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Levels, Differentials and Key Determinants of Under-five Mortality in Ghana

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Authors' contributions

This work was carried out in collaboration between both authors. Author AW designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Both authors managed the analyses of the study and managed the literature searches. Author BE read and approved the final manuscript.

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Abstract

Aims: The disparity in under-five mortality between rural and urban areas in Ghana and other sub-Saharan African countries is a critical national concern. The main purpose of this study is to identify and analyze the levels, differentials and key determinants of under-five mortality in Ghana based on selected socio-economic and demographic variables.
Study Design: This is an analytical cross-sectional study design of the 2008 Ghana Demographic and Health Survey (GDHS) dataset for children.
Methodology: Under-five Mortality rates were calculated based on some selected socio-economic and demographic variables, and segregated into infant and child mortality headings. Also, series of multivariate Cox regression models were fitted to these selected variables segregated into rural and urban headings.
Results: Overall, the likelihood of death among under-five children in the rural areas was significantly higher than that in the urban areas ($p<0.05$). Breastfeeding, twins and size of child at birth were key determinants of mortality in the rural areas, but the influence of region of residence was similar in both rural and urban areas. Infant mortality rate in 2008 was 58.489 per 1000.
Conclusion: Focus of child health strategies to achieving the MDG IV will be on the social and economic

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empowerment of women through education and employment. Also, breastfeeding promotion should be encouraged. Innovative and targeted strategies are required to address rural poverty and region-specific sociocultural factors in order to improve child survival in rural Ghana, especially twin births.

Keywords: Ghana; rural vs urban; under-five mortality.

1 Introduction

Under-five mortality in the world has been a subject of academic interest, political advocacy and speculation. This is because, child mortality rate (CMR) is considered to be one of the strongest indicators of a country's wellbeing, as it reflects social, economic and environmental conditions in which children (and others in the society) live, including their health care. Much of every country's resources is being devoted to reducing under-five mortality rates by two-thirds the 1990 value (122 deaths per 1000 live birth) by the year 2015 (MDG 4). Despite this efforts, under-five mortality rates (U5MR) continue to vary globally from place to place, region to region and from continent to continent. Countries in sub-Saharan Africa (SSA) have high rates and were ranked the top worst performers in reduction of child mortality. Only very few are making progress whiles the majority experiencing no change or a reversal in gains made some 10 or so years previously. Ghana was ranked forty-seventh (47th) in the world in terms of under-five mortality rate in 2002, with a rate of 100 deaths per 1000 live births (down from 126 per 1000 live births in 1990) and an infant mortality rate (IMR) of 57 per 1000 live births [1]. Studies have shown that child survival in the first 5 years of life is influenced by a myriad of risk factors. Becher et al., 2004 quantified the effect of the risk factors for childhood mortality in a typical rural setting of Burkina Faso by performing a survival analysis of births within a population from a demographic surveillance system in 39 villages. Child mortality that demonstrated gender-based disparities, [2] varied with socio-economic inequalities and was influenced by variation in coverage of interventions [3]. Findings on the effect of birth order were mixed, with some studies reporting that higher order births were associated with increased risk of under-five mortality [4] but others finding, no influence on child mortality [5]. Regarding to the sex of child, a study conducted in Malawi did not find a significant effect on child mortality [6]. However, a study in Nairobi slums showed that male children were significantly more likely to die than female children [7]. Contrary to this findings, a study conducted in India suggested that male children were less likely to die early than female children [8]. The effect of household socio-economic status on child mortality had also been examined by previous studies [9] but a national study conducted in Tanzania did not find a significant effect of household socio-economic status on infant and child mortality [10]. Evidence from studies conducted in developing countries suggest that poverty is an underlying factor in many cases of child deaths [9]. A study using the 2008 Nigeria Demographic and Health Survey found higher odds of child death among the poorest households compared with the richest households in rural Nigeria [11].

