 years constitute just about 68% of the female population in the reproductive age bracket, they are disproportionately over represented (93%) among women who died of a maternal cause. Although not significantly different statistically, female residents of Viwandani and women with a higher education are less likely to die of a maternal cause.

The arbitrary cut off of 42 days for a pregnancy related death to be defined as maternal death may be leading to underestimation of burden of deaths attributed to pregnancy and child birth. Since we reviewed all pregnancy related 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 percent of all pregnancy related deaths and 7.5 percent of all female deaths. HIV/AIDS and TB accounted for over 51.5% of all female deaths in the two slums and about 59.1% of all late maternal deaths. Based on the 29 maternal deaths and the 5205 live births recorded in demographic surveillance system, the maternal mortality ratio for this population is about 557 per 100,000 live births. 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 MMR would be 730/100,000, within 6 months MMR would be 845/100000 and up to one year MMR would be 980/100,000. 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. Also because of the small numbers of maternal deaths covered by KDHS 2003, maternal mortality estimates were not disaggregated by region or province hence there are no estimates for Nairobi province to compare with.

All pregnancy related deaths accounted for about 17.4% of all female deaths (see Figure 1), and about 9.9 percent can be classed as maternal deaths according to the WHO definition. Pregnancy related deaths are the second most important cause of female deaths in this population.

**[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 by a skilled birth attendant, only about 21 percent of all 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 percent of these took place in a health facility. The pregnancy

outcomes of all maternal deaths were mainly abortions (31 percent) and still births (38 percent) as can be seen from Table 2.

**[Table 2 about here]**

Table 3 gives a breakdown of the main causes of maternal deaths as generated from the verbal autopsy data and from the medical records of health facilities. As can be seen from the results, the leading causes of direct maternal death are more or less the same from the two data sources (abortion complications, antepartum and postpartum hemorrhage, postpartum sepsis and 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 complications are the leading cause, 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 percent of medical records didn't have information on cause of deaths and were thus excluded from 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 approach whereas anemia and malaria are the major indirect causes as per the medical records. It is not clear whether the differences are due to measurement errors where 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 might also have over diagnosed HIV/AIDS especially for cases where vague signs and symptoms were reported further biased by their knowledge that HIV/AIDS is prevalent and a major cause of adult deaths.

**Discussion**

Maternal mortality although a relatively rare event compared to other health events such as child mortality, has a lot of significance because of its ramifications at the family and societal levels. The developed world managed to reduce maternal mortality through reduced fertility and unwanted pregnancies but more importantly through effective early detection and management of obstetric complications. Current evidence and opinion suggests that this is the way to go for the developing world. With no vital registration systems 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 the usual controversies of which estimates are valid. There is however consensus on the need to remove barriers and make emergency obstetric care available to the majority of women at the highest risk<sup>(1, 3, 10-12)</sup>.

Results from this study concur with what is known as the major causes of maternal mortality in sub-Saharan Africa (13-19). The difference is the individual contribution of each of the major causes depending whether the studies are population or hospital based.

For instance abortion turns out to be the leading cause as per results from this study compared to eclampsia from hospital based studies. It is important to note that whereas only 1% of pregnancy outcomes are recorded as either miscarriages or abortions in this population, abortions complications claim 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. Given the legal restrictions of the procedure, health facilities may deliberately not record abortion as a cause of death especially the criminal ones. 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 towards HIV/AIDS or due to recording of only one cause (immediate cause of death) of death in the registers which might not reflect other co-morbidities<sup>(20)</sup>.

The relatively high estimate of maternal mortality recorded here as compared to the national estimate by KDHS could have been affected by the small numbers in this study. However the revised estimates of maternal mortality in Kenya by WHO suggests a estimate of 1,000 deaths per 100,000 live births. 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 associated with poverty and so forth. 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 circumstances. Due consideration need to be given to late maternal deaths in all estimates and service provision plans.

