Correlates of Maternal Mortality in Adama Town and Environ: Evidence from Hospital Records

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Introduction

Among the many roles women play in society, their reproductive role, which ensures perpetuation of the human species, is of great importance. Yet, in the performance of this role, more than half a million women, worldwide, die annually from complications of pregnancy and childbirth. Barely one percent of these deaths occur in industrialized countries, demonstrating that they could be averted (Family Health International (FHI), 2003, Reed et al., 2000:4).

In sub–Saharan Africa, there are between 600 and 1,500 maternal deaths for every 100,000 live births. This tragedy occurs despite the fact that pregnancy is a natural biological process and that we know how and have the means to reduce the risks associated with pregnancy and childbirth. For women in industrialized countries, the lifetime risk of death from pregnancy complications is 1 in 4,085. This risk for women worldwide is 1 in 75 and for women in Africa it is 1 in 16 (FHI, 2003; WHO/UNICEF/UNFPA, 2003). The wide gap in maternal mortality between developed and developing countries may be attributed to disparities in medical facilities; antenatal, delivery and postnatal care; reproductive factors; and economic and socio-cultural factors.

In Ethiopia, national and regional levels of maternal mortality and their correlates are not well known. Estimates of the level range between 452 and 1,528 maternal deaths per 100,000 live

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births. Recent estimate from the 2000 Ethiopia Demographic and Health Survey put the national level at 871 maternal deaths per 100,000 live births (CSA and ORC Macro, 2001). This implies that, at the prevailing mortality and fertility rates, an Ethiopian woman has a lifetime risk of maternal death of 1 in 9, which is higher than the African average and much higher than that of a developed country like the United Kingdom (1in 5,100). Lack of good antenatal, delivery and postpartum care, maternal malnutrition and anemia, high parity and septic abortion, are believed to contribute to the high rate of maternal mortality in the country (World Bank, 1998: 68). Broadly, factors that contribute to the risk of maternal mortality can be classified into pathogenic factors, health service factors, demographic, economic and socio-cultural factors (Shane, 1997).

In major international conferences, reduction of maternal mortality has been one of the major goals. The Millennium Development Goals calls for reducing maternal mortality ratio by 75 percent between 1990 and 2015.

This paper identifies the correlates of maternal mortality among women in the study hospital, which will provide valuable information to planners and policy makers devoted to improving maternal health in the study area.

The Study Area

Adama hospital is located in Adama town, which is the capital of Oromiya Region of Ethiopia. Adama is one of the large towns in the country. According to the 1994 population and housing census of Ethiopia, the total population of Adama was 127,842. Because of the official transfer

of the capital of Oromiya Region from Addis Ababa to Adama in 1999, its population has grown rapidly and was projected to have reached 375, 489 in 2003[1].

Evidence from the records showed that the hospital does not only serve people living in Adama town. People living within 400-500 kilometers radius, in the surrounding rural areas of Adama, other areas of Easter Shoa Zone, and even other zones of Oromiya Region, also attend the hospital.

Adama hospital has 130 health professionals and 101 administrative and support staff. Before 1996, the gynecology and obstetrics department had neither a gynecologist nor sufficient number of midwives. However, since 1996, there has been only one gynecologist and three midwives who provide maternal services in the department. The absence of blood transfusion service is a major problem that makes it difficult and sometimes impossible to save the lives of bleeding mothers. Often, women referred to Addis Ababa for blood transfusion die on the way.

Data and Methods

This study is based on data from hospital records of 16,279 women who were admitted for maternal causes in Adama hospital, during the seven-year period, September 1993 to August 2000. Among these women, 341 maternal deaths occurred during the reference period.

Information available in the records include few socio-demographic (place of residence, age of woman, gravidity, parity) and more of clinical variables (e.g. hemorrhage, obstructed labour, abortion, hypertensive disorder, infection, anemia, malaria etc). To estimate the net effect of these variables on the risk of maternal mortality, the logistic regression model was employed.