Regarding the association between socio-economic status and infant and child mortality, Caldwell [12] reported that mother's education has the effect of reducing child mortality. He defends that mother's education does this through changing feeding and care practices which leads to better health seeking behavior, hence changing the conventional familial relationships. To support this explanation, Hobcraft in 1993 [13] explained that education contributes to child survival due to the fact that educated women are more likely to enter motherhood late, have fewer children and immunize their children. However, according to Devlieger in 2005, [14] the effect of maternal education on child survival is weaker in sub-Saharan Africa. Counter intuitive results were also identified by Adetunji in 1995 [15] when he examined the 1986-1987 Ondo State DHS using birth history data from 2 635 women aged 15-49. The study revealed that infant mortality was higher among those born to mothers with secondary education compared to uneducated mothers. He suggested that lower maternal age at birth and less duration of breastfeeding which were associated with this group of women could be the possible reason for this finding.

Contrary to other studies, Mturi and Curtis in 1995 [10] identified lack of infant and child mortality differentials by such socio-economic factors as maternal education, partner's education, urban/rural

residence, and presence of radio in the household in Tanzania. However, demographic factors such as short birth interval (less than 2 years), teenage pregnancies (< 20 years) and previous child death were rather found to be all significantly associated with increased infant and child mortality. There was also lack of infant-child mortality differentials by economic status (wealth index), ethnicity and sex of the child. The higher rates of under-five mortality in Ghana, as compared to the world average rate of 57 deaths per 1000 live births in 2010 [16], coupled with the observed regional disparities and stagnation of under-five mortality [17,18], the lack of good understanding of newborn care practices and risk factors of child mortality at household level [19], the fact that statistics on the causes of child mortality are in great demand for developing and implementing public health interventions and that, most researches on child mortality in developing countries have been undertaken by clinically oriented medical practitioners who narrowly attribute the immediate causes of death among children to malnutrition and diseases all imply that, significant personnel must redirect their plans to evidence-based approaches which provide greater credibility to mortality control initiatives in their efforts to assuage under-five mortality. Based on these findings, this study will identify the socio-economic factors which have much effects on child mortality in rural and urban Ghana after adjusting for the many independent variables. This study will give better understanding of the association between selected factors and child mortality that could be credible and consistent with the available information.

2 Methodology

2.1 Study design and sampling

This is an analytical cross-sectional study through secondary data analysis of the 2008 Ghanaian Demographic and Health Survey (GDHS) dataset for children. The 2008 GDHS was a household-based survey, implemented in a representative probability sample of more than 12,000 households selected nationwide. The GDHS collects nationally representative data on women of child-bearing age (15-49 years) and their children. A nationally representative sample of 11,778 households was interviewed, and in half of the households, 4,916 women age 15–49 and 4,568 men age 15–59 were interviewed. This represents a response rate of 99% for households, 97% for women, and 96% for men. This sample was selected in such a manner as to allow for separate estimates of key indicators for each of the 10 regions in Ghana, as well as for urban and rural areas separately.

2.2 Model specification

This study use variables available in the GDHS 2008 dataset. The outcome variable is the hazard ratio (relative risk) of dying in a specific age range of childhood. The age ranges that is used in this paper is:

- Child mortality (4q1): the probability of dying between the exact age one and the fifth birthday. This included all deaths among children aged 0–59 months born to mothers in the study. The period of inclusion spanned the 5 years preceding the date of interview. The risk factors (independent variables) examined in the study were selected based on scientific literature.

2.3 Methods of data analysis

A three levels of analysis-bivariate, specific death rates and multivariate analyses were conducted. The differences in frequency of all-cause under-five mortality between rural and urban areas were assessed using bivariate (Pearson's $\chi 2$) analysis. The analysis involved the Cox proportional hazards regression [20] which was used to simultaneously investigate the effects of the demographic, socioeconomic and maternal factors on child mortality. In this regression model, risk factors were included based on the likelihood of an association with childhood mortality seen from a literature search and their level of statistical significance ($p<0.25$) from the bivariate analysis. A model was fitted for the overall sample and the relative effects were expressed as hazard ratios and the corresponding 95% confidence intervals. After fitting the model, the p-value was used to test the overall significance of the variables and the model.

