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# Effect of maternal migration on under-five mortality in the Navrongo HDSS area

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## Abstract

**Introduction** Mortality under five years is an important indicator and a significant index for assessing the health and general wellbeing of a country. Even though global efforts to reduce under-five mortality have yielded some positive results, the rates are still high in most low- and middle-income countries. There is general consensus that migration and its associated remittances alleviate poverty at the rural places of origin. This tends to improve household living standards and leads to improvement in child health and survival. This paper seeks to investigate the impact of maternal migration on under-five mortality in two districts in the Upper East Region of Ghana.

**Methods** This study used data from the Health and Demographic Surveillance System (HDSS) of the Navrongo Health Research Centre (NHRC) in Ghana. All children (20,990) born in the study area between 2000 and 2014 were included in the analysis. The outcome variable in the analysis was the survival status of the children (dead or alive). The main independent variable is migration status of the mothers (migrants and non-migrants). The Proportional Hazard Model, with a Weibull distribution, was used to examine the effect of the independent variables on the survival outcomes of the children.

**Results** The results showed that children of migrant (in-migrant or return migrant) mothers are 49% less likely to die compared with children of non-migrant mothers [ $aOR = 0.513$ ;  $CI = 0.451-0.585$ ]. In terms of migration duration before return, survival benefit was highest for children whose mothers had been away for one year and more. Other factors that were associated with increased risk of under-five mortality include children of mothers without education, children of mothers age 15–19 years, children born outside health facility, first order births, multiple births and children without grandmothers in their households.

**Conclusion** The study has established that maternal migration, irrespective duration, contribute to child survival. Specifically, children of migrant mothers have a better survival chance than children of non-migrant mothers. To improve child survival in these poor rural settings, we recommend the promotion of conducive migration opportunities to enable women to earn some income to support their households in terms of childcare and survival.

**Keywords** Maternal migration, Under-five mortality, Navrongo, Ghana, HDSS

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## Introduction

Mortality under age five years is an important indicator and a significant index for assessing the health and general wellbeing of a country worldwide [1]. In view of this, the United Nations in its SDG Agenda, has recommended that nations reduce under-five mortality to 25 deaths per 1,000 live births by 2030 [2]. Even though global efforts to achieve this feat have yielded some



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positive results, the rates are still high in most low- and middle-income countries compared to the developed nations. For instance, under-five mortality has declined from 93 deaths per 1,000 live births in 1990 to 39 deaths per 1,000 live births in 2021, a reduction of about 58.0% within the period [3]. While the global under-five mortality rate declined to 37 deaths per 1,000 live births, the rate for Africa stood at 74 per 1,000 [3]. Apart from the regional differences in the mortality rates, there are also substantial inequalities among countries and within population subgroups [4]. Among the factors that contribute to differentials in under-five mortality is household wealth and maternal education [4–6].

It has also been established that migration is an avenue for improving household wealth. There is also general consensus that migration and its associated remittances alleviate poverty at the rural places of origin and improve household living standards [7]. Studies have also shown that migration reduces income inequality and leads to general improvement in household wealth both at place of destination and origin [6–9]. Specifically, there are studies that have revealed that migrant households have a higher socio-economic status than non-migrant households [10–13]. Therefore, given that literature has demonstrated how household wealth and maternal education impact under-five mortality [5, 6, 14], it is hypothesized that children of women who have ever migrated and returned (in-migrants or return migrants) will have lower mortality than children of mothers who have always stayed at the place of origin (non-migrants).

Opportunities exist to substantially address the problems of high mortality rates, but these are contingent upon the identification, understanding, and adoption of appropriate measures to address key social, economic, and cultural factors that affect child mortality. However, few studies have assessed the socioeconomic benefits of female migration, with particular reference to child survival [15–19]. This paper, therefore seeks to use longitudinal data spanning 15 years to investigate the impact of maternal migration on under-five mortality in two districts: Kassena-Nankana Municipality (KNM) and Kassena-Nankana West (KNW) District in the Upper East Region of Ghana. This will contribute to our understanding of the complex relationship between female migration and child survival in deprived rural areas of Ghana. In other words, we explore how female migration impacts child survival in the study districts in northern Ghana.

## Methods

### Study setting

Data for the analysis were extracted from the Navrongo Health and Demographic Surveillance System (HDSS) database, which contains routine demographic data

from the Kassena-Nankana Municipality (KNM) and the Kassena-Nankana West (KNW) District in the Upper East Region of Ghana. These two districts together cover 1,675 km<sup>2</sup> along the Ghana–Burkina Faso border to the north. The ecology is typically Sahelian (hot and dry) in the Guinea Savannah Belt. At the end of December 2018, the population was 166,993, out of which 52.3% were females. The study area had about 32,000 households in the study area, with an average household size of 4.7. About 12% of the population is less than five years of age. Total fertility is 3.5, with 36% of the married population being polygynous. In terms of the economy, subsistence agriculture is the mainstay of the people, which is complemented by some retail trading.

