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Research article

Child survival: the role of a mother's education

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ABSTRACT

In developing countries, children are considered as social and human capital needed for growth and development. However, the ability of uneducated parents to provide basic services to keep a child alive has always been in doubt. This has resulted in the avoidable deaths of children. This study seeks to examine the role of a mother's education in keeping a child alive. This is achieved by using the Ghana Demographic and Health Survey (DHS) Dataset (1988–2014) with 33,896 observations. This study uses the negative binomial model and finds an inverse and statistically highly significant relationship between a mother's education and the survival of her child in Ghana. Further robustness checks confirm that the result is consistent across gender of child and years of data collection. In line with the finding, this study recommends women's education from the basic education level as it drives the probability of saving a life. Globally, we suggest that education, especially at the basic level, should include health education to address numerous health concerns.

1. Introduction

The value of children to their parents in the form of social capital and their consequent translation into human capital, all else held constant, is necessary for economic growth and development. The hope of children becoming human assets has motivated parents and society to demonstrate their commitment to children's development through enduring the challenges and cost of bearing and rearing children. Inasmuch as children are considered as assets, they are equally vulnerable, thus requiring special care and attention for their survival. As proof of the world's commitment to children's rights, in September 2000 the United Nations (UN) sanctioned Millennium Development Goal (MDG) 4. As part of a continuum, the Sustainable Development Goal (SDG) 3 [1&2] which has it that "by 2030 [we should] reduce the global maternal mortality ratio to less than 70 per 100,000 live births" and "end preventable deaths of newborns and children under 5 years of age" was sanctioned in September 2015 by the UN (Amega, 2020).

Evidence from UNICEF (2018) indicates that across the globe, mortality among children has decreased substantially, yet in 2017, the number of children and young adolescents who died is estimated at 6.3 million. As many as 85% of these deaths were five years old and below. Most of these deaths continue to occur in Sub-Saharan Africa (SSA). For instance, from 1990–2017, there was a 58% decline in the under-five mortality rate in SSA. Nonetheless, in 2017, the region recorded 76 deaths per 1,000 live births. This implies that, currently, regarding mortality rates, the region remains the highest scores in the world.

The main objective of this study was to investigate whether empowering a mother through education correlates with the probability that their own child will survive. Given the paucity of such studies in developing countries and especially in Ghana, we first explore the literature to authenticate the "paucity" claim and identify possible gaps that require the contribution of this study.

Several studies in developing countries have revealed that infant mortality is largely correlated with maternal education, suggesting that maternal education might be associated with the reduction of infant mortality. Kiross et al. (2019) in employing systematic review and meta-analysis examined the impact of different levels of maternal education on infant mortality in Ethiopia. An I-square test and a funnel plot were employed to examine possible heterogeneity and publication bias respectively. The authors noted that attending primary education was associated with a 28% reduction in the odds of infant mortality compared to those infants born to mothers who were illiterate. Besides, they found that attending secondary education and above was correlated with a 45% reduction in the odds of infant mortality as opposed to those infants born to mothers who were illiterate. Other studies have also confirmed that maternal education is one of the most important factors that has an association with infant mortality; educated mothers are also likely to carry out key components of newborn care such as weighing the infant at birth

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and not giving a prelacteal feed, thus depicting correlation with infant mortality (e.g., Abuqamar, et al., 2011; Mehta et al., 2014).

More so, evidence from cross-sectional studies reveals that proper maternal education has been associated with strong impact on infant mortality reduction. However, cross-sectional studies do not provide trend evidence. Cross-sectional studies and longitudinal approaches often reach different conclusions in terms of the association between key explanatory variables and outcomes (Page and Czuba, 1999 cited in Schellekens, 2021). Pooling data from all available phases of the Demographic and Health Survey, Schellekens (2021) deployed longitudinal, individual-level analysis of the determinants of trends in infant mortality in Indonesia. Using data from 1980 to 2015, the author found that effective maternal education explains 15% of the infant mortality decline in Indonesia. The author mentioned that infant mortality has lessened significantly in less developed countries owing to three reasons: improved living standards, advances in medical care and public health, and better maternal education. About half of the decline in infant and early childhood mortality between 1970 and 2009 can be associated with increased educational attainment among women of reproductive age (Gakidou et al., 2010 cited in Schellekens, 2021).

Wu (2016) examined the impact of maternal education on child mortality in Bangladesh. Findings from the instrumental variable estimation show that an additional year of maternal schooling reduces both under-five and infant mortality by about 20 percent. Analysis of potential mechanisms indicates that maternal education reduces child mortality through greater wealth and literacy, positive assortative mating, lower fertility, delayed marriage and childbearing, greater health-related knowledge, better health-seeking behaviors, and female empowerment, but not through female employment.

Using evidence from the free secondary education policy in the Philippines, Aung and Wong (2022) in their study on the relationship between education on fertility and child mortality found that increasing education by one year reduces 0.829 child born per woman and decreases child mortality by 1.659% in the Philippines. The empirical evidence shows that increasing opportunities for women to enter and complete secondary education can reduce fertility rates and cause a significant decline in child mortality in developing countries. Kiross et al. (2019) maintain that better-educated mothers seek medical attention more actively and conform to sanitary precautions, nutritional information, and health services; they are better able to recognize serious child health conditions, follow immunization demands, actively seek prenatal care, and receive postnatal care services leading to child survival.

Although studies have established the association between mother education and child survival, among such studies, many were not conducted in Ghana but rather in Ethiopia, Indonesia, Bangladesh, and the Philippines to list just a few. Also, most related studies are cross-sectional while the present study relies on longitudinal data. Our finding that different levels of education is associated with different levels of correlation on child survival presents an insightful lesson for other countries not to trivialize some levels of education, as they are all important but at different degrees. To the global community with similar characteristics, it can be inferred that including health education at all levels of education is relevant to child survival.

It must be acknowledged that the present study is not the first time a study of this nature has been conducted in Ghana. In the health care literature, Buor (2003) has observed that mothers' education has a relationship with survival of children. Admittedly, we acknowledge the paucity of empirical evidence on the subject matter in Ghana, thus creating a gap in developing comprehensive policy frameworks. The authors argue that the scanty existing studies have been qualitative. In cases where quantitative approaches were adopted (example Buor, 2003), simple descriptive statistics were employed which the authors argue as inadequate. Although the authors attempt to use linear regression to establish correlational changes in child mortality because of mothers' education, they used a simple linear regression model without recourse to relevant controls, implying that the authors are assuming that education is the only variable that has a relationship with a child's survival. Again, the econometric technique used excluded possible zeros in the dependent variable which may be an empirical challenge. The point of departure from the current study is that this present study builds on Buor's approach by using a negative binomial model for the estimation in addition to a relatively larger number of observations over several rounds of data collection, thus defining the uniqueness of the current study. Again, we show the robustness of our results which is largely nonexistent in similar studies on Ghana. Lastly, unlike the previous studies on Ghana, we establish that different levels of mother's education correlates differently with child mortality over time.

It is expedient that we define some concepts. To avoid confusion, we maintain that mother's education means mother's empowerment, and equally means mother's literacy. These terms or concepts are used interchangeably throughout this paper. In the present study, each of the concepts means: enhancement of knowledge, skills and appropriate behaviour in a mother. We also assert that the outcomes of empowerment are commensurate with that of education or literacy. The outcomes in the current studies are health, income, self-discipline, freedom, security, and decision-making ability. The realization of such outcomes augments the mother's own child's survival. The following section firms up the literature evidence of the assertion that there is a correlation between mother's education and her own child's survival. More importantly, the gaps in the extant literature and how our current study bridges such gaps have been established.