2.4 Reason for the popularity of the model

The Cox Proportional Hazard model is preferred in analysis to other models because of the following reasons;

1. Robustness: Cox model is a safe choice of a model in many situations
2. The model is of the form: $logh(t) = log\lambda(t) + \beta 1Xi1 + \cdots + \beta kXik$
3. The estimated hazards are always non-negative and can be computed or estimated using a minimum of assumptions.
4. The Cox model is preferred to a logistic model, since the latter ignores survival times and censoring information.

2.5 Interpretation of the hazard ratio

A hazard ratio of 1.0 indicates that the variable has no impact on the outcome, that is, under-five mortality. A hazard ratio of less than 1.0 indicates that the variable decreases the likelihood of the outcome. A ratio exceeding 1.0 indicates that the variable increases the likelihood of the outcome. A ratio of 2.0 suggests that the variable doubles the likelihood of the outcome. A ratio of 0.5 suggests that it halves the risk of the outcome [20].

2.6 Ethical considerations

The study involved secondary analysis of data from the 2008-2009 GDHS which excluded participant identifiers.

3 Results and Discussion

3.1 Results

3.1.1 Bivariate analysis of risk factors for under-five mortality

The results of the bivariate analysis of risk factors for under-five mortality in rural and urban areas of Ghana are shown (Table 3.1 in Appendix A). Mortality among under-five children was more frequent in rural twins compared with twins born in the urban areas. Similarly, deaths among under-five children differed significantly with the size of child at birth in rural areas compared with urban areas ($P<0.001$). The proportion of under-five deaths that never breastfed were lower in rural areas than those for similar children in urban areas ($P<0.05$). Among the deaths in rural areas, the proportion in private health sector was lower than in this category of health facility in the urban areas. The association of age of mother and sex of child with under-five mortality were not significantly different in either residence location. High prevalence of under-five deaths was seen in the rural areas in the Greater Accra, Eastern, Brong-Ahafo and Northern regions, and in the urban areas of Western, Central, Upper East and West regions. Similarly, higher proportions of under-five deaths were also seen in the rural areas of Guan, Mande and Gruma ethnicity, and in the urban areas Mole-Dagbani and the Grussi ethnicity. Among the deaths in rural areas, the proportion in maternal education in the higher education was higher than in this category of education in the urban areas. The prevalence of under-five deaths was higher among the poorest households in the urban areas and the richest households in the rural areas. The association of mother's occupation with under-five mortality was significantly different with higher prevalence of under-five deaths among rural unemployed mothers than their counterparts in the urban area.

3.1.2 Levels and differentials

Out of 2992 single and multiple live births surveyed, there were 175 deaths before the first birth date giving IMR of 58.5 per 1000 live birth (Table 3.2 in Appendix A). In terms of levels, twin children's have the

highest level of IMR. Male children have higher level of IMR than female children who rather have a higher Post-natal mortality rate (PNMR). Again, Mande children have the highest IMR. Grussi children also have the highest level of PNMR while it is the least in the Ga/Dangme and the Mande ethnic groups. Upper west region also recorded the highest level of IMR while Central region has the highest level of PNMR. Whiles urban area shows a higher level of IMR, rural areas show a little level of higher PNMR than in urban areas. Uneducated mothers have the highest level of infant and child mortality than educated mothers Ghana. Highest level of infant and child mortality rates were found among mothers who are not working than those in the working categories in Ghana. Also, children born to Poorest households have the highest level of PNMR whiles middle households have highest level of IMR.

3.1.3 Multivariate analysis of risk factors for under-five mortality

The results of the multivariate analysis of risk factors for under-five mortality in Ghana are shown (Table 3.3a in Appendix A). Overall, child is twin and child size at birth were significant determinants of under-five mortality with the highest likelihood of mortality among children in the rural areas ($P<0.001$). This effect was seen in the overall sample as well as rural areas. The influence of breastfeeding on the likelihood of under-five mortality was not similar in rural and urban areas with children who ever breastfed having significantly lower probability of mortality than children never breastfed. In both rural and urban areas, place of delivery, maternal age and sex of child were not significant determinants of under-five mortality. Among the geographic region of Ghana, Central had significantly greater likelihood ($P<0.05$) of under-five mortality. When disaggregated by place of residence, this association was seen in the Eastern and the Upper West regions in the rural areas and in the Volta, Ashanti, Brong-Ahafo, Northern and the Upper East regions in the urban areas. Ethnicity, maternal education, wealth index and mother's occupation were not also seen as significant determinants of under-five mortality in the overall sample and when disaggregated in rural and urban headings. In the model using the overall sample, place of residence was not a significant determinant of under-five mortality as seen in the hazard ratio 1.04 for rural areas.