In terms of access to healthcare, the study area has two hospitals, with one located in each of the two district capitals. There are also fourteen health centres located in some of the communities. There is also a health centre that is managed by the Catholic Mission, which has an orphanage that takes care of children who have lost a parent or two. The Mission also rescues children who are alleged to be spirits and are sometimes killed [20]. The study area has 50 functioning Community Health Planning and Service (CHPS) compounds. These health facilities are complemented by community-based health officers (CHOs) who do periodic visits to houses to deliver door-to-door services in most parts of the study area. In terms of illnesses, the main causes of morbidity and mortality that have persisted over the years include malaria, gastro-enteritis (diarrhea), and acute respiratory infections [21]. Located in the meningitis belt, there are also periodic outbreaks of cerebrospinal meningitis (CSM) that cause widespread morbidities and deaths [22, 23]. As a result, there are annual and periodic vaccinations for people against the disease [24, 25].

Even though under-five mortality rate has been declining in the study area, the rate is still high. For instance, the rate decline from a high of 174 to 32 deaths per 1000 live births between 2000 and 2014, the period of this analysis [26]. Even though the rate is lower than the national average and exceeds the MDG target, it is higher than the SDG target of 25 deaths per 1000 live births [2]. Embedded in the under-five mortality are the neonatal and infant mortalities. Therefore, understanding factors associated with under-five mortality will encompass those of neonatal and infant mortality, albeit some little variations. The choice of under-five mortality is also premised on the fact that it provides us with a broader understanding of the challenges associated with the overall health system. Under-five mortality rate is often used as proxy indicator of the general level of social and economic development. Therefore, determination of the factors associated with under-five mortality and applying

context-specific interventions will go a long way to reduce under-five mortality, which will include neonatal and infant mortality rates.

### Data source

Data for this study was extracted from the Health and Demographic Surveillance System (HDSS) of the Navrongo Health Research Centre (NHRC) in the Upper East Region of Ghana. The HDSS was set up in 1992 with the main objective of monitoring the demographic dynamics of the study area to provide the requisite platform to facilitate research activities of the NHRC [5]. The operations of the HDSS involve trained fieldworkers making periodic visits to houses and households to collect and update information on their demographic and socio-economic characteristics. Data that are collected routinely include pregnancies and their outcomes (live births, stillbirths, miscarriages, and abortions), marriages, religion, deaths, in- and out-migrations, childhood vaccination, and verbal autopsies (VA) on all deaths. Annually, information is collected on educational status and national health insurance enrolment. Household socio-economic information is updated every other year, and information collected includes the type of dwelling facility, household assets, among others.

During the routine visits, respondents, who are usually household heads, provide information on the presence or absence of a household member. In cases where an individual is reported to have died, an indication of death is made against that individual's name in the register and a death form is completed, providing detailed information such as date and place of death, among others. On the other hand, if the individual is reported to have migrated and has been away for at least 90 days, an indication of migration is made in the register against the individual's name, and an out-migration form is filled, providing detailed information such as date of migration, place of destination and reason for migration, among others. An individual who is reported to have been away for less than 90 days at the time of a visit is considered a temporary migrant.

In terms of in-migration, which is the main event for this analysis, it happens when an individual moves into the study area and stays for at least 90 days. An in-migrant is identified during a fieldworker's routine visit to a household when it is reported that a previously non-resident person has moved into the household and has stayed for 90 days or more. The name and some bio-information of the individual are written in the register, and an in-migration form is filled out, providing detailed information such as date of migration, reason for migration, and place of origin. There are also return migrants who were previously in the study area and had been

registered into the HDSS but moved out of the study area for a period before returning. The main independent variable of this study is the migration status of the women. This variable is categorized into two. One category is those known as migrants and comprise of women who moved, for the first time, into the study area from elsewhere and have stayed for at least 90 days (in-migrants). Another group of migrants, known as returned migrants, are those who were previously resident members of the area, but moved for at least 90 days and have returned to the community. The in-migrants and the returned migrants are simply referred to as migrants. The non-migrants are those women who have been in community since the inception of the HDSS without moving out of the study area. These two groups of women [Migrants (in-migrants/return migrants) and non-migrants] are the main subjects of this analysis. Information that are collected on all deaths during the periodic visits to households provides mortality information, including under-five mortality, which is the outcome variable for this analysis. In effect, migrant mothers are thus compared with their non-migrant counterparts with respect to under-five mortality in the study area, controlling for the effect of other confounding factors.

