Research

Exploring the policy implications of household wealth differentials and under-five child deaths in Ghana

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Abstract

Background Ghana was one of the few countries commended to have halved extreme poverty after the MDG era yet the under-five mortality rate (U5MR) was dire. Ghana's U5MR is still above the national and global SDG target. As a result, the government has over the years implemented other complementary social and policy interventions to improve the socioeconomic status of households to ensure better child health outcomes. Yet key gaps exist and threaten child health outcome sustainability, and child health-related SDG targets. In this regard, we hypothesize that household wealth should therefore not influence under-five child deaths significantly.

Methods The paper first reports the under-five mortality trend over the past 30 years in Ghana. It uniquely analyses the levels and trends in wealth as measured by the Gross National Income per capita at purchasing power parity (ln GNI/p, ppp) as a proxy of the mean Comparative Wealth Index (CWI) against under-five child deaths in Ghana. Using data from the 2014 Ghana Demographic and Health Survey and employing the logistic regression estimation technique, the paper further estimates the effect of household wealth and other key covariates on under-five child deaths. Implemented government poverty-alleviating policies and intervention programs to reduce childhood mortality in Ghana were reviewed to identify risk gaps to child deaths.

Results The 30 year trend analysis from 1990 to 2020 shows that the under-five mortality rate in Ghana is still high, falling short of the rate of decline that is expected toward achieving the 2030 SDG target for U5MR of 25 deaths per 1000 live births. Our empirical estimations show that household wealth still has a negative and significant relationship with under-five child deaths despite the government's existing poverty-alleviating and pro-poor health policies. In addition, the results show that regional differences, maternal age, the number of children alive, and attendance to postnatal healthcare services are crucial for child survival.

Conclusion The results imply that the government should consolidate universal programmes with intensified targeted interventions toward improving household wealth, especially in the Northern Savannah regions. A new and dynamic child health policy is imminent to reflect strategies towards achieving the SDG target on U5MR. Additionally, intensive education on active maternal participation in postnatal care should be given critical consideration to improve child survival.

Keywords Household · Wealth index · Poverty · Under-five mortality · Child death · Regression · Government · Intervention · Policy · Ghana

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Abbreviations

CHPS	Community-Based Health Planning Services
CWI	Comparative wealth index
DHS	Demographic health survey
GDHS	Ghana Demographic Health Survey
GSS	Ghana Statistical Service
IWI	International Wealth Index;
LEAP	Livelihood Empowerment Against Poverty
Ln GNI/p, ppp	Natural log of the Gross National Income per capita based on purchasing power parity
MPI	Multidimensional Poverty Index
NCCE	National Commission for Civic Education
NDA	Northern Development Authority
NDPC	National Development Planning Commission
NHIS	National Health Insurance Scheme
PNC	Post-natal care
SADA	Savannah Accelerated Development Authority
SDG	Sustainable development goal
U5D	Under-five deaths
U5MR	Under-five mortality rate
UN IGME	United Nations Inter-Agency Group for Child Mortality Estimation
WHO	World Health Organisation

1 Background

Ghana was recognized as one of the few countries in the sub-region to have successfully halved extreme poverty before the onset of the Sustainable Development Goals (SDGs) [1]. However, despite this accomplishment, the rate of reduction in child under-five deaths has shown slow progress [1]. While evidence indicates a decline in child mortality rates over time, they still present a significant challenge to Ghana's national development endeavors [2]. Global estimates from WHO showed that 1 in 27 children died before reaching age five [3]. In Ghana, the statistics are even more concerning, with 1 out of every 17 Ghanaian children succumbing to mortality before their fifth birthday, as reported in the Ghana Demographic and Health Survey [4].