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. 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<sup>(21-23)</sup>. It however suffers from the risk of recall bias and possible misclassification due to wrong recording and interpretation of signs and symptoms. 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. 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 before their deaths and these could have been of a maternal nature. In an urban household setting, when death occurs especially of a spouse or household head, there is a greater likelihood that the rest of the household relocates to another place before a verbal autopsy is conducted hence the close to the 15% female deaths for whom a verbal autopsy was not conducted. The medical records, similarly, were affected by incompleteness 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 facilities and the population based approach.

Finally, it is important to note that although most deliveries took place outside of a health facility, most of them visited a health facility before death. This has implication on the functioning of emergency obstetric care, accessibility and affordability. For most obstetric complications, timeliness of life saving intervention is of paramount importance. This concept is being used in programs aimed at improving maternal health by targeting removal of unnecessary delays in making the decision to seek care, in reaching a facility, and in receiving care once at the health facility<sup>(2, 24, 25)</sup>.

### **Policy implications**

Abortions are a major cause of maternal mortality and seems to be an under world experience not easily detectable by the conventional health management information systems more so where quality of service is below standard such as among the urban poor. 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 infection control measures during delivery or caesarean section in health facilities. Also given the fact that just about 20% of maternal deaths had deliveries in health facilities, demonstrates the dare need to use professionals as birth attendants. There is need for close supervision for both private and public maternity facilities to maintain minimum standards and provide on job training to ensure quality but most important is 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 they have been accused of doing 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.

Different research approaches and sources of data need to be employed 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.

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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	Total female Deaths N=293	Maternal deaths N=29	Late maternal Deaths N=22	Non-maternal female deaths N=242	<i>P value</i>	Population distribution of 12-49 yr females (mid 2004) N=14,918
<b>Age</b>						
< 20 yrs	4.8	6.9	18.2	3.3	0.00	23.3
20-29 yrs	34.8	58.6	50.0	30.6		47.2
30-39 yrs	41.3	34.5	22.7	43.8		20.8
40-49 yrs	19.1	0.0	9.1	22.3		8.8
<b>Residence</b>						
Korogocho	63.5	69.0	40.9	64.9	0.07	52.7
Viwandani	36.5	31.0	59.1	35.1		47.3
<b>Ethnicity</b>						
Kikuyu	34.8	27.6	31.8	36.0	0.58	34.7
Luo	31.7	34.5	22.7	32.2		17.3
Kamba	13.3	17.2	22.7	12.0		20.9
Luhya	13.3	13.8	22.7	12.4		13.4
Others	6.8	6.9	0.0	7.4		13.7
<b>Education</b>						
No education	9.9	6.9	4.6	10.7	0.33	6.3
Primary	70.0	82.8	81.8	67.4		69.2
Secondary	20.1	10.3	13.6	21.9		24.5

Table 2: Delivery and death circumstances among the maternal death and late maternal death  
 NUHDSS: 2003-2005

Characteristics	Total pregnancy related deaths N=51	Maternal deaths (Death within 42 days after outcome) N=29	Late maternal deaths (Death after 42 days but within 1 yr) N=22	<i>P value</i>	All pregnancy outcomes 2003-05 N=5,141
Delivered by health professional					
Non-professional	74.5	79.3	68.2	<i>0.37</i>	34.5
Professional	25.5	20.7	31.8		65.4
Place of delivery					
Outside of Health facility	88.2	86.2	90.9	<i>0.61</i>	36.5
Health facility	11.8	13.8	9.1		64.5
Outcome of pregnancy					
Abortion/miscarriage	23.5	31.0	13.6		1.0
Live birth	54.9	31.0	86.4	<i>0.00</i>	97.8
Still birth	21.6	37.9	0.0		1.2
Place of death					
Outside Health Facility	51.0	37.9	68.2	<i>0.03</i>	
Health Facility	49.0	62.1	31.8		
Sought care before death					
No	9.8	13.8	4.6	<i>0.27</i>	
Yes	90.2	86.2	95.5		

**Table 3: Major causes of maternal mortality using data from two different sources. Nairobi Urban Health Demographic Surveillance Site, 2003-05.**

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 year old) by cause. Nairobi Urban Health Demographic Surveillance Site, 2003-05**