### Analytical method

The analysis started with background characteristics of the respondents as well as a bivariate analysis, where Chi<sup>2</sup> test was used to determine the association between the outcome variable and the independent variables. The proportional hazard (survival analysis) technique was used to address the objective of this study. Survival and hazard functions are the major concepts in event history or survival analysis, as they describe the probability of survival up to a certain time and is denoted as  $S(t) = \Pr(T > t)$ , where  $S(t)$  is survival up to time  $t$ ,  $\Pr$  is the probability and  $T$  is the time of death. Several techniques or models abound for the analysis of the relationship between a set of predictors and survival time. For this study, the Cox proportional hazard model [27] was initially used to assess the relationship between under-five mortality and the main independent variables as well as each of the covariates. However, the proportionality assumption was violated and so the Cox model could not be used. As a result, other survival analytical models had to be considered. The Weibull distribution Model [28] was found to have the best fit for this dataset compared with the Exponential and Gompertz models, which are also good for modeling survival data. Table 1 shows the test results for model selection, using the AIC and BIC test. The results show lowest values of AIC and BIC for the Weibull Model compared to the Exponential

**Table 1** Table of AIC and BIC values for model selection

Model	Obs	11 (null)	11 (model)	Df	AIC	BIC
Gompertz	21,199	-11,199.3	-11,027.50	23	22,101.08	22,284.20
Exponential	21,199	-12,265.3	-12,124.90	22	24,293.82	24,468.98
Weibull	21,199	-10,123.8	-9,964.12	23	19,974.25	20,157.37

and Gompertz Models, justifying the use of the Weibull Model for the analysis.

**Source: generated from the AIC and BIC tests**

For the regression analysis, each variable was regressed on the outcome variable to ascertain the gross effect of each of the independent variables on the dependent variable. This yielded the unadjusted association under Model 1 of Table 4. On the other hand, the adjusted model was fitted when all the independent variables were regressed on the outcome variable, where the other variables serve as controls, to ascertain the net effect of each of the independent variables on the dependent variable, as shown in Model 2 of Table 4.

The theoretical model employed for this analysis is the Grossman Health Production Function [29]. According to the model, the health status of a child at any point in time (i) is denoted as;

$$H_i = h(M_i, T_i, K_i, B_i, \pi_i), \text{ where.}$$

$H_i$  is the health status of child  $i$ ,

$M_i$  is the medical and nutritional inputs of child.

$T_i$  is the time spent on child by parents.

$K_i$  is the maternal health knowledge on child care.

$B_i$  is the biological endowment of child.

$\pi_i$  is the random health shocks such as disease outbreaks, strikes, natural disasters, among others.

According to the model, parents invest in their children for future benefits, for which the health and survival of the child is an important component of this investment. However, resources are needed to meet the investment (M, T & B in the model) required to achieve the optimum child health outcome. One important means by which households acquire these resources is by migration [30]. This is particularly important in rural poor settings where poverty is pervasive with limited economic opportunities.

**Results**

**Respondents background characteristics**

In all, a total of 20,990 women were used for the analysis. In terms of migration status, as high as 90% of the women had ever migrated, while 10% had never migrated outside the study area. For duration of

migration, about 19.0% of the women migrated and stayed for less than six months before returning to the study area. Those who moved out for 6–11 months constitute 14%, while those who returned after being away for at least a year were about 57% (Table 2). Of the total number of 20,990 women studied, 8.8% lost at least a child who was less than five years.

The highest proportion of 23.8% of the women gave birth to their children while within age 25–29 years. The smallest proportion of the study participants was in the age group 45+ years, who constituted only 3.0%. About 11.0% of the births occurred among women within the age group 15–19 years. Also, it is observed that more than half (57.1%) of the women in this analysis have never attended school. About 25.5% of them have education up to primary school, while 11.8% have junior or middle school education. Only 5.6% of the women have attained education at secondary school level and beyond.

In terms of household socio-economic status (SES), about 22.0% of the women were found in the poorest households, while those from the poorer households represented 19.0% of the total study participants, with 30.6% of them living in poor households. Only about 11.0% of the women were in the less poor households while those in the least poor (“richest”) households constituted 17.0% of the study population.

The distribution of women by place of birth of their children shows that 45.6% of the women delivered their children in a health facility, with almost 28% delivering at their respective homes. About 26.5% of them delivered at other places other than a health facility or their own homes. These other places of delivery include traditional healers’ homes, traditional birth attendants (TBA) homes, marketplaces, and on the way to certain destinations.

About 23.4% of the children of the women are first-order births, while second to fourth-order births constitute 37.8%. Children of birth order of five and higher form 38.8% (Table 2). Among the study population, about 2.2% of them had their children born as multiple births (2 or more babies from a single pregnancy). Also, about 44% of women had mothers-in-law (grandmothers to their children) in their respective households.