Taking the four significant factors without the categories, the results are shown in Table 3.3(b). The Wald estimate for the variable breastfeeding (19.940), twin (17.254) as compared to that of region (12.969) and size of child at birth (7.051).This show that breast feeding is more important in the model as the higher the Wald value, the more important it is. This can be supported by the p-values of the breastfeeding (P-value (0.000) <0.05 at 95% C I), twin (P-value (0.000) < 0.05 at 95% C I), region (p-value (0.000) <0.05) and that of size of the child at birth (P value (0.008)<0.05 at 95% C I).Therefore the independent variables that were significant for under-five mortality are breastfeeding, twin, region and size of the child. Inspecting the values of the SEs in Table 3.3(b) (Appendix A), ranging from 0.028-0.229 is within the acceptable criterion, that is, must be between 0.001-5.000(Chan, 2004) and this shows that multicollinearity does not exist among the independent variables. Hence, the model is statistically stable.

3.2 Discussion

This study identified the key proximate determinants of under-five mortality. A very wide variation in the level of infant mortality rate and child mortality rate between single and multiple births (singleton and twin) in Ghana. For instance, the infant mortality rate for twins, (2 or more), was almost the triple of that for singleton. This disparity, which has been observed in national surveys and other studies in Ghana and other Sub-saharan countries [21] has been ascribed to inequalities in location, socioeconomic factors, socio-cultural beliefs and practices and individual level risk factors in the population [11]. Concerning mortality differentials by sex, males had higher infant mortality rates as compared to females in the early stages of life. This is consistent with many studies that have reported similar findings including the decrease of the females' advantage while ascending in the child age [22]. Greater variations in the levels of infant and child mortality rates also exist between the different ethnic groups in Ghana. Infant mortality rate of Mande-Busanga was almost 4 times that of Ewe and Guan. This may be attributed to socio-economic inequalities between these ethnic groups. The results also showed that whiles some regions, such as Western and Eastern, recorded zero child mortality rates, other regions like the Central and the Brong-Ahafo had higher child mortality rates. Regarding child mortality rate, Upper West region had the highest compared with other

regions. Similar variability between regions has been reported elsewhere [23]. As stated earlier, this disparity observed in this study and many others in Ghana and sub-saharan countries are attributed to inequalities in location, socio-economic and cultural factors and beliefs and the individual level risk factors in the population. Furthermore, there was difference in the levels of infant and child mortality rates between higher educated mothers and the other categories. Whiles mothers with higher education had zero child mortality rate, the other categories, except secondary education, had rates exceeding 10 deaths per 1000. In terms of infant mortality, the other categories had rates which were triple its value, with those without education dominating. This due to the fact that education increases a mother's level of knowledge and skills, thus enabling her to effectively understand and utilize available information and resources critical for child health and survival [24].

The results showed consistent relationship between socio-economic status, measured by occupation and infant and child mortality. Whiles non-working mothers had the highest rates for both infant and child mortality; business people had higher infant mortality level than farmers. The results also showed inconsistent relationship between wealth index and infant and child mortality rates. While children born to poorest households had the highest child mortality, those born to middle households had the highest infant mortality. This finding is difficult to explain and need further examination about the data collection and the wealth index as a measure of socio-economic status.

The multivariate analysis showed that apart from birth status (twins or not), birth size, breastfeeding and region of residence, all other selected socio-economic factors (place of delivery, maternal age, sex of child, ethnicity, maternal education, wealth index, mother's occupation and place of residence) had no significant association with child mortality in both rural and urban levels. The results have implied very high p-value, thus, excluding even the presence of weak association. The association of under-five mortality with biological variables, namely, child is twin, birth size and breastfeeding, was not similar for both rural and urban children. The results highlight differences in risk factors for under-five mortality between rural and urban areas in Ghana. The effects of breastfeeding, child is twin and size of child at birth were significant only in rural areas regarding their impact on child deaths. A lower likelihood of under-five deaths associated with twins in urban areas compared with rural area. This is consistent with other studies and may suggest that levels of awareness of child health care are greater among urban women, especially the more educated mothers [21]. Due to lack of improved modern health facilities, high level of poverty in the rural areas couple with cultural beliefs and knowledge, rural women may not be mature enough to deal with the requirements of child mortality as determine by the variable child is twin.