The most recent comprehensive child policy implemented by the government of Ghana was the Under-Five Child Health Policy from 2007 to 2015, with the objective of reducing under-five mortality to 40 deaths per 1000 live births by 2015 [5]. However, by 2015, this target was not met and has sparsely been met even with recent estimates (see Table 1). Essentially, at the end of the national policy in 2015, Ghana recorded a relatively high under-five mortality rate of 54.6 per 1000 live births. Though this ratio has reduced marginally in recent years from 46.2 in 2019 to 45 deaths per 1000 live births in 2020 [6, 7], these estimates are still above the national policy and SDG targets of 40 deaths and 25 deaths per 1000 live births, respectively. This has critical implications for future child health policies and ensuring sustained economic growth and development.

Studies have shown that improving household socio-economic circumstances through efficient health financing schemes and policies has been identified as a critical driver of development [8–10], including a reduction in the rate of under-five child deaths and morbidity [11]. Between 2006 and 2011, the disparity in child mortality rates between the rich and the poor had doubled in Ghana, with children in rich groups now twice as likely to survive as poor children [12]. Socioeconomic differences, especially the uneven distribution of wealth are widely known to have long and adverse effects on child survival [13], thereby obscuring progress in achieving the SDGs.

Our results of the 30-year trend analysis from 1990 to 2020 show that the under-five mortality rate in Ghana is still high, falling short of the expected rate of decline that is needed toward achieving the 2030 SDG target for U5MR of 25 deaths per 1000 live births. Using data from the 2014 Ghana DHS, the empirical estimations show that under-five child deaths are higher in the relatively poor northern regions despite the government's poverty-alleviating policies. However, household wealth played a significant effect in the reduction of under-five child deaths, especially for those in the upper 20 percent of the wealth quintile. In providing robust policy recommendations, we call for the intensification of poverty-alleviating programmes and reassessment of the under-five child policy to meet current demands. Beyond the regional

Table 1 5 year interval levels and trends in under-five mortality rates and under-five deaths in Ghana

Year	Under-five mortality rate (per 1000 live births)	Under-five deaths
1990	127.4	72,685
1995	114.2	71,055
2000	99.7	66,852
2005	83.0	59,481
2010	69.1	53,884
2015	54.6	45,807
2020	44.7	39,214
(U5MR Target: SDG = 25; National = 40)		

Source: UN IGME Database (2022)

locational differentials, other statistically significant covariates were the age of the woman, the number of children living in the household, and the critical role of post-natal care attendance.

Studies have rarely considered an examination of government policies in the context of addressing under-five children's health and well-being. Furthermore, an assessment of complementary government policy measures and a look at how the country can adapt to more sustained under-five child survival-based interventions in achieving the SDG target for 2030 is sparsely indicated in the literature. Also, trends in the rate of under-five deaths in informing advancements toward achieving the SDG target are rarely analyzed in Ghana. This paper seeks to address this gap. Hence, this paper hinges on the hypothesis of the factors influencing under-five child deaths given existing complementary government interventions in reducing child deaths in Ghana.

Following this background, this research paper is structured as follows: the second section identifies key government policies in addressing health outcomes while the third section provides a review of household wealth and under-five child deaths in Ghana. In Section. 4, the paper assesses the trend analysis while the fifth section introduces the theoretical framework of the study. Details of the study methods as well as the results and discussion are shown in sections six and seven, respectively. This is then followed by concluding remarks with key policy recommendations.

2 key poverty-alleviating government interventions in improving child health outcome in Ghana

In most countries, health expenditures have been rising more rapidly than national income, to the extent that more countries are finding that in spite of cost containment measures, some are devoting more resources to pay for health-related services and goods, including childcare [14, 15]. Hence, improving household wealth has become very crucial across nations. To improve health, most countries embark on policy reforms: the provision of logistics, services, social and capital intervention programmes to improve the wealth status of inhabitants aimed at spurring economic growth. These reforms are equally critical to child survival and child health.