**Table 2** Background characteristics of the study population

Variable	Number	Percent	Variable	Number	Percent
<b>Migration status</b>	2,108	10.0	<i>Presence of Mother-in-law</i>	11,725	55.9
Non-migrants	18,882	90.0	No	9,265	44.1
Migrants			Yes		
<i>Mothers migration Duration</i>	2,108	10.0	<i>Maternal Education</i>	11,975	57.1
Non-migrants	3,973	18.9	No education	5,342	25.5
Less than 6 months	2,937	14.0	Primary	2,487	11.8
Between 6-11 months	11,972	57.1	JHS/Middle	1,186	5.6
At least 12 months			SHS+		
<i>Child Survival</i>	19,136	91.2	<i>Multiple births</i>	20,528	97.8
Alive	1,854	8.8	No	462	2.2
Dead			Yes		
<i>Household SES</i>	4,665	22.2	<i>Mother's Age at birth</i>	2,247	10.7
Poorest	3,993	19.0	15-19	4,730	22.5
Poorer	6,415	30.6	20-24	4,995	23.8
Poor	2,354	11.2	25-29	4,021	19.2
Less poor	3,563	17.0	30-34	2,802	13.4
Least poor			35-39	1,562	7.4
			40-44	633	3.0
			45+		
<i>Place of birth</i>	9,575	45.6	<i>Birth order</i>	4,902	23.4
Health facility	5,850	27.9	1	7,936	37.8
Own Home	5,565	26.5	2-4	8,152	38.8
Other			5+		

### Bivariate analysis

The results of the bivariate analysis of the dependent variable with each of the independent variables, using the chi-square technique are presented in Table 3. From the results, it is observed that a high proportion of 19.4% of the non-migrant women lost a child under-five, compared with 7.7% among all the migrant women in the study. When broken down by duration of migration, not much disparity is seen. However, migrant mothers who had the longest duration of migration of at least 12 months recorded the lowest proportion of 7.3% of under-five deaths in comparison with those with migration duration of less than six months (8.2%) and those with 6–11 months duration (8.3%). The results show a statistically significant relationship between migration status/duration and under-five mortality.

### Source: generated from the HDSS database

There is also a statistically significant association between household SES and under-five deaths, with children of mothers in households of higher SES being associated with lower proportions of deaths compared to others with lower SES. For instance, 10.4% of children of women from the poorest households died before the age of five years, while women in the poorer households had about 9.4% of their children dying before reaching age five. Again, 8.7% and 8.5% of children of women in poor and less poor households, respectively, died before

celebrating their fifth birthday while the lowest proportion (6.6%) of under-five deaths was associated with women in the least poor (richest) households.

The results further indicate that maternal education is inversely associated with under-five deaths as the proportion of deaths decreases with higher education. This ranges from 11% of children whose mothers had no education as the highest, to 4.3% of children whose mothers had SHS and above. Nonetheless, the proportion of deaths of children among women with primary school education (6.1%) is about the same as those with JHS/Middle school education (6.2%).

The bivariate results also revealed a statistically significant association between under-five mortality and mothers' age at birth of child. The expected U-shape pattern also emerged from this association as children of younger and older mothers experienced higher under-five deaths compared with children of mothers in the middle child-bearing ages. For instance, 9.6% of children whose mothers were aged 15–19 years died, while 8.3% of children of mothers who were 20–24 years died before reaching age five years. The lowest proportion (6.7%) of under-five deaths was associated with children whose mothers were 25–29 years old. The proportions increased thereafter to almost 13% for children whose mothers were 44–49 years old at the time of birth.

The place where a woman delivers a baby is an important determinant of child survival. This was found to be significantly associated with under-five mortality. As