2. Literature on mother's education and child survival

There have been a few studies that examined mothers' education and child survival. Andriano and Monden (2019) indicated in their study that extant literature of the last forty years is filled with insights showing that maternal schooling (education) plays a critical role in determining children's survival possibility in low- and middle-income countries. Andriano and Monden (2019) conducted their study in Malawi and Uganda. Applying a two-stage residual inclusion method and merging individual-level data from Demographic and Health Surveys with district-level data on the intensity of the reform, the authors examined the extent to which increased maternal education lessens children's likelihood of dying before age 5. It was found that with each additional year of maternal schooling, children's probability of dying dropped by 10 percent and 16.6 percent respectively in Malawi and Uganda. The study also examined the pathways that might explain this effect of maternal education, and it emerged that financial limitation, medical care, attitudes toward modern health services, and rejection of domestic violence may play a role.

In addition, deploying 2012 Demographic and Health Survey (DHS) data, and two-stage probit regression for analysis of data, Oyekale and Maselwa (2018) examined the impact of maternal education and fertility on child survival in the Islands of Comoros. The authors found that while child survival dropped remarkably ($p < 0.05$) as heads of households aged, per a mother's number of business trips, and per the number of marital unions, it increased with maternal education, fertility, male household headship, and the child being breastfed immediately after birth. The authors maintained that the level of maternal education is associated with child survival.

In another study, a factorial analysis empowerment index was constructed and ordered probit models were specified and estimated employing national-level household survey data. The author, Hossain (2020), found that maternal empowerment has a relationship with the prevalence of child malnutrition in Bangladesh. A partner's educational level and household income were also associated with child malnutrition. If malnutrition due to lack of knowledge can lead to infant mortality, then it implies that maternal education or empowerment has an association with child survival.

More so, employing data from the 2003 Nigerian Demographic and Health Survey ($N = 12,076$), Smith-Greenaway (2013) examined the

conditionality of the relationship between mothers' reading skills and child mortality. The author found out that among Nigerian children whose mothers had decision-making power, mothers' reading skills carried a 27 percent lower risk of child mortality; however, for children whose mothers lacked decision-making power or reading skills, there was no such survival advantage. The current researchers share the belief that mothers' literacy skills are emerging as a key factor correlated with children's health and survival in low-income economies, with a focus on the cognitive and psychological agency that literacy skills provide.

Several efforts have been made by various governments in Africa to ensure child survival. These include providing free medical consultations. However, the high cost of drugs and lack of access to healthcare facilities, inadequate training for healthcare workers, residing in remote communities, poverty, lack of essential medicines and treatments, prevailing socio-cultural norms and structural barriers, low literacy levels, and lack of access to potable water have crippled such projects (Buchanan, 2012).

Additionally, Buchanan (2012) observes that CARE International initiated a five-year (October 1, 2002 to September 30, 2007) child survival project in the Farta district of South Gondar zone (Amhara region) of northern Ethiopia, funded by the United States Agency for International Development (USAID). The purpose was to improve the health of children under 5 years and women of childbearing age. The strategies used included behavioural change communication/information, education and communication, community mobilization and training to realize sustainable results and a dramatic increase in health-seeking behaviours as well as quality of care. The project focused on improving nutrition, building sanitation facilities, controlling of diarrhoeal diseases, identification/treatment of acute respiratory infection, and increasing immunization (Buchanan, 2012). Note that behavioural change comes through positive responses to women's empowerment or education.

These studies reviewed immediately above, however, were carried out mainly in other African countries including Malawi, Uganda, Islands of Comoros, Nigeria, and Ethiopia and in other developing countries like Bangladesh. Also, their methodologies employed in analysing the data are different from the one used in the present study. The current study used a negative binomial model for the estimations, in addition to a relatively large number of observations over six rounds of data collection. The current study contributes to bridging such gaps in the literature of the domain.

It is important to acknowledge that some of the earlier studies in the literature on this subject were motivated by the seminal paper on Nigeria by Cleland and van Ginneken (1988). Unlike Buor (2003), Cleland and van Ginneken (1988) controlled for several socio-economic factors and still found that the survival of a child largely depends on the education of the mother. Subsequent developing country studies such as those by Hobcraft et al. (1984), Mensch et al. (1985) and Frost (2005) have still provided evidence to support the theoretical and empirical expectation of a direct relationship between women's education and child survival. In a related study, Hobcraft (1993) provided a review and concluded that the evidence from the literature is consistent with the situations in both developing and developed countries.

Amega (2020) revealed that many countries in the Sub-Saharan Africa (SSA) could not attain the Millennium Development Goal target of reducing under-five mortality by two-thirds between 1990 and 2015. The author also observed that a great proportion of those who died under five in SSA and other developing economies were due to under-nutrition and very poor environmental conditions. He predicts that inability to address the inhibiting factors will also lead to inability of many countries to meet the Sustainable Development Goal 3.2 target which is geared to lessening under-five mortality to less than 25 deaths per 1000 live births by 2030. He then proposed the following as intervention tools: investment in school feeding, programmes addressing household air pollution, strengthening child welfare clinics, and improving water, sanitation, and hygiene (WASH) services in basic schools (Amega, 2020). There are countries whose primary health services are so weak that they have no effect on the health of mothers and children (Cleland and van Ginneken, 1988).

Although the immediately preceding studies focused on child survival, the factors they applied in examining child survival were different from the focus of the current study. The current study examines the extent to which education can empower a woman to enhance the survival of her own child.

In Ghana, the mortality rate of under-5 (per 1,000 live births) dropped significantly from 209.40 in 1960 to 49.30 in 2017. Impressive as it may be, albeit higher than the world's estimate of 39.1 for the same period (World Bank, 2019), this provides enough justification that Ghana like most of the countries within Sub-Saharan Africa (SSA) is lagging behind and a conscious policy direction is needed in meeting global standards. The causes of child mortality in Ghana are enormous. Given the limited government budget allocation to the health sector, donor support is required annually in dealing with child mortality causes. Unfortunately, the constraints (such as delays) associated with donor funding have caused several policy initiatives to be halted at implementation stages. Alternative policy measures that do not depend on donor funding yet significantly influence the possibility that a child will survive are the way forward. The policy is maternal education or empowerment and is consistent with the literature (Smith-Greeaway, 2013; Oyekale and Maselwa, 2018; Buor, 2003; Desai and Alva, 1998).

In the 2017/18 academic year, the Government of Ghana launched a Free Senior High School (SHS) policy with the aim of providing secondary education for all. In furtherance of the drive to educate all, the key research question is: can women's education (empowerment) influence the survival of children in Ghana? In this regard, this study seeks to empirically investigate the extent to which education of women can contribute to reducing child mortality in Ghana.

The rest of the paper is presented as follows: In sections 3, we present the conceptual framework and the methodology, respectively. Section 4 presents the results and analysis of the study. Section 5 concludes the paper with policy recommendations.