1. Unpublished figure provided by the Central Statistical authority, Addis Ababa, Ethiopia.

The outcome of interest in our model is whether a woman admitted in Adama hospital for maternal cause during the reference period died or survived. The log-odds of maternal death is expressed as a linear function of the predictor variables as follows: $\ln(P_i /1- P_i) = ß_0 + ß_1X_{i1} + ß_2X_{i2}+\ldots+ ß_kX_{ik}$, where, P_i is the chance of the i^{th} woman dying due to maternal cause, $1 – P_i$ is the chance of the i^{th} woman not dying due to maternal case. The quantity $(P_i /1- P_i)$ is the odds of the i^{th} woman dying due to maternal cause, and X_1, X_2, $X_{3...}$ represent predictor variables. The $ß_0, ß_1, ß_2, \ldots ß_k$ are unknown parameters to be estimated.

Results

Among the 16,279 women admitted for maternal causes in Adama hospital during the study period, Table 1 indicates that 16 percent were in their teens, while about 12 percent were 35 years and over. About four in ten of the women were of gravidity one, and a quarter had experienced at least four pregnancies. Apparently, due to miscarriages and stillbirths, the proportion nulliparous was very high (at least 45 percent), regardless of place of residence. On the contrary, compared with their gravidity status, the proportion of women who had experienced at least 4 live births, seems to be somewhat lower. Again suggesting the influence of pregnancy wastage earlier mentioned.

A little over a quarter (26 percent) of the women from outside Adama town. Proportionately, more of the women attending the hospital from outside Adama town, compared with their counterparts who live in Adama town were in the high risk groups, that is – the teens, those aged at least 35, and those of high gravidity and parity.

Table 1: Percent Distribution of Women Admitted in Adama Hospital for Maternal Causes by Age, Gravidity and Parity by Residence, 1993-2000

Variable	Residence		
	Adama Town (N=12,015)	Outside Adama Town (N= 4,264)	Total (N=16,279)
Age			
15-19	15.8	17.1	16.1
20-34	74.3	66.6	72.3
35+	9.9	16.3	11.6
Gravidity			
1	43.6	42.6	43.4
2-3	34.3	26.5	32. 2
4+	22.1	30.9	24.4
Parity			
0	46.1	44.9	45.8
1-3	40.7	32.6	38.6
4+	13.2	22.5	15.6

Source: Adama Hospital Records.

Levels and Trend of Maternal Mortality

Hospital-based records may underestimate or overestimate the actual level of maternal mortality in the general population, depending on the characteristics of women admitted and the quality of available records. However, the estimates may, at least provide a rough idea of the magnitude of the problem.

For the most recent one-year period, September 1999 to August 2000, maternal mortality ratio was 2,743 maternal deaths per 100,000 live births, which is too high even by African standards. It is 52 percent higher than the upper limit of 1,800 per 100,000 live births reported by Goliber (1997) for Eastern African countries, and three times as high as the national estimate for the same period (CSA and ORS Macro, 2001). However, over the period for which available records cover (1993-2000), maternal mortality ratio in the study hospital seemed to have declined by about 15 percent. This obviously resulted from two factors - the provision of improved maternal services in the hospital, and increasing use of maternal services in the hospital. The recruitment of a gynecologist and increasing the number of midwives to three in

the gynecology and obstetric department in 1996, meant that more deliveries and even cesarean section can be handled in the hospital.

Table 2: Estimates of Maternal Mortality Ratio in Adama Hospital for the Period Sept. 1993-Aug. 2000

Year	Number of live births *	Number of Maternal deaths	Maternal mortality ratio(per 100,000)
Sept.1993-Aug 1994	1,271	41	3,226
Sept.1994-Aug 1995	1,707	56	3,281
Sept.1995-Aug 1996	1,356	45	3,319
Sept 1996-Aug 1997	2,407	51	2,119
Sept.1997-Aug.1998	1,990	47	2,362
Sept.1998-Aug 1999	1,972	49	2,485
Sept.1999-Aug.2000	1,896	52	2,743

Source: Adama Hospital Records. *: There were 248 stillbirths whose mothers survived.