**Table 3** Association between child survival and predictor variables

Variable	Alive		Dead		P-value
	n	%	n	%	
<i>Migration status</i>	1,699	80.6	409	19.4	<0.001
Non-migrants	17,428	92.3	1,454	7.7	
Migrants					
<i>Migration Duration</i>	1,699	80.6	409	19.4	<0.001
Non-migrants	3,649	91.8	324	8.2	
Less than 6 months	2,692	91.7	245	8.3	
Between 6-11 months	11,096	92.7	876	7.3	
At least 12 months					
<i>Household SES</i>	4,180	89.6	485	10.4	<0.001
Poorest	3,618	90.6	375	9.4	
Poorer	5,859	91.3	556	8.7	
Poor	2,153	91.5	201	8.5	
Less poor	3,326	93.4	237	6.6	
Least poor					
<i>Maternal Education</i>	10,653	89.0	1,322	11.0	<0.001
No education	5,016	93.9	326	6.1	
Primary	2,332	93.8	155	6.2	
JHS/Middle SHS+	1,135	95.7	51	4.3	
<i>Mother's Age</i>	2,032	90.4	215	9.6	<0.001
15-19	4,339	91.7	391	8.3	
20-24	4,659	93.3	336	6.7	
25-29	3,684	91.6	337	8.4	
30-34	2,503	89.3	299	10.7	
35-39	1,368	87.6	194	12.4	
40-44	551	87.1	82	12.9	
45+					
<i>Place of birth</i>	9,043	94.4	532	5.6	<0.001
Health facility	5,309	90.8	541	9.2	
Own Home	4,784	86.0	781	14.0	
Other					
<i>Birth order</i>	4,483	91.5	419	8.5	<0.001
1	7,370	92.9	566	7.1	
2-4	7,283	89.3	869	10.7	
5+					
<i>Multiple births</i>	18,727	91.2	1,801	8.8	<0.001
No	409	88.5	53	11.5	
Yes					
<i>Mother-in-law presence</i>	10,507	89.6	1,218	10.4	<0.001
No	8,629	93.1	636	6.9	
Yes					

expected, mothers who delivered their children at health facilities had 5.6% of their children dying before attaining the age of five years, while those who delivered their children at their own homes had 9.2% of their children dying before age five. Those women who delivered their children elsewhere apart from the health facility or their own homes recorded the highest proportion (14.0%) of their children dying before celebrating their fifth birthday.

In terms of birth order of child, first-order births were associated with 8.5% of deaths before age five compared to 7.1% for children of birth order 2–4 while children of birth order five or higher recorded the highest proportion

of deaths (10.7%). These results exhibit a U-shape relationship between birth order and child deaths, which is consistent with findings from other studies [31–33].

Deaths of children associated with multiple births also showed a higher proportion of under-five deaths (11.5%) when compared with singleton births (8.8%). Also, children with grandmothers in their households had a lower proportion (6.9%) of deaths compared with 10.4% for children without grandmothers. This results conforms with the grandmother hypothesis, where children tend to benefit from the presence of older women in the household [34, 35], as shown in Table 3.

### Multivariate regression results

Table 4 shows the multivariate results, where two models were run; the first model (Model 1) considered the gross effect of maternal migration on under-five mortality. The second model (Model 2) examined the above relationship but adjusted for the moderating effects of household and other socioeconomic variables that included household SES, place of delivery of child, mother's education, and presence or absence of grandmother.

From the results, migration status and their durations are significant predictors of under-five mortality. As shown in Table 4, children whose mothers had ever migrated, irrespective of duration, are 53% less likely to die before age five compared with children whose mothers have never migrated (Model 1). When the model is controlled with confounding variables, the survival benefits still prevail, where children of migrant mothers are 49% less likely to die before age five compared with their counterparts whose mothers have never migrated (Model 2).

With respect to duration of migration, children of mothers with the longest migration duration of 12 months or more were about 54% less likely to die before age five compared with children whose mothers never migrated. However, when other variables are introduced into the model, children of these migrants (12+ months) were 45% less likely to die before age five, compared with children of non-migrant mothers. On the other hand, after controlling for other confounding variables, children of women with a migration duration of between six and 11 months were about 40% less likely to die before age five compared with children of non-migrant mothers. Similarly, children of mothers with a migration duration of less than six months were about 43% less likely to die before age five compared with children of non-migrant mothers, as shown in Model 2.

In terms of household SES, the results show that household SES is associated with under-five mortality, as established at the bivariate stage. However, after adjusting for the effects of confounding variables, only children