The association of under-five mortality with the birth size of the child was only seen in rural areas and the overall sample. The effect brought the no significant difference between average and small birth sizes regarding their impact on child mortality in urban areas. Though this was not significant in urban areas, the hazard ratio is indicative of higher likelihood of survival among urban twins.

Apart from the other significant biological variables examined in this study, the duration of breastfeeding was also a significant determinant for under-five mortality. Numerous studies showed that children who never breastfed had greater risk of death compared with those who ever breastfed for some periods.

Of the demographic variables already examined in this study, only region of residence was a significant risk factor for under-five mortality. The high likelihood of under-five mortality in both rural and urban areas is seen in Central region of Ghana. The urban areas of all regions other than Greater Accra and Upper West had significantly higher under-five mortality compared with the corresponding rural areas. Factors that may underlie these observed outcomes include a higher proportion of the population are found in these areas.

The higher probability of dying in childhood period for males compared to females is consistent with many studies all over the world. Reports shows that biological reasons, males are more prone to die in the first months of life than females. Contrary, Mutunga in 2004 [25] used 2003 Kenyan Demographic Health Survey data to study the relationship between child mortality and some environmental factors and found that, there is no sex differentials in child mortality.

The absence of a relationship between maternal education attainment and mortality in both rural and urban areas of Ghana is surprising, given evidence in literature of lower child mortality rates being associated with higher maternal education [24]. However, in the urban areas, the hazards ratios were indicative of a lower risk of child mortality, although this was statistically significant.

However, adjusting for all explanatory factors in the multivariate analysis showed lack of socio-economic differentials for child mortality both in rural and urban areas. Also, the lack of association between mortality and other variables even for maternal education, had been seen in one study conducted in Tanzania in 1995. Mturi and Curtis [10] found that socio-economic factors like; maternal education, rural/urban residence and wealth index all no association with child mortality. This explained the reason why the Tanzanian government implemented a successful policies on developing the rural areas through provision of health, primary education and clean water supply. The significance association between region of residence and mortality could be attributed to the unequal levels of health infrastructural development in the country. Also, in Ghana and other sub-saharan countries, the effects of socio-economic inequalities between the different regions undermine the effect of maternal education.

4 Conclusion

This study identified key proximate determinants of child mortality in Ghana. Results from the fitted Cox regression models shown lack of significant association of child mortality and place of residence in Ghana. In both rural and urban areas, because of the assumed differences in the availability of health services, the survival of the child is determined by his/her mother's region of residence. The predictors of the survival probability are dominated by the demographic factor, region, in both urban and rural areas. In addition, breastfeeding, child is twin and size of child at birth, are the most important factors in rural areas. In order of priority to child mortality, breastfeeding and twin were ranked first followed by region and the least is the size of the child at birth. Once the child has survived the first months of life, region becomes the next most key determinant of mortality in both urban and rural settings. This is followed sequencely by breastfeeding status, twin, size of child, and the least significant ones are the mother's age and her highest level of education which though are insignificant but have p-values less than 0.10. Infant mortality rate was approximately 58 deaths per 1000 live births, which was higher than childhood mortality rate.

Competing Interests

Authors have declared that no competing interests exist.