The Government of Ghana introduced policies and programmes to augment the opportunity cost of financing healthcare services and to further promote public health and health outcomes, including reducing child deaths. Some of these key policies include the promulgation of the National Health Insurance Scheme (NHIS) law in 2003 (consisting of free maternal healthcare, and free treatment of children aged below 18 years), the construction of Community-Based Health Planning and Services (CHPS) to serve as easy access to healthcare facilities, the Livelihood Empowerment Against Poverty (LEAP) cash transfer and the formation of the Northern Development Authority (NDA) erstwhile Savannah Accelerated Development Authority (SADA) which targets mainly the Northern Savannah Ecological Zone (NSEZ) of Ghana where poverty and child deaths are comparatively highest [16]. Despite their positive impacts, prevailing challenges put child health outcomes at risk, either directly or indirectly.

The NHIS was introduced in 2003 to remove financial barriers by abolishing user fees and ensuring more equitable access to health care, especially for the poor and the vulnerable, including the objective to reduce child deaths. Children below 18 years old, individuals aged 70 and above, formal sector workers contributing to the Social Security and National Insurance Trust (SSNIT), and those identified as indigents are not required to pay annual premiums. In July 2008, the Ghanaian government introduced a policy offering free maternal care, which waived premium and processing fees

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for all expectant mothers. This initiative aimed to enhance access to skilled attendance at delivery, ultimately reducing maternal and child mortality rates and advancing the achievement of Millennium Development Goals 4 and 5 [9, 17]. Despite its positive impact, issues of managerial capacity, inadequate and uneven distribution of medical facilities and healthcare professionals, cost escalation, fraud and abuse, and delayed reimbursement of providers threaten the sustainability of the scheme [18].

The Community-based Health Planning and Services (CHPS) initiative which was launched in 2000 is a nationwide healthcare reform effort that leverages volunteerism, resources, and traditional institutions to support primary healthcare at the community level. It entails delivering healthcare services directly to the doorsteps of community members, especially rural women, and children. The construction of CHPS compound health zones is to reduce the indirect cost of health such as time and distance by ensuring proximity to the nearest health facility. In a qualitative survey, [19] identified the lack of incentives for Community Health Officers and Community Health Volunteers and inadequate infrastructures such as potable water and electricity as well as inadequate equipment and poor community engagement as setbacks to the progress of the CHPS policy.

The LEAP cash transfer was implemented in 2008 to provide bimonthly cash transfers to poor and vulnerable households including access to basic health. Beneficiaries of the programme constitute the bottom 20% of the poorest in Ghana with the target group consisting of orphans and vulnerable children (OVCs) along with their caregivers, individuals aged 65 and above lacking livelihood support, and persons with disabilities (PWDs) who do not have any productive capacity. However, it has been discovered that irregular payments, insufficient cash amounts, and difficulty in accessing complimentary services, especially healthcare access rob beneficiaries of enjoying the full benefit of the LEAP programme [20].

The establishment of the Northern Development Authority was established in 2017 to provide framework avenues to reduce the wealth and health gap between the relatively poor geographic north and the relatively rich south including policies and programmes to improve child and maternal health through increased household wealth opportunities within the regions in the north. However, according to Kwao and Amoak [21], after years of sustained concentration of development aid and NGO operations in the region, entrenched poverty remains pervasive in northern Ghana, with significant implications for rural livelihoods including under-five child deaths.

The literature on child health outcomes in Ghana given the existing government interventions is sparse. In effect, these policies and programmes, which among other objectives, are targeted at increasing household wealth. Hence, with these policies, current household wealth should not significantly influence under-five deaths. We further examine other contextual factors that significantly influence under-five child deaths in Ghana and then propose some policy recommendations for achieving the 2030 SDG targets on U5MR.

3 Household wealth and under-five child deaths

Childhood mortality rates are used to monitor a country's progress towards the Sustainable Development Goal 3, specifically, target 3.2 which aims to reduce under-five mortality to at least 25 per 1000 live births by the year 2030 [22]. Many lives of children can be saved if the gaps in wealth across countries are closed [23]. The differentials in household wealth in a country have spillover effects on child health outcomes while disparities in wealth also affect the child health status of individuals within and among groups [24]. Hence increases in household wealth imply increases in health demand and consumption of quality health services which calls for regular policy reforms [25].