**Table 4** Results of the Regression Analysis on the association between child survival and predictor variables

Variable	Model 1-Unadjusted		Model 2-Adjusted for all variables.	
	Hazard Ratio	[95% CI]	Hazard Ratio	[95% CI]
<b>Migration status</b>	-	-	-	-
Non-migrants	0.473**	0.423-0.528	0.513**	0.451-0.585
Migrants				
<b>Migration duration</b>	-	-	-	-
Non-migrants (RC)	0.489**	0.422-0.565	0.572**	0.488-0.671
<6 months	0.515**	0.440-0.604	0.598**	0.504-0.710
6-11 months	0.457**	0.407-0.515	0.545**	0.474-0.626
12+ months				
<b>Household SES</b>	-	-	-	-
Poorest (RC)	0.909	0.795-1.041	0.936	0.818-1.072
Poorer	0.846*	0.749-0.956	0.919	0.813-1.038
Poor	0.832*	0.706-0.981	0.941	0.798-1.110
Less poor	0.661**	0.566-0.772	0.846*	0.721-0.992
Least poor				
<b>Mother education</b>			-	-
No education (RC)			0.605**	0.533-0.687
Primary			0.662**	0.557-0.787
JHS/Middle			0.553**	0.413-0.741
SHS+				
<b>Place of birth</b>			-	-
Health facility (RC)			1.516**	1.338-1.717
Own Home			2.129**	1.869-2.426
Other				
<b>Mothers Age</b>			-	-
15-19 (RC)			0.893	0.747-1.068
20-24			0.694**	0.564-0.855
25-29			0.675**	0.536-0.850
30-34			0.680**	0.530-0.872
35-39			0.624**	0.477-0.818
40-44			0.614**	0.447-0.843
45+				
<b>Birth order</b>			-	-
1 (RC)			0.741**	0.635-0.865
2-4			0.687**	0.562-0.838
5+				
<b>Multiple births</b>			-	-
No (RC)			1.719**	1.305-2.265
Yes				
<b>Grandmother presence</b>			-	-
No (RC)			0.876*	0.784-0.978
Yes				

Generated from regression output

RC Reference Category

\*p-value≤0.05; \*\*p-value≤0.01

from the least poor (“Richest”) households have a statistically significant higher chance of survival compared to children from the poorest households. For instance, after model adjustment, children from least poor households were 15% less likely to die compared with those from the poorest households.

Maternal education has been found to have a significant effect on child survival. For instance, the results of the multivariate analysis show that children whose

mothers had education up to primary level were about 39% less likely to die compared with children whose mothers had no education. Similarly, children whose mothers had education up to the junior high (JHS) or middle school level were about 34% less likely to die before age five compared with children whose mothers had no education. As expected, the highest survival advantage was associated with children whose mothers had education up to secondary school and beyond, where those children were about 45% less likely to die

before celebrating their fifth birthday compared with their counterparts whose mothers had no education.

The relationship between under-five mortality and maternal age at birth of a child has been found by several studies to exhibit a U-shape characteristic, with the risk of child death being highest at both ends of the reproductive age spectrum of females [14, 36, 37]. However, the results of this study exhibit more or less linear relationship, where child survival gets better with increases in mothers' age. For example, as shown in Model 2 (Table 4), where the model has been controlled for the effects of some confounders, children whose mothers were 25–29 years old, were about 31% less likely to die compared with children whose mothers were age 15–19. Children whose mothers were in the age group 30–34 years and 35–39 years, each were 32% less likely to die compared with children whose mothers were 15–19 years. Concerning children whose mothers were 40–44 years old, they were 38% less likely to die compared with children whose mothers were in the youngest age group. Children whose mothers were in the oldest age group were 39% less likely to die compared with children whose mothers were in the age group 15–19 years.

In terms of place delivery, the results showed that children who were delivered outside a health facility have a higher risk of under-five mortality compared with those born in health facilities (Table 4). For instance, children who were delivered at their respective homes were about 52% more likely to die compared with those who were born at a health facility. On the other hand, those who were born elsewhere, other than their own homes were about 2.1 times more likely to die compared with those children who were born at a health facility.

Studies have revealed some association between birth order of a child and under-five mortality. As shown in Model 2 of Table 4, the results of this study show that children of birth order 2–4 were about 26% less likely to die compared with children of first-order births. On the other hand, children of birth order five and higher were about 31% less likely to die compared with children of first-order births. This is based on the intra-household Resource Dilution Hypothesis, where more household members lead to little resources to take care older children [38]. On the other hand, some studies have found that children of first order have a higher mortality compared with children of higher order births.

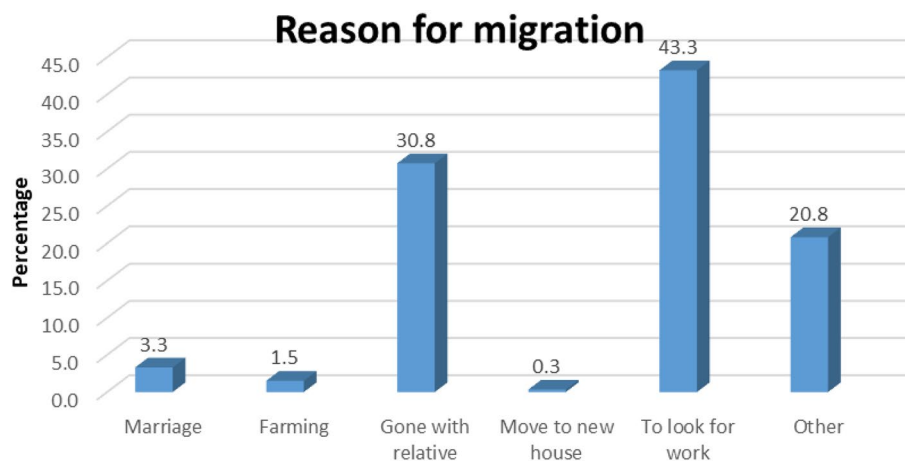
Multiple births have also been found to have high risks of deaths as studies attest to this fact [38]. The results of this study confirm this assertion, where multiple birth children have about 72% higher probability of dying compared with children born singleton. This finding is consistent with the results of the bivariate analysis.