3. Conceptual framework

Generally, empowerment is described by Page and Czuba (1999) as a construct that is applicable in several disciplines including economics, psychology, development studies and education. This makes it extremely difficult to agree on one definition of the construct. Nonetheless, the present authors define empowerment as "a multi-dimensional social process that helps people gain control over their own lives. It is a process that fosters power (that is, the capacity to implement) in people, for use in their own lives, their communities, and in their society, by acting on issues that they define as important" (p. 2). In the context of this study, we define women's empowerment as women's education, that is, as a process that fosters power (that is, enhances knowledge, skills, and disposition) in women to be in control of their own lives as well as their household/environment. Simply put, it is the power of a woman that creates the awareness in her regarding knowing the things to do or avoid in order to save the life of her own child.

Developing a conceptual framework on women's empowerment is complex and methodologically challenging to measure and analyze (Narayan-Parker, 2005). So, we present a simple education (empowerment) framework that analyses the process of how education or empowerment enhances knowledge, skills acquisition as well as appropriate behaviour, and generates outcomes that could also be referred to as empowerment/literacy outcomes. This is based on the hypothesis that higher levels of education equate higher empowerments. In other words, empowerment outcomes are wholly attributed to education. For this to hold true, we assume that all else which includes the role of government, religion, culture, and behavioural factors are held constant.

According to Sandiford et al. (1995), education depends on economic, social and psychological factors which also connect to women's

empowerment and good health outcomes. Figure 1 shows education, whether pursued through formal schooling or unorthodox means, is regarded as a means that promotes women's advancement. This is because education imparts knowledge that enables women to be self-conscious and creates awareness of their decisions and their consequences. In other words, a woman who has acquired knowledge through education tends to behave differently from one of the same gender that lacks knowledge. For example, a woman who has been educated on how to prevent pregnancies has a higher probability of not getting pregnant compared with a woman who is ignorant of such knowledge. Again, a woman who has knowledge about prenatal challenges and how to deal with them stands a higher chance of saving herself and the child from premature death. However, women who lack prenatal knowledge are always susceptible to sicknesses and premature death threats. Knowledge, they say, is power; hence, the absence of it is without its consequences.

Acquisition of knowledge, skills and behaviour translates into empowerment outcomes. Knowledge empowers women to take control of their lives for improved wellbeing. The outcomes of women's empowerment as per the definition provided above is expected to affect not only the woman but her dependents or better still her community. A woman who is educated has a higher chance of getting a white-collar job (office-related jobs such as an economist) which is associated with higher wages compared to blue-collar jobs (manual labour such as cleaners). Generally, such highly paid women have the purchasing power to access health care for their children, unlike lower-paid women who lack the ability to pay and may opt for risky health care practices.

Again, knowledge and skills acquired through education have the ability to alter attitudes, behavioural intentions and social status. It seems plausible, for example, that for women who hitherto were excluded from household decision-making, through education they become knowledgeable and skilful in contributing to decisions that affect the survival of their children. Similarly, mothers who are informed regarding the right nutrition and time for vaccination of their children are more likely to keep their children alive compared to an uninformed mother.

Education enhances knowledge, skills and requisite disposition. The former is the ability one has acquired through education to perform a task with competence. The latter is the behaviour acquired through education or empowerment to perform a task well. All three outcomes of education (knowledge, skill, and requisite disposition) translate into women's empowerment, which yields better health outcomes to the woman as well as her household, including the children.

4. Data and methods

This study used a repeated cross-sectional dataset from the Ghana Demographic and Health Survey (DHS) over the period 1988 to 2014 with 33,896 observations. The data collection was undertaken by the Ghana Statistical Service (GSS) over six different rounds. Generally, it is considered as nationally representative data with a very high level of credibility and reliability due to the processes by which it is obtained.

The DHS has three main questionnaires, namely: Household level Questionnaire (which also covers children 6 months–5 years), Woman's Questionnaire (15–49 years) and Man's Questionnaire (15–59 years). Given the objective of the study, we used the dataset from the Woman's Questionnaire with some additional variables from her household. This questionnaire was originally drafted in English and translated into the respective major local languages for easy understanding by all respondents whether literate or illiterate. The questionnaire administrators were well trained, and a pilot survey was undertaken outside the earmarked sampled areas before the main survey was administered.

Generally, the sampling frame used by the GSS was designed to exclude nomadic and institutional populations (e.g., inmates, barracks, etc.). Following the approach for the national census, a multi-stage stratified probability design was used. The sampling technique followed a two-stage approach (i.e., clustering and systematic sampling). At the first stage, area-level clusters were selected consisting of urban areas and rural areas. At the second stage, households within the clusters were systematically sampled. To achieve this, households were listed and selected from each cluster. As can be seen in Table 1, this gave a sample size of 4488 for 1988, 4562 for 1993, 4843 for 1998, 5691 for 2003, 4916 for 2008, and 9396 for 2014. Therefore, aggregating the sample size from 1988 to 2014 yielded 33,896 representing the total number of

Table 1. Sample size Distribution from 1988–2014.

Year of Sample	Frequency	Percent
1988	4,488	13.24
1993	4,562	13.46
1998	4,843	14.29
2003	5,691	16.79
2008	4,916	14.50
2014	9,396	27.72
Total	**33,896**	**100**

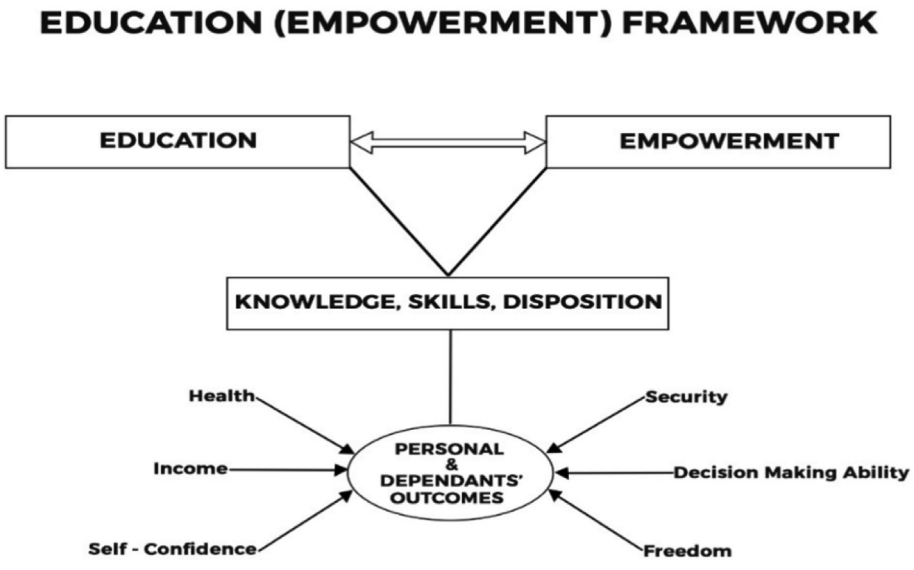

Figure 1. A Framework of Education (Empowerment) Outcomes. Authors' own Construct.

observations used for the study. Generally, the number of observations can be described as very high and representative for generalization.