It is instructive to note that, maternal mortality ratio was lowest for 1996-1997 when the highest delivery was recorded in the hospital. The higher number of hospital deliveries from 1997, which translated to lower maternal mortality ratios compared with the case before 1997, suggests that the risk of maternal deaths can substantially be reduced, if the fundamental strategies of safe motherhood initiative (namely, antenatal and postnatal care, family planning services, clean delivery and essential obstetric care) are faithfully pursued.

Demographic Factors Affecting Maternal Mortality

The age of mother at delivery, her, gravidity and parity showed significant association ($p<0.01$) with maternal mortality in this study. Consistent with expectation is the elevated incidence of maternal death among women aged 35 and above and those who had experienced at least 4 pregnancies or child-births. This is true regardless of place of residence.

In general, the association of maternal mortality with age at maternity, gravidity and parity revealed large difference by place of residence. The risk of maternal mortality was between 8-16 times as high among women attending the hospital from outside Adama town as among their

counterparts who live in Adama town. Overall, 81 percent of all the women who died, were from outside Adama town, while only 19 percent were residents of Adama town.

Table 3: Maternal Mortality among Women Admitted for Maternal Causes in Adama Hospital by Some Demographic Variables, and Residence, 1993-2000

Variable	Percent of Women Who Died					
	Adama Town		Outside Adama Town		Total	
	N	%Dead	N	%Dead	N	%Dead
Age						
15-19	1,893	0.4	729	6.2	2,628	2.0
20-34	8,934	0.5	2,840	6.0	11,774	1.9
35+	1,188	1.0	695	8.5	1,883	3.8
Gravidity						
1	55,43	0.6	1,818	4.8	7,061	1.7
2-3	4,123	0.4	1,128	5.1	5,251	1.4
4+	2,649	0.8	1,318	9.9	3,967	3.8
Parity						
0	5,543	0.6	1,914	4.6	7,457	1.6
1-3	4,888	0.4	1,392	6.7	6,280	1.8
4+	1,584	0.9	958	9.8	2,542	4.2
Total	12,015	0.5	4,264	6.4	16,279	2.1

Source: Adama Hospital Records.

Effect of Pathogenic Factors on Maternal Mortality

Table 4 examines the association between specific direct and indirect pathogenic factors of maternal mortality. Among women who suffered from severe bleeding, 23.1 percent died. This fatality rate was glaringly twice (46.1percent) the average among women from outside Adama town. While lack of blood transfusion service in the hospital generally exacerbated the fatality rate of hemorrhage, delayed intervention due to distance, bad road and lack of transport, compounded the problem in the case of women from outside Adama town. This is evidenced by only 8.3 percent of women from Adama town that died of hemorrhage. Other major pathogenic killers of mothers observed in this study include anemia, infection, hypertension-related disorder, malaria and obstructed/prolonged labour, in that order. The least incidence of death was registered among women who experienced abortion (1.7 percent). The results also suggest that

the risk of maternal mortality associated with each of the pathogenic factors is between 4-10 times as high among women from outside Adama town as among their counterparts who live in Adama town. Overall, pathogenic factors account for almost all (98 percent) the maternal deaths.

Table 4: Distribution of Women and the Percent Who died by the Major Pathogenic Causes of Maternal Mortality by Place of Residence, 1993-2000