As noted earlier, grandmothers are important kin members whose experience in childcare has been found to contribute positively to child wellbeing and survival. In this study, the effect of the presence of a paternal grandmother in the household on under-five mortality was examined. The results revealed that children with a grandmother present in the household were 12% less likely to die compared with children whose households were without a grandmother. This finding is consistent with results from some studies [33, 34, 39], and the pathway through which a grandmother's presence impacts positively on child survival has been explored.

## Discussion

This study sought to establish the effect of maternal migration on under-five mortality in a rural setting of northern Ghana, using longitudinal data spanning a period of 15 years, with 20,990 children included in the analysis. This dataset is unique in establishing such relationship, as cross-sectional data present several shortcomings [40]. The findings show that migration of women contribute positively to child survival, as evident from the various results. Specifically, results show that children of mothers who have ever migrated had better survival chances than children whose mothers have never migrated. Migration duration also showed varied results in relation to their effect on child survival, but all had favourable child survival outcomes compared to children of non-migrant mothers. In particular, children whose mothers ever migrated and stayed longest (12+ months) before returning had the highest survival advantage of being 45% less likely to die compared with non-migrant children. These findings are consistent with several studies conducted in diverse settings, where children of migrant mothers experienced a higher survival advantage compared with children of non-migrant mothers [29, 41].

The relationship between maternal migration and enhanced child survival is an indirect one, working through improved household SES and knowledge acquisition. As women migrate from these poor rural areas, where there are limited economic opportunities, to other destinations with better economic opportunities, they work to accumulate wealth and either remit or send home upon their return. These earnings are used for immediate consumption, for investment or both, and thus contribute to the improvement of household SES [9, 29, 42]. Households with such return migrants are in a better position to adequately provide for their children in several respects, thereby enhancing their wellbeing and survival, compared with children in non-migrant households. This economic benefit is what motivates women to migrate, as 43.3% of them migrate for the purpose of job



**Fig. 1** Reasons for migration

seeking, while about 31% follow relatives to support them for economic reasons, as shown in Fig. 1.

In addition to the economic gains from migration, migrant women acquire some knowledge at place of destination. Such knowledge may be useful for child care upon return to their places of origin. As migrants move to places of better opportunities (mostly urban areas), they learn about basic hygiene, better lifestyle behaviour, contraceptive use, sanitation and proper diet. As reported by Hildebrandt & McKenzie, (2005), being a migrant mother increases health knowledge by 0.65 standard deviation. Given that the study area is a deprived rural area with low levels of female education and limited economic opportunities, it is not surprising that migration tends to contribute to better child survival. An important point to note is that, in this setting, farming as the main economic activity is seasonal, which is from April to November. This is the period women engage in some farming activities. During the dry season, economic opportunities are limited and an important means for women to earn an income during the dry (non-farming) season is to migrate to other places, mostly urban areas where they engage in menial jobs.

The results also show that household SES is associated with child survival, where higher SES is associated with better child survival. However, after controlling for the influence of other confounding variables, only children of the least poor households have a higher survival compared with those children from the poorest households. This inverse relationship between child mortality and household SES is consistent with results from other studies [43, 44]. Household wealth contributes in diverse ways to improve child health and survival. These include the ability to adequately provide for the child in terms of nutrition, adequate healthcare, safe environment, among

others [44–46]. In this study setting, poverty is rife and pervasive and parents are unable to adequately provide for child care, and so poor health outcomes and death are not uncommon.

An important determinant of child mortality that has been well documented is maternal education. As expected, the results of this study show that higher maternal education is associated with lower child mortality and the reasons are not far-fetched. Literate mothers are better equipped with skills to deal with issues pertaining to child health, leading to better health outcomes [47, 48]. Literate mothers are also more empowered, both economically and socially to adequately provide for their children and to seek prompt and better health care for them. Feeding habits, adherence to therapy and use of preventive care, which enhance child health and survival, are associated with higher levels of maternal education [49–51]. Given the importance of maternal education, policies to improve child health and survival should consider empowerment of women through education, formal or informal.