At the global level, between 1990 and 2016, by relative difference, children in the poorest quintile were twice as likely to die before their fifth birthday compared to those in the richest quintile [26]. The study by Bado and Apunni [27] shows that across seven West African countries, it was realized that households in the poorest wealth quintile had the highest proportion of under-five deaths. In all the countries under review, the value of the concentration index was negative, and it therefore showed that under-five mortality is concentrated among children from poor households as compared to children from wealthy households. However, both studies did not situate their results in any specific existing government policies on child health.

In Ghana, the study on under-five child mortality by Lartey et. al. [13] showed that there was a significant relationship between household wealth status and child survival in Ghana, but the study was limited to the period 1993 to 2008. Aheto [28] also analyzed predictive factors for child under-five mortality in Ghana but the study was limited in its inability to examine the key role of household wealth to child health outcomes which is critical for policy formulation and efficient allocation of resources. Moreover, whereas the study by Acheampong and Avorgbedor [29] failed to consider household wealth in their analysis, the study by Aheto et al. [30] found wealth to be an insignificant

predicting factor for under-five child mortality in Ghana. Moreso, these studies did not consider the critical contextual role of postnatal care services on under-five child survival for which this study further uniquely hypothesizes. Additionally, existing studies on child mortality in Ghana were limited as discussions did not consider the assessment of existing government policies aimed at improving household wealth to help reduce under-five child deaths. This study therefore seeks to fill the research gap by finding out if government poverty-alleviating policies are having a significant impact and therefore whether household wealth differentials still have any significant effect on under-five child deaths in Ghana.

There are wealth differentials between the north and the south in Ghana [12]. Ghana's northern regions are marked by a relatively larger population who do not have proper healthcare and are within the lower household wealth status [31]. Consequently, most of the government's poverty-alleviating policies are increasingly being implemented in the north and targeted at improving the wealth status of households either directly or indirectly. Hence, we hypothesize wealth plays an insignificant role in child health outcomes.

4 Measuring wealth: levels and trends

Measuring household wealth and wealth across and within nations has always been a daunting task. Direct estimates of household income and expenditure in health-related surveys are desirable but not practical [32]. Health-related surveys have been challenged with the collection of accurate income or expenditure data by factors such as seasonality, volatility, misreporting, and limited interview time [33, 34]. Various methods, notwithstanding their varied limitations, and alternate measures of economic status and poverty have been introduced, such as the DHS Comparative Wealth Index (CWI), the Gross National Income per capita based on purchasing power parity (GNI/p, ppp), Unsatisfied Basic Needs (UBN), Multi-dimensional Poverty Index (MPI), International Wealth Index (IWI) and World Health Survey Methods of Economic Status.

The DHS Comparative Wealth Index (DHS CWI) has widespread comparability and adoption for analyzing differences in population and health indicators between wealth quintiles [35]. However, due to the paucity of data for CWI for Ghana, this study uses GNI/p, ppp [36] as a proxy in examining the association between wealth and under-five mortality in Ghana. The natural log of this measure may come with some limitations including nullifying the homogeneity assumption since incomes are not equally distributed across the country, differences in cost of living and consumption patterns and temporal dynamics, including changes in economic conditions, exchange rates, and revision of methodology. Despite its setbacks, according to Rutstein and Staveteig [37], the trends in the natural log of the Gross National Income per capita based on purchasing power parity (ln GNI/p, ppp) is used as an alternative indicator of wealth since it is highly positively correlated with the mean of the DHS CWI. This section begins by first looking at the trajectory of the changes in ln GNI/p, ppp to changes in under-five child mortality in Ghana and then assessing the levels and trends in wealth (index) for Ghana.