Pathogenic Causes	Percent of Women Who Died by Residence					
	Adama Town		Outside Adama Town		Total	
	N	%Dead	N	%Dead	N	%Dead
Direct Causes						
Hemorrhage						
Yes	315	8.3	204	46.1	519	23.1
No	11,700	0.3	4,060	4.5	15,760	1.4
Infection						
Yes	348	4.9	181	40.3	529	17.0
No	11,667	0.4	4,083	4.9	15,750	1.6
Hypertensive Disorder						
Yes	149	6.0	96	28.1	245	14.7
No	11,866	0.5	4,168	6.0	16,034	1.9
Obstructed/Prolonged Labour						
Yes	471	1.9	285	18.2	756	8.1
No	11,544	0.5	3,979	5.6	15,523	1.8
Unsafe Abortion						
Yes	2,299	0.5	792	5.1	3,091	1.7
No	9,716	0.6	3,472	6.8	13,188	2.2
Other Direct Causes						
Yes	311	1.6	141	10.6	452	4.4
No	11,704	0.5	4,123	6.3	15,827	2.0
Indrect Causes						
Malaria						
Yes	130	5.4	125	24.0	255	14.5
No	11,885	0.5	4,139	5.9	16,024	1.9
Anemia						
Yes	139	7.9	111	33.3	250	19.2
No	11,876	0.5	4,153	5.7	16,029	1.8

Source: Adama Hospital Records.

Multivariate Analysis

The risk of maternal mortality was estimated by constructing three separate logistic models. Model 1 considered only place of residence and the available demographic variables. Model 2 considered only pathogenic factors, while in model 3 all variables - place of residence, the demographic and pathogenic variables were examined. Thus, only model 3 represents a parsimonious construct in this analysis. The forward stepwise method was used in selecting significant variables for entry in each of the models in order to minimize the problem of multi-collinearity. Parity did not show a significant influence on maternal mortality in model 1, but turned out to be an important risk factor in model 3, in the presence of pathogenic factors. Therefore, the variable parity was entered in model I to provide a complete picture of its effect. The results are presented in Table 5.

Place of residence exhibited a strong correlation with the risk of maternal mortality. Women who were admitted in Adama hospital for maternal causes from outside Adama town were almost 12 times more likely to die than their counterparts who live in Adama town. Physical distance, bad roads and lack of transportation among other factors, which can delay arrival of a patient to the hospital to receive needed life-saving care, may have been responsible for the elevated risk of death.

The risk of maternal death showed a positive relationship with parity, especially in the presence of pathogenic factors. This is to be expected since increased exposure to childbearing would invariably increase the risk of hemorrhage, obstructed labour and infection – factors that elevate the risk of maternal deaths. Thus, women who had had

at least four live births experienced twice the risk of maternal death as their counterparts of parity 1-3. Conversely, nulliparous women had decreased but insignificant risk of maternal death compared with those with at most three children.

Pathogenic factors emerged as the dominant predictors of maternal mortality. Their effect became exacerbated when residence and demographic variables were controlled, except in the cases of malaria, anemia and obstructed labour. The result also indicates that abortion mitigates the risk of maternal death, decreasing it by 44 percent. This suggests that safe abortion and proper post-abortion care can reduce the risk of maternal death due to pregnancy and abortion complications.

Hemorrhage, infection and hypertensive disorder exerted the most deleterious effect on maternal survival. The adverse influence of parity and distance (proxied by place of residence) is evidenced by the increased odds of maternal mortality due to hemorrhage, infection and hypertensive disorder in model 3 compared with the associated odds in model 2. For instance, the odds of maternal deaths due to hemorrhage rose by 7 percent, while the odds due to infection and hypertensive disorder rose by 12 percent and 9 percent respectively. The exacerbated risk is expected, since in the event of hemorrhage or infection, delayed intervention due to the distance of health facility would undermine the survival chances of the patient. Also, the risk of maternal death from hypertensive disorders can be mitigated by careful monitoring during pregnancy and by treatment with appropriate drugs in cases of eclampsia. Such services may not be readily available to patients who live far away from a health institution, thus exposing them to higher risk of death.

Anemia and particularly malaria were the only factors whose influence on the risk of maternal mortality was mitigated when residence and demographic variables were controlled. The odds of dying due to anemia reduced by 9.7 percent while the odds associated with malaria reduced by 19 percent.