The results also show that maternal age is an important factor to child survival. Specifically, children of older mothers have higher survival odds compared with children of younger mothers. Plausible reason for this is the fact that young mothers are inexperienced in child rearing and this predisposes their children to all types of risks and deaths. Biologically, these young mothers are not well developed and this affects their unborn babies [52]. Other factors that negatively affect child survival of children of young mothers include limited autonomy, inability to seek healthcare, lack of resources for feeding of children who eventually become malnourished and at high risk of death. In this setting, polygyny is high [34] and some of these young women marry as second or

third wives and have to compete for scarce resources of the husband to take care of themselves and their babies. The more or less linear relationship between maternal age and child mortality, as found in this study, is a deviation from the typical U-shape pattern that characterizes this relationship. However, the bivariate results showed the expected U-shape relationship. The reason for this could be the fact that other factors provide some buffer for older women in terms of child survival. These could include autonomy, acquisition or availability of resources, experience in child care, among others. It is thus important to implement context-specific policies towards improving the status of young mothers in our efforts to reduce child mortality, particularly in rural poor settings where opportunities for these women are limited. Further research is recommended to understand these nuances regarding maternal age and child survival.

In this study, other factors that showed significant association with child mortality include place of birth of child, birth order, multiple births and presence of grandmother. The results show that delivery at a health facility is associated with lower odds of child deaths. Delivery outside health facility is associated with the risk of infection which is mostly felt at the neonatal period, which can lead to death. This comes about due to the poor environment, the use of unsterilized instruments for cutting and dressing umbilical cord and most importantly, the handling of these deliveries by non-professional or untrained health personnel. The results also show that lower order births are associated with higher probability of death. This survival disadvantage could be due to the fact that mothers of these first order children are young and suffer the high risk of death associated with young mothers. Also, lower birth order children sometimes do not have senior siblings to support in their care, as studies have shown that there are survival benefits associated with having a senior sibling in the household [34].

Children of multiple births are found to have a higher risk of death compared with those born singleton [53]. In this study, the results show that children from multiple births have higher odds of death compared with those born singleton. This finding is consistent with results from other studies [54–56]. Given these findings, it behooves on policy makers and implementers to consider instituting and promoting appropriate and context-specific interventions to reduce under-five mortality in the area and beyond.

### Study limitations

The study has some limitations which are worth mentioning. In the first place, the HDSS enumerated the women from 1989 and started monitoring their migration dynamics. This is without background information

on their previous migration history prior to 1989. It may thus be misleading to classify a woman as a non-migrant when we do not know her migration status before enumeration. We also do not know the specific location (destination) where these return migrants had lived before returning home. This is because it is likely that urban or rural destinations could yield different results or outcomes. The third limitation is the use of secondary data which limit the types of variables that may be available for the analysis [57]. Despite these shortcomings, we think that this longitudinal platform with data spanning 15 years provides a unique dataset for examination of the influence of maternal migration on under-five mortality. Also, given the large dataset used for this analysis, any biases will be minimal and will not adversely affect the results.

### Conclusions and policy implications

The results of the study revealed a positive association between maternal migration and child survival. Children of migrant women (return migrants) have a higher survival probability than children of non-migrant mothers. Specifically, the longest (12+ months) migration duration was associated with the best child survival outcome. The child survival benefit of maternal migration comes about as a result of improved socio-economic status of these return migrants. Our findings provide insights into the importance of maternal migration in several respects, but more importantly its contribution to child survival. In the midst of limited economic opportunities in these rural settings, policy interventions to improve child survival should promote conducive migration opportunities, particularly at places of destination for which women can earn some income to support their families while away as well as upon their return. Another overarching policy drive will be to vigorously promote female education to give them economic and social advantage, which will empower them to contribute to our child survival efforts.

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### Authors' contributions

GW conceived the idea and designed the study, as well as performed the data analysis. He also wrote the first draft. SO, SA and SK contributed to the interpretation and analysis of the results. JK, PA and SK were responsible for critical revision of the manuscript. All authors read and approved the final version and take responsibility for any issues that may arise.

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### Data availability

Data for this study came from the Navrongo HDSS, which has been collecting longitudinal data since 1993. Due to the huge volumes of data collected over a long period, it is not practicable to share the data. Another important reason why data cannot be shared is the issue of privacy of individual participants. However, upon special request, some aspects of the data that are directly related to this study may be made available.

### Declarations

#### Ethics approval and consent to participate

This analysis was based on secondary data from the Navrongo Health and Demographic Surveillance System (HDSS). Ethical approval was obtained for HDSS operations and relevant consent was obtained from participating households. The Navrongo Health Research Centre Institutional Review Board approved the operations of the HDSS, for which these data were collected for this analysis. For anonymity, the identity of individuals and their locations were not included in the analysis.

#### Consent for publication

Not applicable.

#### Competing interests

The authors declare no competing interests.

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