Figure 1 shows the relationship between the under-five mortality rate (primary axis) and the natural log of the Gross National Income per capita at purchasing power parity (ln GNI/p, ppp) for Ghana (secondary axis). Rutstein and Staveteig [37] have shown that there is a high positive correlation between the mean Comparative Wealth Index (CWI) and the natural logarithm of the Gross National Income per capita at purchasing power parity (ln GNI/p, ppp) for most countries with Demographic and Health Surveys, in accessing the monetary equivalents of the wealth index. Ln GNI/p, ppp is therefore used as a proxy for household wealth. However, given its limitations as outlined earlier, its use and interpretation in this study should be exercised with caution. From Fig. 1, it is observed that, as ln GNI/p, ppp increases, all things being equal, the under-five mortality rate (U5MR) tends to decrease. Though the general improvements in the decline of U5MR cannot be entirely attributed to household wealth, its contribution towards the demand for better and quality child health survival cannot be underestimated. Over time, though wealth plays a significant role in the determination of health outcomes, the literature relating health to wealth has gained global and local attention [13, 38–40]. Research to inform policy in this area has been limited in the past partly due to the difficulty in collecting wealth data and the limited availability of surveys that collect both wealth and health information in most countries across the world including Ghana.

4.1 Levels and trends in under-five mortality: the case of Ghana

Table 1 presents the trends and levels of under-five mortality rate and the corresponding under-five deaths in Ghana over the five-year interval period from 1990 to 2020 as well as the corresponding estimated figures as extracted from
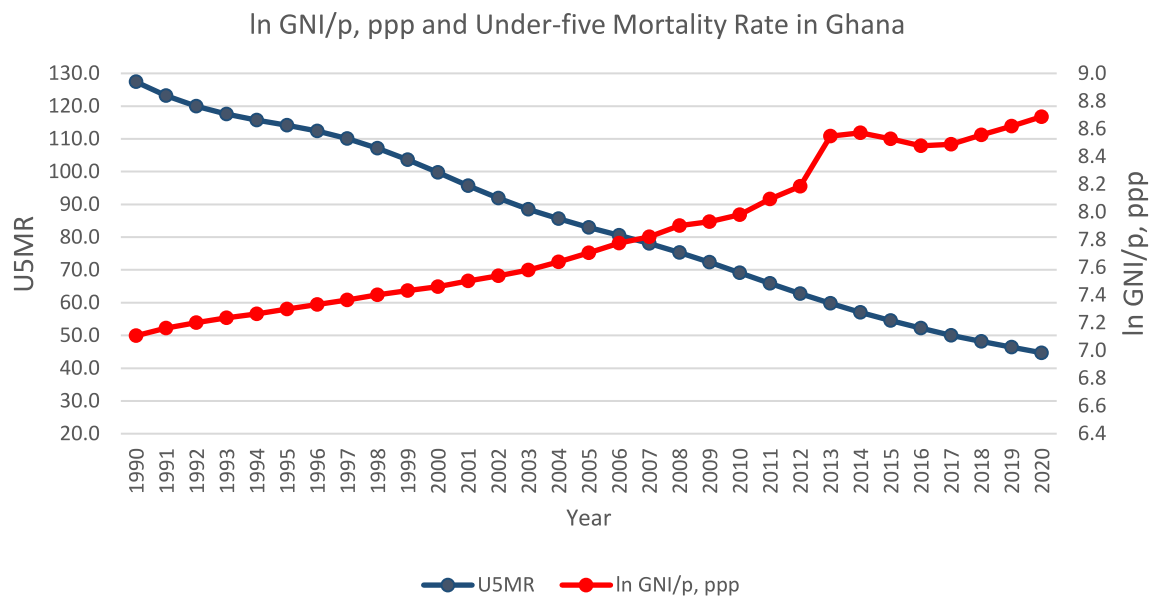
Fig. 1 Wealth and under-five child mortality rate in Ghana, 1990–2020. Source: Estimates were computed from UN IGME (2019) and World Bank Database (2021)

the United Nations Inter-agency Group for Child Mortality Estimation (UN IGME) database. It can be observed that although both indicators are reducing over time, the under-five mortality rate and the number of children dying before their fifth birthday in Ghana are still high beyond the national and SDG targets.