In this study, the dependent variable used is the number of own children who have died per household. As shown in Table 2, this ranges from zero to twelve. Zero indicates households that have not recorded deaths of own children before while twelve represents the household with the highest number of own-child's deaths. The mean and median values are 0.09 and 0.00, respectively. The distribution is positively skewed with heavier tails than a normal distribution. The evidence so far shows a lot of outliers in the data thus posing an empirical challenge in the event of using an ordinary least square estimator. The independent variable of interest is the highest level of education completed by the woman. This is measured as a ranked variable with zero (0) representing no education, one (1) denoting primary education, two (2) meaning secondary education, and three (3) implying those with higher levels of education (e.g., university and above)—all completed. The mean and median values of 1.13 and 1.00 indicate that on the average women in Ghana have at least a basic level of education. Further investigation of the data shows that about 31% of the respondents have no education while 69% have some kind of education. Out of the 69%, approximately 28% had completed primary education, about 38% had completed secondary education, while only 3% of the women had completed a higher level of education. This shows that while the number of women without education is high, the number with higher education is also very low. This gives credence to investigating the extent to which the current levels of education have influenced the own child's death or survival. The evidence is to influence policy makers on their decision to allocate a reasonable amount of government budget to educate women as it contributes to empowerment as well as the child's survival. The case of fathers is relatively higher, albeit higher education is somewhat low.

Several control variables were included as a way of reducing the effect of missing variable bias. First, the study examines whether age matters in the probability of a child's death. Thus, the minimum age is 15 and maximum age is 49, giving a range of 34 years. The distribution shows mother's average age of 29 years with about 71% working. Another driver of deaths in Ghana and other parts of Africa is malaria. In order to control for this in the model, the study used a dummy variable of respondent's household using a bednet for sleeping or otherwise. The average number of households using bednets was 56% as compared to 44% without bednets. Two main demographic variables were also included as controls. These included gender and wealth. The gender of the household head, which was a dummy variable, showed that 64% of the household heads were males. This reflects the male household head dominance in Ghana and most parts of Africa. Wealth index is a ranked variable from a minimum of one (poorest) to a maximum of five (richest). The mean is approximately 3, which is equal to the median depicting the middle-income status of most households in Ghana.

In addition to the pooled descriptive statistics, we present the longitudinal statistics for only our variables of interest, i.e., mothers' education and number of child deaths (See Table A1 in appendix for details).

From Figure 2a, we show that from 1988 to 2014, the number of mothers with no education has declined from 39.73% to 24.28% whiles those with higher education increased from 0.89% to 5.47%. Overall, it is evident that mothers' education has improved significantly, albeit much is still required to be done. Also, Figure 2b depicts a continuous decline in the number of non-zero child deaths ranging from 1 to 12 over the six waves. In contrast, we find an increasing trend in the number of zero child deaths for the same period. This implies improvement in child mortality; however, much is still needed to be done.

4.1. Empirical strategy

To predict the extent to which a woman's education influences her own child's survival, we first specified a simple linear matrix of the form shown in Eq. (1):

$$y = X\beta + \varepsilon \tag{1}$$

where y is an $n \times 1$ vector of observations representing the number of own children who have died, β is a $k \times 1$ vector of unknown parameters to estimate, X is an $n \times k$ vector with k explanatory variables for n observations, and a stochastic term (ε) which is normally distributed. Equation one is re-specified in an explicit form to include relevant controls. This is presented as Eq. (2):

$$y = f(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \gamma + u) \tag{2}$$

From Eq. (2), X_1 is our variable of interest which represents the mother's formal level of education completed. This variable is captured as a discrete or count variable. From the theoretical perspective, one would expect a positive relationship between the level of formal education completed and the number of own children that can be saved. X_2 to X_5 are included as control variables in this multivariate linear regression. X_2 denotes age of the mother in years which is captured as a continuous variable. We expect that mature and experienced mothers may be associated with less risk as compared to immature and less experienced mothers. Hence a positive relationship is expected between y and X_2. X_3 is also included as a squared term of age. This is to test a possible non-linearity in age. X_4 represents the gender of the household head. This is used to capture the role of the household decision-maker on a child's survival. We expect that if the household head is a male, in line with most Ghanaian traditions and conventions, he will definitely obtain the physical support of his partner in taking care of the children. Such complementary efforts have a higher probability of saving the life of the child compared to female household heads who hardly get such physical

Table 2. Pooled descriptive statistics (1988–2014).

Statistics	Child died	Mother's Education	Gender	Wealth	Age	Work	Father's Education	Bednet
	Description of Variables							
	Number of Own Child/Children Who Has/Have Died	Mother's Highest Level of Education	Gender of Household Head Dummy	Household Wealth Index in Quintiles	Age of the Mother	Mother currently working	Father's Highest Level of Education	Woman's HH Has Bednet for Sleeping
	Discrete/Continuous	*Ranked (No Edu.-Uni)*	*Dummy*	*Ranked (Poorest-Richest)*	*Years*	*Dummy*	*Ranked (No Edu. -Uni)*	Discrete/Continuous
Mean	0.09	1.13	0.64	2.96	29.24	0.71	1.27	0.56
Median	0.00	1.00	1.00	3.00	28.00	1.00	1.00	1.00
SD	0.52	0.89	0.48	1.45	9.56	0.45	0.99	0.50
Skewness	9.18	0.01	-0.56	0.02	0.33	-0.92	-0.04	0.08
Kurtosis	120.78	1.74	1.32	1.64	2.02	1.85	1.74	1.07
Min	0.00	0.00	0.00	1.00	15.00	0.00	0.00	0.00
Max	12.00	3.00	1.00	5.00	49.00	1.00	3.00	1.00
N	**33896.00**	**33896.00**	**29408.00**	**29408.00**	**33896.00**	**33839.00**	**23736.00**	**20001.00**

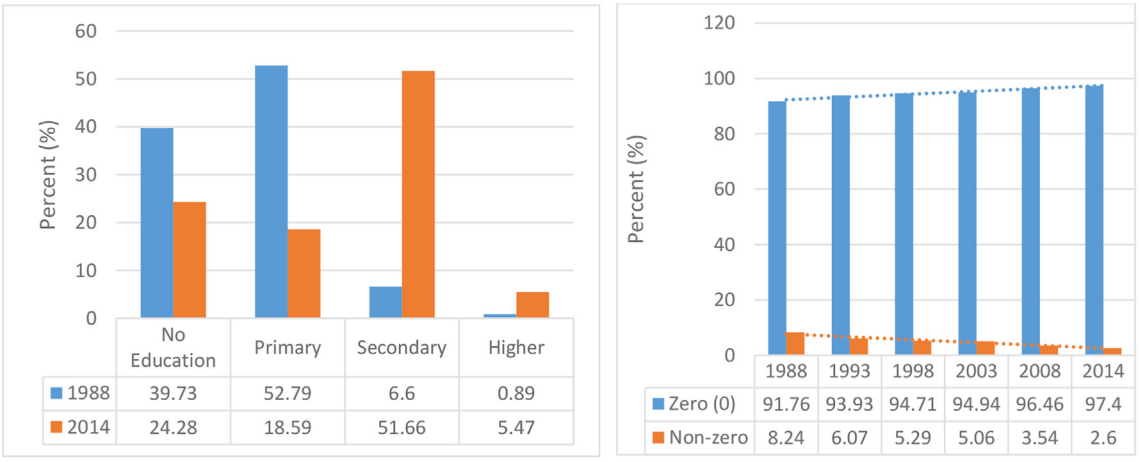

Figure 2. a: Graphical analysis of education trends in Ghana. b: Graphical analysis of child death trends in Ghana.

support. Again, one of the prevalent causes of under-five mortality in Ghana is malaria. A major preventive solution is the use of bednets. X_5 represents households that use bednets. One would expect that the use of bednets will reduce the number of household (including under-five) deaths. This is also represented as a dummy variable where households using bednets are represented by 1, while households without bednets are represented by 0. In this study, a key control variable is a measure of wealth. Wealthy households have the ability to access quality health care and reduce child mortality compared to poor households. Wealth, in this study, is ranked from the poorest household (1) to the richest household (5). Furthermore, mother's economic power (represented by a dummy of mother currently working $[X_6]$) and father's level of education $[X_7]$ are included in the model to control for possible other parental empowerment factors. Intuitively, we expect parental empowerment to negatively drive the probability that a child will die or not survive. Lastly, to ensure that differences in the regions of the country over time are controlled for, we introduced ecological regional dummies (γ) which does not change over the years. To ensure that the results are neatly presented with focus on our variable of interest, we use "Yes" to indicated models with regional dummies and "No" for otherwise.