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Appendix A

Table 3.1. Percentage distribution of under-five deaths by some of the selected explanatory factors disaggregated by urban /rural residency in Ghana (GDHS, 2008)

Variable	Overall			Rural			Urban			χ^2 test for rural vs urban
	Total live births	Total under-five deaths		Total live births	Under-five deaths		Total live births	Under-five deaths		
		N	%		N	%		N	%	
Total	2992	197	6.6	1992	131	6.6	1000	66	6.6	
Biological variables										
1. Child is twin										$\chi^2(1)=105.029$* P-value=.008
Singleton	2860	174	6.1	1916	115	6.0	944	59	6.3	
2 or more	132	23	17.4	76	16	21.1	56	7	12.5	
2. Birth size										$\chi^2(2)=109.011$* P-value=.006
Large	1617	88	5.4	1038	56	5.4	579	32	5.5	
Average	1202	57	4.7	833	41	4.9	369	16	4.3	
Small	154	52	33.8	108	34	31.5	46	18	39.1	
3. Breast feeding										$\chi^2(1)=115.661$* P-value=.007
Never breastfed	1798	177	9.8	1167	60	5.1	631	60	9.5	
Ever breastfed	1194	20	1.7	825	14	1.7	369	6	1.6	
4. Place of delivery										$\chi^2(2)=527.316^*$ P-value=.000
Home	1357	94	6.9	1192	84	7.1	165	10	6.1	
Public health sector	1388	85	6.1	708	43	6.1	680	42	6.2	
Private health sector	235	12	5.1	84	2	2.4	151	10	6.6	
Demographic variables										
1. Age of mother										$\chi^2(1)=1.011$ P-value=.576
$< 18\ years$	23	0	0	13	0	0	10	0	0	
$\geq 18\ years$	2934	192	6.5	1950	128	6.6	984	64	6.5	
2. Sex of child										$\chi^2(1)=0.006$ P-value=.957
Male	1526	105	6.9	1015	70	6.9	511	35	6.9	
Female	1466	92	6.3	977	61	6.2	489	31	6.3	
3. Region of residence										$\chi^2(9)=514.561$* P-value=.003
Western	270	9	3.3	176	4	2.3	94	5	5.3	
Central	227	19	8.4	164	11	6.7	63	8	12.7	
Greater Accra	279	15	5.4	35	4	11.4	244	11	4.5	
Volta	245	7	2.9	186	5	2.7	59	2	3.4	
Eastern	261	16	6.1	186	13	7.0	75	3	4.0	
Ashanti	439	27	6.2	248	14	5.7	191	13	6.8	
Brong-Ahafo	266	12	4.5	174	9	5.2	92	3	3.3	
Northern	479	47	9.8	373	40	10.7	106	7	6.6	
Upper East	227	10	4.4	195	7	3.6	32	3	9.4	
Upper west	299	35	11.7	255	24	9.4	44	11	25.0	
Ethnicity										$\chi^2(8)=178.782^*$ P-value=.007
Akan	1134	64	5.6	661	37	5.6	473	27	5.7	
Ga/Dangme	141	9	6.4	76	4	5.3	65	5	7.7	
Ewe	367	13	3.5	247	8	3.2	120	5	4.2	
Guan	81	5	6.2	61	5	8.2	20	0	0	

Variable	Overall			Rural			Urban			χ^2 test for rural vs urban
	Total live births	Total under-five deaths		Total live births	Under-five deaths		Total live births	Under-five deaths		
		N	%		N	%		N	%	
Mole-Dagbani	767	56	7.3	555	37	6.7	212	19	9.0	
Grussi	161	13	8.1	129	9	7.0	32	4	12.5	
Gruma	201	25	12.4	195	25	12.8	6	0	0	
Mande	24	4	16.7	10	2	20	14	2	14.3	
Others	114	8	7.0	56	4	7.1	58	4	6.9	
Socio-economic variables										
1. Maternal education										$\chi^2(3)=337.064^*$ p-value=.003
No education	1132	86	7.6	943	69	7.3	189	17	9.0	
Primary	722	53	7.3	493	31	6.3	229	22	9.6	
Secondary	1070	57	5.3	542	30	5.5	528	27	5.1	
Higher	65	1	1.5	11	1	9.1	54	0	0	
2. Wealth index										$\chi^2(4)=1432.26^*$ P-value=.000
Poorest	973	72	7.4	954	70	7.3	19	2	10.5	
Poorer	656	35	5.3	579	30	5.2	77	5	6.5	
Middle	504	38	7.5	275	18	6.6	229	20	8.7	
Richer	502	32	6.4	151	8	5.3	351	24	6.9	
Richest	357	20	5.6	33	5	15.2	324	15	4.6	
3. Mother's occupation										$\chi^2(3)=665.587^*$ P-value=.000
Not working	300	23	7.7	160	13	8.1	140	10	7.1	
Business	1028	71	6.9	451	31	6.9	577	40	6.9	
Farming	1190	80	6.7	1111	75	6.8	79	5	6.3	
Skilled/professional	460	22	4.8	261	11	4.2	199	11	5.5	
4. Type of place of residence										$\chi^2(1)=0.016$ P-value=.740
Rural	1992	131	6.6	-	-	-	-	-	-	
Urban	1000	66	6.6	-	-	-	-	-	-	