According to projections by the Global Burden of Disease (GBD) 2017 SDG Collaborators, numerous countries are progressing towards the objective of attaining a rate of no more than 25 deaths per 1000 live births by the year 2030. Nevertheless, approximately 31 countries or territories would be required to attain annual rates of reduction from 2015 to 2030 that are between two and ten times greater than the rates observed during the period from 1990 to 2015 in order to meet this target [41]. Between 1990 to 2015, U5MR in Ghana reduced by 133.3% (Table 1). In the 10-year period between 2010 and 2020, the under-five mortality rate has reduced by 35% (Table 1). Assuming the rate of reduction over this last 10-year period remains the same in the next 10 years from 2020 to 2030, this implies, by 2030, Ghana's U5MR will hover around 30 deaths per 1000 live births which is still above the target set under the sustainable development goal of 25 deaths per 1000 live births. This therefore calls for expedited action in policy reform and strengthening of current interventions in curtailing under-five child deaths. Despite the improvements over these 10 years, the under-five mortality rates across the regional locations are still significantly high and far above the SDG target of 25 deaths per 1000 live births as well as the previously estimated 2015 national target of 40 deaths per 1000 live deaths (see Appendix 1).

5 Theoretical model for child mortality

The theoretical model on under-five deaths used in this paper is founded on the theory of 'demand for health' promulgated by Grossman [42] which was later modified by Wagstaff [25]. The model used in this study is based on the health production function concept of the theory of 'demand for health' which postulates that individuals/households produce health by utilizing socioeconomic variables. According to Wagstaff [25], these socioeconomic determinants influence the health production of an individual. For under-five child deaths, the health outcome of a child is therefore determined by socioeconomic factors that may influence the child's survival. Therefore, the probability of a child's death or otherwise will highly be influenced by these socioeconomic inputs of health such as household wealth, maternal education, and postnatal attendance, among others.

6 Methods

6.1 Empirical estimation

In order to investigate the effect of household wealth status on child health outcome, the study starts with a health model specified in a cross-section form as follows:

$$Y = \alpha_i + X_i\beta_i + u_i \quad i = 1, 2, \dots n \tag{1}$$

where Y is a vector of the dependent variable,

α_i is the intercept which represents the household/individual specific effect.

X_i is the vector of independent variables,

β_i is the vector coefficients of the independent variables and.

u_i is the error term which is assumed to be normally distributed.

The main control variable in this paper is household wealth. However, from the literature, other socioeconomic parameters influence child health outcomes such as maternal education, employment status, and regional location. Given that the main aim of the study is to assess the effect of household wealth on under-five child deaths in Ghana, the paper includes a set of other control variables that have been identified in the literature as determinants of under-five child deaths. These variables include maternal age, number of living children, distance – which captures physical access as an indirect cost to health, and maternal postnatal attendance.

Adding these set of control variables into Eq. (1), we have:

$$U5D = \alpha_i + \beta_1 We_i + \beta_2 Rg_i + \beta_3 Re_i + \beta_3 Ed_i + \beta_4 Em_i + \beta_5 Ag_i + \beta_6 Ch_i + \beta_7 Dh_i + \beta_8 Pn_i + u_i \tag{2}$$

where 'U5D' is under-five child death, 'We' is the household wealth index, 'Rg' is the regional location, 'Re' is the residential status, 'Ed' is the female educational level, and 'Em' is the employment status of the female. In addition, 'Ag' is the age of the woman, 'Ch' is the number of living children born to the mother, 'Dh' is the distance to the nearest health facility, and 'Pn' is the postnatal care attendance by the woman within two months of childbirth.

6.2 Estimation technique

The Logit model is employed in this paper. Given the binary outcome of the dependent variable, a dichotomous response regression model is employed. We explain the logit model by considering under-five child death as a representation of child health output regressand (i.e., U5D).

The logistic regression predicts the probability of an event occurring [43]. For our estimation, we specify the logit function as follows:

$$L_i = \ln\left(\frac{P_i}{1 - P_i}\right) = \beta_1 + \beta_2 X_i + u_i \tag{3}$$

where u_i is the stochastic error term.