In Figure 3, the dependent variable (y) is the number of own child deaths. Given the positively skewed distribution of the dependent variable with a greater fraction of the observations being zero (0) and an outlier, it is appropriate to use a Tobit model for possible left and right censoring instead of an ordinary least square model (see Amoah et al., 2022). So, Eq. (1) is re-written as Eq. (3) in line with the Tobit model as:

Tobit Model

$$y = X\beta + \varepsilon \;\; if \;\; X\beta + \varepsilon > 0$$
$$y = 0 \quad if \;\; X\beta + \varepsilon \leq 0 \tag{3}$$

Here, y appears as a latent variable while all the other variables are as earlier defined. Below the censoring limit of zero (0), y is assumed to be unobserved, yet it can be observed above zero (0). Also, for purposes of robustness, because the dependent variable is a count data, we also estimated a Poisson model. In Eq. (4), ν shows a non-negative integer outcome while λ denotes the Poisson mean.

Poisson Probability Model

$$P_{r(\nu)} = \frac{e^{-\lambda}\lambda^{\nu}}{\nu!}, \nu = 0, 1, 2\cdots\cdots \tag{4}$$

Owing to the evidence of over-dispersion (see Table 3, Model 2), we further estimated a Negative Binomial model. After comparing the AIC and the BIC results in Table 3, our preferred estimation technique is Eq. (5).

Negative Binomial Probability Model

$$P_{r(\nu)} = \frac{\Gamma\left(\nu + \frac{1}{\alpha}\right)}{\Gamma(\nu+1)\Gamma\left(\frac{1}{\alpha}\right)} \left(\frac{\frac{1}{\alpha}}{\frac{1}{\alpha}+\lambda}\right)^{\frac{1}{\alpha}} \left(\frac{\lambda}{\frac{1}{\alpha}+\lambda}\right)^{\nu} \tag{5}$$

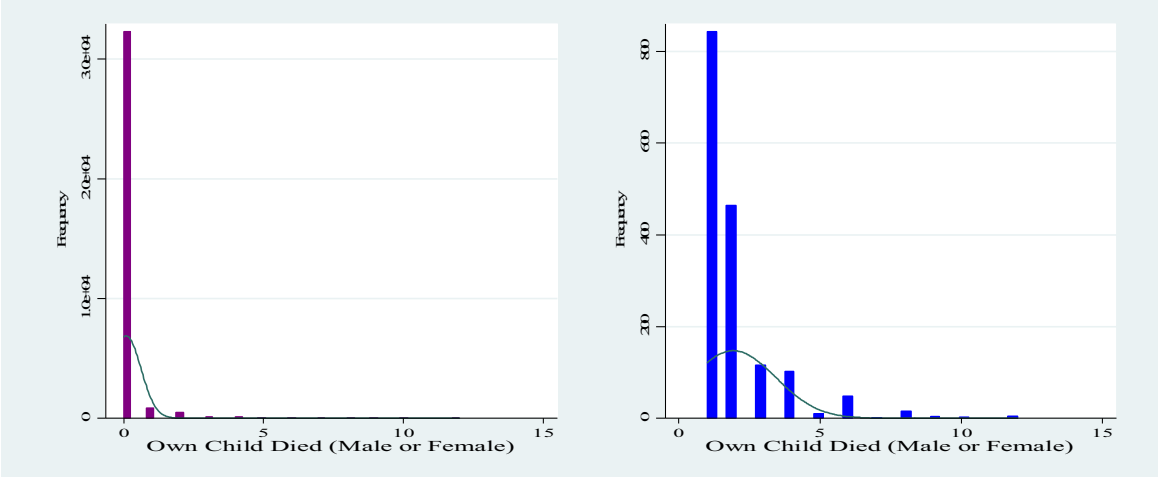

Figure 3. Distribution of dependent variable.

Table 3. Regression results.

Variables	†Tobit Model (1)	Poisson Model (2)	Negative Binomial Model (3)	Delta-Method (dy/dx) (4)
	Child Died	Child Died	Child Died	Marginal Effects
Mothers' Education Level (No education = 0)				
Primary Edu. Level = = 1	-0.2246* (0.217)	-0.1647* (0.125)	-0.1009* (0.133)	-0.0095* (0.013)
Secondary Edu. Level = = 2	-1.2269*** (0.235)	-0.7273*** (0.149)	-0.7083*** (0.149)	-0.0666*** (0.014)
Higher Edu. Level = = 3	-3.1777*** (1.039)	-2.3325*** (0.725)	-2.3341*** (0.696)	-0.2194*** (0.066)
Control Variables				
Gender of Household Head (Male)	0.1245 (0.177)	0.0080 (0.117)	0.0288 (0.114)	0.0027 (0.011)
Mother currently working (Dummy)	-0.0508 (0.272)	-0.0356 (0.168)	-0.0226 (0.172)	-0.0021 0.0162
Age of Mother	0.5940*** (0.111)	0.4500*** (0.073)	0.4723*** (0.065)	0.0444*** (0.007)
Age of Mother Squared	-0.0050*** (0.002)	-0.0041*** (0.001)	-0.0044*** (0.001)	-0.0004*** (0.000)
Mother's household has bednet for sleeping	-0.4366*** (0.155)	-0.2401*** (0.096)	-0.2875*** (0.101)	-0.0270*** (0.010)
Household wealth index in quintiles (*Poorest = = 1*)				
Wealth index(poor) = = 2	-0.1132 (0.225)	-0.1093 (0.129)	-0.1043 (0.141)	-0.0098 (0.013)
Wealth index(Middle) = = 3	-0.1627* (0.267)	-0.0949* (0.170)	-0.1739* (0.164)	-0.0164* (0.016)
Wealth index(Richer) = = 4	-0.3750** (0.320)	-0.3633** (0.2046)	-0.3476** (0.208)	-0.0327** (0.020)
Wealth index(Richest) = = 5	-1.1292*** (0.390)	-0.6711*** (0.273)	-0.7448*** (0.277)	-0.0700*** (0.027)
Father's *Primary Edu. Level = = 1*	0.1677 (0.278)	0.1082 (0.163)	0.0272 (0.163)	0.0026 (0.015)
Father's *Secondary Edu. Level = = 2*	-0.3440 (0.216)	-0.1627 (0.123)	-0.1694 (0.134)	-0.0160 (0.013)
Father's *Higher Edu. Level = = 3*	-0.8817** (0.400)	-0.6981** (0.246)	-0.6768** (0.260)	-0.0636** (0.025)
Regional Dummies	*Yes*	*Yes*	*Yes*	
Constant	-19.0333*** (2.211)	-12.1821*** (1.365)	-12.7728*** (1.232)	
LR Chi (20)/Wald Chi (20)	857.07***	628.66***	639.60***	
AIC (df = 17)	8370.07	7873.17	6673.44	
BIC (df = 17)	8496.52	7968.01	6807.80	
Pseudo R2	0.1161	0.1967	0.2092	
Alpha & †Chi-bar (Alpha = 0)			19.07 & 1698.60***	
Turning Point in Mother's Age (Years)	59.00	55.00	54.00	56.00
Observations	13,305	13,305	13,305	13,305

Dep Variable: Number of own child (Son/Daughter) death, Robust Standard errors (SE) in parentheses, †No Robust SE***p < 0.01, **p < 0.05, *p < 0.1, 12,643 left-censored observations at cd ≤661 uncensored observations, 1 right-censored observation at cd ≥ 12.