Table 3.2. Levels and differentials of Infant mortality rate by selected maternal socioeconomic background variables (GDHS, 2008)

No.	Variable	Category	Infant mortality rate (per 1000 live births)	Child mortality rate (per 1000 live births)	Under-five Mortality Rate (per 1000 live births)
1.	**Child is twin**	Singleton	53.497	**7.692**	**58.489**
		Two or more	**166.667**	7.576	7.687
2.	**Sex of child**	Male	**63.565**	5.898	**35.428**
		Female	53.206	**9.550**	30.749
3.	**Ethnicity**	Akan	52.910	4.409	**21.725**
		Ga/Dangme	63.830	0	3.008
		Ewe	32.698	2.725	4.345
		Guan	37.037	24.691	1.671
		Mole-Dagbani	65.189	7.823	18.717
		Grussi	43.478	**37.267**	4.345
		Gruma	114.428	9.950	8.356
		Mande	**166.667**	0	1.337
		Others	61.404	8.772	2.674
4.	**Region**	Western	37.037	0	3.342
		Central	66.079	**17.621**	6.350
		Greater Accra	50.179	3.584	5.013
		Volta	24.490	4.082	2.340
		Eastern	61.303	0	5.348

No.	Variable	Category	Infant mortality rate (per 1000 live births)	Child mortality rate (per 1000 live births)	Under-five Mortality Rate (per 1000 live births)
		Ashanti	59.226	2.278	9.024
		Brong-Ahaf0	30.075	15.038	4.011
		Northern	85.595	12.526	**15.709**
		Upper East	39.648	4.405	3.342
		Upper West	**100.334**	16.722	11.698
5.	**Place of residence**	Rural	57.731	**8.032**	**43.783**
		Urban	**60.000**	7.000	22.393
6.	**Mother's education**	No education	**64.488**	**11.484**	**28.743**
		Primary	62.327	11.080	17.714
		Secondary	52.336	1.869	19.385
		Higher	15.385	0	.334
7.	**Mother's occupation**	Not working	**66.667**	**10.000**	7.687
		Business	63.230	6.809	23.730
		Farming	58.824	8.404	**26.738**
		Skilled/professional	41.304	6.522	7.353
8.	**Wealth index**	Poorest	63.721	**10.278**	**24.064**
		Poorer	45.732	7.622	11.698
		Middle	**65.476**	9.921	12.701
		Richer	59.761	3.984	10.695
		Richest	56.022	2.801	7.019
Total			**58.489**	7.687	66.176

Table 3.3(a). Hazard ratio estimates for determinants of under-five mortality in rural and urban Ghana