$P_i / 1 - P_i$ is simply the odds ratio in favour of whether a child under 5 years died. This ratio shows the probability of the event occurring to the probability of the event not occurring. The logit (natural logs) regression expresses the odds of the unknown binomial variable as linearly dependent on the explanatory variable and this linear relationship is derived from the logistic Cumulative Density Function (CDF). To suit our estimation equation on the effects of the independent variables, we have

$$\frac{P_i}{1 - P_i} = e^{\left(\beta_1 + \sum \beta_{2i}X_{2i} + \sum \beta_{3i}X_{3i} + \sum \beta_{4i}X_{4i}\right)} = e^{\beta_1}e^{\beta_2 X_2} \dots e^{\beta_i X_i} \tag{4}$$

$\sum X_{2i}$ = vector of the effect of household wealth.

$\sum X_{3i}$ = vector of other socioeconomic factors (mother's education, employment status).

$\sum X_{4i}$ = vector of demographic and other independent variables.

e raised to the power β_i is the factor by which the odds ratio changes when the ith independent variable increases by one unit.

6.3 Data

This study uses the 2014 Ghana Demographic and Health Survey (GDHS) for its analysis.[1] The data were obtained from the DHS MEASURE Program [44] which is freely available online and contains information on a wide range of population, health, and nutrition indicators such as childhood mortality, maternal and child health, use of family planning methods, nutritional status of women and children as well as household socioeconomic variables. This is a nationally representative survey of 9,396 women aged 15–49 and 4,388 men aged 15–59 from 11,835 interviewed households [16]. The 2014 GDHS is the sixth in a series of population and health surveys conducted in Ghana as part of the global Demographic and Health Surveys (DHS) Program. The earlier rounds of the surveys were conducted in 1988, 1993, 1998, 2003, and 2008. The survey was implemented by the Ghana Statistical Service (GSS), the Ghana Health Service (GHS), and the National Public Health Reference Laboratory (NPHRL) of the GHS using three types of questionnaires, namely, Household Questionnaire, Women's Questionnaire, and Men's Questionnaire. These questionnaires were adapted to reflect the population and health issues relevant to Ghana.

The child mortality status in the GDHS is extracted from information gathered in the birth history section of the Woman's Questionnaire. Our analysis was based on the recoded under-five children's data which consists of 5,884 observations. Women aged 15–49 were asked whether they had ever given birth. Those who had ever given birth were asked to report the number of sons and daughters living with them, the number living elsewhere, and the number who had died. Women were also asked for the number of births they had that did not end in a live birth. A detailed history of all births was gathered in chronological order starting with the first birth. Women were also asked whether a birth was single or multiple, the sex of the child, the date of birth (month and year), survival status, the age of the child on the date of the interview if alive, and, if not alive, the age at death of each child born alive.

7 Results and discussion

7.1 Descriptive analysis

The summary statistics of the selected factor variables of child under-five deaths are presented in this section. The 2014 GDHS asked women who had given birth within the five-year period prior to the survey questions about child health. The chi-square test is employed to determine whether there exists some bivariate association between the dependent and independent variables. A look at Table 2 shows that, for under-five deaths, bivariate associations are observed for regional location, distance to health facility, the number of living children, and postnatal attendance.

For under-five deaths, Table 2 shows that relatively, households in the Poorer (5.29%) and Poorest (5.14%) wealth quintile have higher proportions of under-five deaths compared to the Richer (4.64%) and the Richest (4.40%) groups. At the regional level, we also observe that the Northern, Central, Ashanti, and Upper West regions each recorded more than 5 percent of under-five child deaths. Similar proportions are observed for women whose ages were above 29 years. Moreover, the number of under-five deaths for women who attended postnatal check after delivery was higher (1.64%) compared to those who did not attend postnatal (6.09%).