For simplicity of analysis and interpretation, we estimated the marginal effects of the Negative Binomial Model using the delta method and presented the results in Table 3, Model 4.

5. Results

In Table 3, we estimated the Tobit and Poisson models because the ordinary least square may not be appropriate for count data, truncation of data at zero deaths and over-dispersion problems. Before we proceed, it is imperative to investigate whether there is evidence of over-dispersion or not. With an Alpha value of 19.07 and a Chi-bar value of 1698.60, which is highly significant at one percent level of significance, we reject the null hypothesis that alpha (α) is zero and conclude that there is evidence that the conditional mean is not equal to the conditional variance. In addition, AIC and the BIC model fitness tests support the Negative Binomial as the best model for the study. In line with the evidence of over-dispersion and the model fit tests, the Negative Binomial is considered the best model for estimation. Admittedly, in terms of signs and significance, we have evidence of some robustness as the same conclusions would be reached irrespective of the estimation procedure used. Nonetheless, to obtain the parameter estimates for the relationship between a mother's education and her own child's survival, our preferred model is the Negative Binomial model.

Additional diagnostic tests such as multicollinearity and heteroscedasticity are investigated. Given that multicollinearity can be detected without a special test but by examining the standard errors or confidence interval, we can conclude that with respect to the independent variables, multicollinearity is not severe to influence the variances and covariances. Better still, we specified and estimated a linear model and found a mean variance inflation factor (VIF) of 1.47. This supports the absence of severe multicollinearity in the model; hence, we are confident of the estimation precision. Again, the models that allow for robust standard errors were estimated with it. We are confident from the standard errors that heteroscedasticity is also not a problem in our estimation. However, endogeneity is not addressed due to data limitations so our results should be interpreted as an association rather than causal impact. This in no way invalidates the results as a myriad of previous studies have investigated association and not causal impact (see for example, Tetteh et al., 2022; Amoah et al., 2022).

The primary objective of this study is to examine the extent to which a mother's education correlates her own child's survival. In order to achieve this, the variable of interest, mother's education, is included in the model as a right-hand side variable. This is a categorical variable with no education as the base case or reference category. Mother's education at all reported levels is found to be statistically significant and shows the expected negative sign. For primary level of education completed relative to no level of education, we obtained a marginal effect of -0.0095. This suggests that those who have completed primary education on average experience approximately 1% less deaths compared with a mother with no level of education. In the case of secondary level of education completed relative to no level of education, we obtained a marginal effect of -0.0666. By implication, a mother who has completed a secondary level of education on average is likely to experience approximately 7% less deaths compared with a mother with no level of education. For higher levels of education, compared to no level of education, we obtained a marginal effect of -0.2194. This means that those who have

completed higher levels of education on average experience approximately 22% less deaths compared with a mother with no level of education, and it is consistent with the extant literature (UNICEF, 2018; Andriano and Monden, 2019). Simply put, mother's education from primary to higher is associated with an average of approximately 1%–22% reduction in own child mortality in Ghana.

In a broader sense, relative to an uneducated mother, the results imply that mother's education levels (i.e., primary and above) correlates with child survival (UNICEF, 2018; Amega, 2020). This is plausible on the grounds that, a priori, education correlates positively with good health because of the possibility of accessing and exploiting relevant health-related information for better child-care practices. Stated differently, education grants mothers the opportunity to access health endowments through knowledge. Thus, while the educated person can read and apply knowledge, one cannot say the same for the uneducated. Hence, the child of an educated mother stands a greater chance of benefiting from her healthier lifestyle, which can keep the child alive as compared to an uneducated mother. In effect, education of the mother has health and survival payoffs to both the mother and the child. Similar evidence is found in Das Gupta (1990) and Hossain (2020), who argue that a woman who is educated is likely to have basic child-care skills, engage in domestic management of ill-health and preventive care, as well as use modern medical services. Similarly, women who are empowered through education has a correlation with higher productivity in the home which translates into child survival (Hill and King, 1995; Cleland and van Ginneken, 1988; Hobcraft et al., 1984; Hossain, 2020). All these lead to human capital investments which are drivers of economic growth.

As part of the control variables used in the model, we included age of the mother, as, generally, immature and less experienced mothers have a relatively higher risk in childbearing than experienced mothers. In line with expectation, there is a marginal effect of 0.0444 for age of the mother. This implies that a one-year increase in age is associated with an average of about 4% increase in the number of own child death. Simply put, there is a positive and statistically significant relationship between the age of a mother and the number of own child/children who have died. That is, as mothers age, they have a higher tendency of losing a child as compared to a younger mother. On the contrary, the non-linear effect of age, i.e., age squared, decreases the possibility of a child's death by an average of 0.04%. This means that as mother's age increases beyond a threshold of approximately 56 years, the probability that a child will die turns negative.

The gender of a household head with *female* as the reference category is included in the model to show whether the role of the final household decision-maker influences the probability that her own child will survive. The result is unexpectedly positive and statistically insignificant.

Similarly, we controlled for mother's economic power using a dummy of mother's employment status (i.e., *mother currently working*). As expected, we find evidence of a negative relationship between mother's economic power and the probability that her own child will survive, albeit statistically insignificant.

In addition, the mother's household behaviour towards threats to the life of the household is represented by whether the mother's household has a bednet or otherwise. This is very important especially in Ghana where malaria is pervasive, and the entire country is still believed to be at risk. This is included to control for the possibility that the death of a child is predominantly driven by malaria. Consistent with theoretical expectation, the results suggest that a unit increase in the number of mother's household using bednets decreases child mortality by about 2%, all else held constant.

In a developing country with high levels of inequality and poverty, it is always expedient to control for their effect on the number of child's death. For the *poor* relative to the *poorest*, we obtained a marginal effect of -0.0091. This suggests that those who are poor on average experience about 0.91% less deaths compared with the *poorest*. Also, for the *middle quintile* relative to the *poorest*, we obtained a marginal effect of -0.0215. By implication, the *middle quintile* on average experience about 2% less deaths compared with the *poorest*. For the *richer*, relative to the *poorest*, we report a marginal effect of -0.0354. This means that the *richer* on average experience approximately 4% less deaths compared with the *poorest*. The last quintile, *richest*, has a marginal effect of -0.0686. This implies that the *richest* on average experience approximately 7% less deaths compared with the *poorest*. The *middle* and the *richest quintile* are statistically significant, although the *poor* is not statistically significant.