Determinant	Overall		Rural		Urban	
	HR	95% CI	HR	95% CI	HR	95% CI
Biological variables						
1. Child is twin (ref: Singleton)						
2 or more	0.39**	0.25-0.63	0.333**	0.19-0.59	0.622	0.26-1.52
2. Birth size(ref: Large)						
Average	0.44**	0.27-0.74	0.389**	0.21-0.72	0.474	0.17-1.30
Small	0.58**	0.35-0.97	0.525*	0.29-0.97	0.537	0.20-1.48
Breastfeeding(ref: Never breastfed)						
Ever breastfed	1.99**	1.44-2.76	2.246**	1.49-3.39	1.596	0.92-2.78
Place of delivery(ref: Home)						
Public health sector	0.94	0.49-1.80	2.26	0.53-9.66	0.66	0.26-1.66
Private health sector	0.91	0.50-1.67	2.072	0.49-8.84	0.64	0.31-1.31
Demographic variables						
1. Age of mother (Ref: $< 18\ years$)						
$\geq 18\ years$	0	0	0	0	0	0
2. Sex of child(ref: Male)						
Female	1.12	0.84-1.50	1.132	0.79-1.62	1.134	0.68-1.90
3. Region of residence(ref: Western)						
Central	0.26**	0.11-0.62	0.23*	0.06-0.82	0.288*	0.08-1.05
Greater Accra	0.49	0.21-1.14	0.468	0.15-1.43	1.92	0.16-2.33
Volta	0.35*	0.14-0.85	0.867	0.18-4.14	0.198**	0.06-0.69
Eastern	0.23**	0.08-0.65	0.303	0.09-1.08	0.168	0.02-1.21
Ashanti	0.41*	0.18-0.94	0.713	0.25-2.05	0.166*	0.04-0.78
Brong-Ahafo	0.37**	0.18-0.77	0.434	0.16-1.16	0.287*	0.09-0.91
Northern	0.30**	0.14-0.67	0.456	0.18-1.16	0.157**	0.04-0.69
Upper East	0.56	0.31-0.99	0.750	0.32-1.54	0.142**	0.04-0.50
Upper west	0.35**	0.17-0.74	0.348*	0.14-0.85	0.288	0.06-1.39
4. Ethnicity(ref: Akan)						
Ga/Dangme	1.11	0.49-2.52	0.828	0.26-2.61	1.062	0.29-3.84
Ewe	1.36	0.49-3.79	0.654	0.15-2.94	2.33	0.50-10.8

Determinant	Overall		Rural		Urban	
	HR	**95% CI**	**HR**	**95% CI**	**HR**	**95% CI**
Biological variables						
Guan	0.88	0.33-2.35	0.546	0.15-2.07	1.03	0.20-5.17
Mole-Dagbani	1.22	0.38-3.87	1.326	0.34-5.12	0	0
Grussi	0.96	0.44-2.13	0.818	0.27-2.48	1.103	0.30-4.01
Gruma	1.03	0.39-2.73	0.823	0.22-3.10	1.68	0.35-7.98
Mande	1.85	0.75-4.61	1.264	0.42-3.85	0	0
Others	3.06	0.80-12.05	3.95	0.67-23.4	1.247	0.12-12.6
Socio-economic variables						
1. Maternal education(ref: No education)						
Primary	4.36	0.57-33.10	0.781	0.09-7.12	0	0
Secondary	5.30	0.71-39.78	0.935	0.10-8.62	0	0
Higher	4.09	0.55-30.31	0.84	0.09-7.71	0	0
Wealth index(ref: poorest)						
Poorer	0.87	0.39-1.93	0.395	0.11-1.39	2.948	0.50-17.3
Middle	0.79	0.38-1.65	0.384	0.11-1.31	1.124	0.35-3.62
Richer	1.01	0.53-1.92	0.454	0.13-1.58	1.595	0.73-3.48
Richest	0.96	0.53-1.77	0.450	0.12-1.67	1.47	0.57-2.32
2. Mother's occupation(ref: Not working)						
Business	1.40	0.76-2.57	1.242	0.55-2.82	1.27	0.50-3.27
Farming	1.40	0.85-2.30	1.358	0.68-2.73	1.13	0.55-2.33
Skilled/professional	1.24	0.73-2.10	1.332	0.68-5.6	1.027	0.32-3.33
Type of place of residence(ref: urban)						
Rural	1.04	0.66-1.65				

*HR, Hazard ratios; NR, no rural population. †HR computed using Spss, *p<0.05; **p<0.01*

Table 3.3(b). Summary results for significant risk factors of under-five mortality (Overall)

Predictor	B	SE	Wald	Df	Sig.	Exp(B)	95.0% CI for Exp(B)	
							Lower	**Upper**
Region	.099	.028	12.969	1	.000	1.104	1.046	1.166
Twin	.950	.229	17.254	1	.000	2.586	1.652	4.049
Breastfeeding	-.733	.164	19.940	1	.000	.480	.348	.663
Size	.303	.114	7.051	1	.008	1.354	1.083	1.693

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