Table 5. Results of Logistic Models Predicting the risk of Maternal Mortality among Women Admitted for Maternal Causes in Adama Hospital, 1993- 2000

Variable	*Model 1*		*Model 2*		*Model 3*	
	SE(B)	*Exp.(B)*	*SE(B)*	*Exp.(B)*	*SE(B)*	*Exp(B)*
Gravidity						
1	*0.327*	1.593				
2-3(RC)		1.000				
4+	*0.197*	1.897				
Parity						
0	*0.325*	0.631			0.155	0.922***
1-3(RC)		1.000				1.000
4+	0.186	1.074			0.165	1.874***
Residence						
Within Adama(RC)		1.000				1.000
Outside Adama	0.139	11.677			0.157	11.737***
Hemorrhage						
No(RC)				1.000		1.000
Yes			0.151	25.066	0.165	26.807***
Infection						
No(RC				1.000		1.000
Yes)			0.183	23.613	0.192	25.847***
Hypertensive disorder						
No(RC)				1.000		1.000
Yes			0.227	12.573	0.236	14.069***
Obstructed /Prolonged.lbr+						
No(RC)				1.000		1.000
Yes			0.173	8.234	0.182	8.218***
Abortion						
No(RC)				1.000		1.000
Yes			0.196	0.529	0.205	0.557***
Malaria						
No(RC)				1.000		1.000
Yes			0.241	10.014	0.253	8.154***
Anemia						
No(RC)				1.000		1.000
Yes			0.220	3.510	0.239	3.168***
Constant	*0.143*	*-4.705*	*0.106*	*-5.079*	*0.243*	*-7.093*
Model chi-square		***491.3***		***1,018.9***		***1389.0***
Df		***6***		***7***		***10***
N		***16,279***		***16,279***		***16,279***

*** Significant at P<0.01 level, **, Significant at P<0.05, *Significant at P<0.1: +: lbr = Labour

The relative importance of the independent effect of each of the variables in predicting the risk of maternal mortality is examined in Table 6. Based on data in model 3, hemorrhage, place of residence and infection were the major predictors of maternal mortality among the study population. On the other hand, anemia, parity and abortion in that other, exerted the least deleterious influence on maternal survivorship.

Table 6: Relative contribution of each Factor in the logistic regression model predicting the risk of maternal mortality to the model chi-square: Adama Hospital, 1993-2000

Variable	Contribution of Factors in Model 3 to Model Chi-square	
	Absolute	%
Residence	409.8***	29.5
Parity	20.4***	1.5
Abortion	8.7***	0.6
Anemia	22.6***	1.6
Hemorrhage	425.0***	30.6
Hypertensive disorder	89.2***	6.4
Infection	225.8***	16.3
Malaria	82.0***	5.9
Obstructed labour	105.5***	7.6
Model chi-square	1389.0***	100.00
Df = 10		
N = 16279		

***: Significant at least at 0.01 level
Source: Compiled from the improvement chi-square statistics of the logistic regression model output.

Discussion

The adverse impact of early entry into, or late exit from childbearing, as well as prolific childbearing on the risk of maternal death is clearly evident in this study. Equally highlighted is the difference that easy access to health services makes in the reduction of the risk of maternal mortality. This is clearly demonstrated by the differential fatality rate by place of residence among women who experienced hemorrhage, infection and obstructed labour for instance. Only 8.3 , 4.9 and 1.9 percent of women from Adama town who experienced hemorrhage, infection or hypertensive disorder, respectively died. These contrast with 46.1, 40.3 and 18.2 percent, respectively of their counterparts from outside Adama town who died of similar causes. That 81

percent of all maternal deaths among the study population occurred to patients from outside Adama (mainly due to hemorrhage, infection, hypertension-related disorder, obstructed/prolonged labour and complications of abortion), is indicative of the increased danger that delayed life-saving intervention can cause. It can be argued of course, that some of the women from outside Adama town may have ignored the early signs of danger, only to be brought to the hospital when their condition had become critical. Thus, raising awareness of the need of women to reach the hospital for emergency care without delay if danger signs are noticed, as well as improving access (physical, economic and social) to health services would significantly mitigate the risk of maternal death in the study area. Provision of blood transfusion services in the hospital, as well as emergency obstetric intervention services are critical to reducing the risk of maternal mortality to a tolerable level.

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