The spillover effect of a father's education is expected to determine the probability that own child will not die but survive. Relative to *no level of education*, a father with *primary* or *secondary level of education* depicts ambiguous sign and is statistically insignificant. However, a father with *higher level of education* is associated with a statistically significant marginal effect of -0.0636. This means that relative to no level of education, a father with higher level of education is associated with a 7% probability that his own child will not die but survive.

5.1. Robustness checks

For further investigation of the results, we undertook robustness checks by estimating the marginal effects for the various rounds of the DHS survey from 1988 to 2014 based on available data.

In all cases, as shown in Table 3, we find evidence to support the earlier findings that, from primary to higher levels of education compared to no education, there is an inverse relationship which is found to be statistically highly significant. This implies that as a mother's level of education rises, the number of own-child deaths decreases, with a net effect of an increase in child survival (UNICEF, 2018; Oyekale and Maselwa, 2018; Hossain, 2020). Thus, we further show evidence to support the earlier results and claim that there is a negative and statistically significant relationship between mothers' education and own-child survival. This evidence is presented in Table 4.

Further robustness checks were undertaken on whether a mother's education influences the survival of a son differently from a daughter. For easy comparison of the multivariate results and the negative binomial results, we excluded the marginal effect results. All relevant controls as used in Table 3 were included in Table 5 before estimation. The evidence provided in Table 5 shows that in terms of sign and significance there is no difference. However, the magnitude differs. So, in our preferred Negative Binomial Model, for primary education the magnitude is larger for sons as compared to daughters. However, for secondary and higher, the magnitude for the daughter is larger for daughters as compared to sons. In all cases, the results affirm our earlier findings that education of the mother is a statistically significant driver in reducing own-child death or the rate at which children will die. Stated differently, the higher a mother's level of education, the greater the under-five mortality rate, and this attests to the extant literature (UNICEF, 2018; Oyekale and Maselwa, 2018; Andriano and Monden, 2019; Hossaine, 2020).

5.2. Validity and reliability

A pilot study heralded and informed the quality of the main study. The data collection was undertaken by the GSS over six different rounds. Generally, it is considered as a nationally representative data with a high level of validity and reliability due to the processes by which it is normally obtained such as engaging statistical tools to test the reliability of the scale items under a construct and factor analysis for testing the adequacy of validity.

The deployment of the Tobit model for possible left and right censoring, the Poisson model, and the Negative Binomial model as varied data analytical tools enhanced rigour in the analysis, thus contributing to the validity and reliability of the results. Additionally, several control variables were included as a way of reducing the effect of missing variable bias. Robustness checks confirmed that the results were consistent across gender and years of data collection. The present results indicate that mothers' educational levels from primary and above reduce the likelihood that a child will die as compared to the case where the mother is without education. This is an incontrovertible statement that is valid and reliable

Table 4. Regression results by year.

Variables	Delta-Method (dy/dx) *Marginal Effects*	Delta-Method (dy/dx) *Marginal Effects*	Delta-Method (dy/dx) *Marginal Effects*	Delta-Method (dy/dx) *Marginal Effects*	Delta-Method (dy/dx) *Marginal Effects*	Delta-Method (dy/dx) *Marginal Effects*
	1988	1993	1998	2003	2008	2014
Mothers' Education Level (No education = 0)						
Primary Edu. Level = = 1	-0.2090*** (0.0277)	-0.1443*** (0.0208)	-0.0855*** (0.0234)	-0.9346*** (0.0201)	-0.0538*** (0.0159)	-0.0463*** (0.0103)
Secondary Edu. Level = = 2	-0.3917*** (0.0951)	-0.3436*** (0.0638)	-0.1945*** (0.0287)	-0.1576*** (0.0230)	-0.1279*** (0.0212)	-0.1101*** (0.0131)
Higher Edu. Level = = 3	-3.4737*** (0.2330)	-2.1357*** (0.1638)	-0.2486*** (0.0781)	-0.3279*** (0.1026)	-1.3751*** (0.1364)	-0.1980*** (0.0502)
Observations	4,488	4,562	4,843	5,691	4,916	9,396

Dep Variable: Child (Son/Daughter), Robust Standard errors (SE) in parentheses.
**p < 0.01, **p < 0.05, *p < 0.1.

Table 5. Robustness regression results.

Model	Multivariate Tobit		Negative Binomial	Negative Binomial
VARIABLES	Male (Son) Died	Female (Daughter) Died	Male (Son) Died	Female (Daughter) Died
Mothers' Education (No education = 0)				
Primary Edu. Level = = 1	-0.3112*** (0.065)	-0.1136*** (0.066)	-0.2516*** (0.055)	-0.5446*** (0.058)
Secondary Edu. Level = = 2	-0.7063*** (0.062)	-0.7155*** (0.066)	-0.6047*** (0.055)	-1.2835*** (0.059)
Higher Edu. Level = = 3	-1.1739*** (0.170)	-1.3960*** (0.194)	-1.0115*** (0.175)	-1.8937*** (0.218)
Controls	*Yes*	*Yes*	*Yes*	*Yes*
Constant	-8.5653*** (0.346)	-8.4267*** (0.358)	-8.8999*** (0.380)	-1.3247*** (0.048)
lnsigma/lnalpha	*0.6360*** (0.012)*	*0.6403*** (0.014)*	*0.5348 (0.066)*	*0.3413 (0.0869)*
Sigma/alpha	*1.889*** (0.024)*	*1.8970*** (0.027)*	*0.5858* (0.1070)	*1.4067* (0.1222)
rho	0.2105*** (0.018)	0.2074*** (0.017)	N/A	N/A
			N/A	N/A
Observations	20,001	20,001	20,001	20,001
Wald chi2/LR chi2	*4074.47****		2961.92***	2563.39***
Likelihood ratio test of rho = 0: chi2(1) = 144.921 Prob > chi2 = 0.0000			*LR test of alpha = 0: chibar2(01) = 128****	*LR test of alpha = 0: chibar2(01) = 89.33****

Dependent Variable: Son/Daughter Died. Robust Standard errors in parentheses, ***p < 0.01, **p < 0.05, *p < 0.1.

because this study together with previous studies have scientifically provided some reasonable justification to authenticate the claim.

5.3. Ethical consideration

As earlier indicated in the data section, this study relies on the DHS secondary data which was originally collected by the Ghana Statistical Service (GSS). Although this study does not require ethical clearance from the authors, nonetheless, we requested copies from the DHS office for the purpose of this study. We are confident that all dataset used for this study received ethical clearance from the Institutional Review Board of the Ghana Health Service Ethical Review Committee. For want of space, we have attached the most recent ethical clearance with reference number GHS-ERC 18/03/14 (Refer to Appendix Section A1, pages 38–40: Ethical Clearance Form). All the sources of information used in this study have all been properly referenced.

5.4. Limitations of the study and direction for future studies

The dataset, although the most comprehensive (vis-à-vis, time and content), does not include all controls (i.e., child-level, parent's personal-level and environmental-level characteristics) that may play into the connection observed between maternal education and child mortality.

Specifically, mothers with certain motivational characteristics may both be more inclined to remain in school and to enact parenting practices that reduce the likelihood of child mortality. Likewise, mothers living in settings with better access to environmental conditions that reduce the likelihood of child mortality (e.g., access to potable water, better sanitation, more limited exposure to certain teratogens) may also be more likely to attain greater education. We hereby pinpoint that although the statement raised above is true, unfortunately, based on the dataset limitations, proxy controls used in the present study could only partially account for both the personal and contextual factors.

With decisive and deliberate steps to reduce the levels of limitations as a result of missing variable bias leading to endogeneity, we have added some father's and mother's level control variables to the model. That notwithstanding, we have still acknowledged that we couldn't perfectly control for environmental and child-specific factors, hence a gap for future studies. As already indicated, due to data paucity our results should be interpreted as an association rather than a causal impact as originally intended. We acknowledge that this is not the first study to have focused on regression-based correlations (most recently, see Tetteh et al., 2022). To address endogeneity and to attempt to establish causality of education and child survival, a more robust dataset must be used in future studies.

The researchers have assumed that education uniquely drives child survival. Although this assumption is oversimplified, the correlational effect advances the literature on the subject. Further, the study is relevant, as an important pattern is established where education through knowledge, skills and appropriate behaviour in parents translates into child survival. In as much as relevant variables of the father are controlled for, it is important to also observe that household-level factors are also included as additional controls. That notwithstanding, we still acknowledge that we could not perfectly control for all relevant factors. In place of this, we have included regional specific dummies for unique regional characteristics of the environment, child and the household to be partly controlled for. So, future studies in Ghana are encouraged to test causal impact instead of regression-based correlations with controls. Indeed, regression-based correlations with controls are more informative

than bivariate correlation tests as exist in earlier studies. It is worth noting that most of the controls had no data on some of the years, hence threatening the strength of the model in an attempt to include them. We believe that in addition to the limitations acknowledged, this should suffice for a regression-based correlational study with robust statistical evidence.

5.5. Policy discussion and recommendation

This study has demonstrated that a mother's education has a statistically significant association with the number of "own-child/children" who have died. The results remain consistent and robust over the study period and across gender and various data collection rounds from 1988 to 2014 (Andriano and Monden, 2019; Hobcraft, 1993). The evidence provided in this study is not new in the literature; however, the results come to support the argument that most developing countries, especially Ghana, can plausibly harness the policies that are not wholly dependent on donor support.

In Ghana, one sector that has to a large extent relied on donor funding has been the health sector. Yet, due to inadequate donor funds, delays in the release of funds, as well as conditionalities attached to such funds, the government of Ghana as a matter of policy has launched a charter and a strategy document towards Ghana Beyond Aid. The primary purpose of this policy document is to ensure that sectors such as the health sector will employ policies and practices that are not depended on foreign aid or donor funding. A key social determinant of health that can be harnessed and promoted in line with Ghana Beyond Aid is the mother's health education, to educate mothers in order to equip them with the requisite disposition (behaviour), skills and knowledge necessary for positive health outcomes for the child and the entire household.

Following this evidence on Ghana, this study recommends that health education should be included in the academic curricula from the basic level through the higher levels of education because it can impact positively on child survival. This is more effective and sustainable than relying on donor support annually with the accompanying strings and undue delays that stifle policy implementation in healthcare. The Ministry of Education, Ministry of Health and Ministry of Finance should collaborate to ensure that this is implemented.

Students must be encouraged to pursue health education to acquire a basic knowledge of quality healthcare. For implementation purposes, this can be incorporated into the free compulsory basic and secondary education policies that are currently being implemented. In other words, without necessarily depending on donor funding, science teachers at the basic level can include in their syllabus content that borders on practices for keeping the under-five alive. This can be modified with a lot more detail as the pupil progresses in his or her academic life.

For the illiterates, a simple and affordable community-level health education should be encouraged so that the spread of health knowledge will not be lopsided. Thus, health education should not be limited to those in formal education. Mothers who have passed the basic level should be encouraged to take up community-level programs. In addition, providing radio and television health education in local languages with relevant demonstrations can better communicate with the locals for better health outcomes. In recent times, mobile phone use has recorded a very high penetration in Ghana. Telecommunication companies, as part of their corporate social responsibility, can promote health education through their interactive voice response (IVR) platform. Social media platforms such as WhatsApp and Facebook can be used to promote health education. By this, health education would be encouraged at all levels of education for a further reduction in child mortality and other health concerns in Ghana.

Government budgetary allocations to the health sector must have a good portion earmarked for maternal education or empowerment that aims to reduce the mortality of children under five years of age. The Ministry of Finance and Ministry of Education must have a long-term plan to ensure that this is implemented.

5.6. Contribution to knowledge

The knowledge addition comprises the researchers' own construction of a conceptual framework that informs the study, the methodological rigour and the key findings that have policy impact. The findings provide evidence to influence policymakers to allocate a reasonable amount of the government budget for the education of women, as it contributes to empowerment as well as the survival of children.

The outcome has implications for formulating an Adult Education policy that provides continuous health education for women that can translate into child survival or into reducing infant mortality. The findings have a reflection on public policy by way of focusing attention on maternal empowerment and investment in maternal health education to increase the health of mothers in the current and future generations. Lastly, the findings support the need for future studies to further examine how robust social structures can enhance the benefits of mothers' knowledge, skills and behaviour for children's health and survival.

6. Conclusion

This paper was motivated by the fact that Ghana has in recent times experienced a marked decline in child mortality. However, in comparison with the global average, child mortality can be described as quite high in Ghana. In such a developing country with low-income levels, one social determinant that can promote the health outcomes for children and correlates with child mortality is the mother's level of health education. In the absence of a variable that measures a mother's health education from the DHS dataset, we used *mother's level of education completed* as its proxy. This study sought to explore whether a mother's education correlates with child survival. This is very important given the call for sustainable child health and policy for sustainable funding of the health sector in the light of the Ghana Beyond Aid initiative. Women's empowerment through education and knowledge has been identified in the literature as associated with child survival. To test this relationship, this study adopted a negative binomial model using all the six rounds of the DHS dataset from 1988–2014 with 33,896 observations. The results show that educating a mother is an important variable associated with child mortality in Ghana. In other words, if you educate a mother, you have a higher chance of saving the life of a child, as compared to the result of denying a mother an education. The result is consistent over all the rounds of data collection (i.e., from 1988–2014). In addition, the result is robust across gender. In short, our evidence show that maternal education is associated with an average of approximately 6%–20% reduction in child mortality in Ghana.

Further to the results, we argue that inasmuch as a mother's education is associated with child survival, we admit that it is not the only variable. Other equally statistically significant determinants include wealth, use of bednets by households, and experience of pregnancy termination among others.

In line with the Ghana Beyond Aid policy, this study is recommending a non-donor-funded approach, that is to say, health education should be incorporated into the academic curricula at all levels of the academic ladder so that students will be equipped with health knowledge before they become mothers. In addition, community-level programs through television, radio, durbars and platforms driven by information communication and technology (ICT) should be harnessed in promoting quality health education in Ghana.

Declarations

Author contribution statement

Anthony Amoah: Conceived and designed the experiments; Performed the experiments; Analyzed and interpreted the data; Contributed reagents, materials, analysis tools or data; Wrote the paper.

Moses Kumi Asamoah: Contributed reagents, materials, analysis tools or data; Wrote the paper.

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Data availability statement

Data will be made available on request.

Declaration of interest's statement

The authors declare no conflict of interest.

Additional information

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