7.2 Empirical results

The estimates for the determinants of under-five deaths in Ghana are presented in Table 3. The multivariate logistic estimation shows that wealth, regional location, age of the woman, number of children alive, and postnatal attendance of the female, have a statistically significant relationship with under-five child deaths in Ghana.

Analysis of the household wealth differentials in Table 3 shows that, in general, females in higher wealth quintile households are less likely to experience under-five deaths. Specifically, the odds of under-five deaths are statistically significant and are less likely to occur amongst households in the upper 20 percent of the wealth quintile (richest category) compared to their counterparts in the bottom 20 percent (poorest category). In Ghana, there are significant differences between the rich and the poor and this is geographically captured in the north–south gap. Within the country, it can be observed from

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[1] Recent data for the 2022 GDHS has been collected but has not been released to the public for further research as at the time this paper was curated.

Table 2 Descriptive statistics for under-five child deaths

Individual Variables	Under-five child deaths		Pearson's Chi-Square
	No (%)	Yes (%)	
Wealth			1.37
Poorest	94.86	5.14	
Poorer	94.71	5.29	
Middle	95.38	4.62	
Richer	95.36	4.64	
Richest	95.60	4.40	
Region			26.73***
Western	96.91	3.09	
Central	94.86	5.14	
Greater Accra	97.17	2.83	
Volta	95.43	4.57	
Eastern	94.31	5.69	
Ashanti	93.49	6.51	
Brong Ahafo	96.17	3.83	
Northern	93.35	6.65	
Upper East	96.91	3.09	
Upper West	93.50	6.50	
Residence			0.019
Urban	95.14	4.86	
Rural	95.06	4.94	
Education			6.06
No Education	94.17	5.83	
Primary	95.62	4.38	
Secondary and above	95.56	4.44	
Employment Status			0.25
Not Working	95.40	4.60	
Working	95.03	4.97	
Age(years)			9.82
15–19	97.10	2.90	
20–24	95.04	4.96	
25–29	96.12	3.88	
30–34	94.89	5.11	
35–39	94.16	5.84	
40–44	94.71	5.29	
45–49	92.57	7.43	
Distance to health facility			10.65***
A big problem	93.75	6.25	
Not a big problem	95.72	4.28	
Birth order			11.07***
1 Child	94.91	5.09	
2–4 children	95.90	4.10	
5 or more children	93.67	6.33	
Postnatal check			60.88***
No	93.91	6.09	
Yes	98.36	1.64	

Source: Author's computation from the 2014 GDHS

the results that the mortality rates are relatively higher in the northern part of the country compared to the other parts of the country especially, the Greater Accra Region, where most of the well-advanced health facilities and infrastructure are located. This is due to the wealth disparity that exists between the relatively poor north compared to the south of the country [12]. Our empirical estimates show that the odds of women experiencing child under-five deaths in the Northern, Upper

East, and Upper West Regions were about six, five, and four times higher than the odds of their counterparts in the Greater Accra Region, respectively. These further lay credence to the relatively increasing risks of child deaths associated with lower-income groups in the country.

In terms of age, relative to females in the age group of 15–19 years, a woman's age has been depicted to be statistically significant in influencing under-five deaths at all age groups with the exception of those in the 20–24 year group. The magnitude of the odds of age influencing child deaths increases with higher age groups. For example, the odds of under-five deaths experienced by women in the age group of 45–49 years is about 127 times higher relative to the reference category (15–19 years). The results from Table 3 also show that as the number of living children born to a woman increases by one, it reduces the odds of a child dying before his/her fifth birthday whereas the attendance of postnatal care by mothers significantly reduces the chances of under-five deaths. Also, relative to the odds of women who did not attend postnatal, the odds of women who received postnatal checks within two months after childbirth were less likely to experience under-five child deaths.

7.3 Discussion

The study sets out to investigate the critical role of household wealth in influencing under-five mortality in Ghana given the government's policies and programmes aimed at improving household wealth and consequently, child health outcomes. The study also examined other key maternal characteristics influencing under-five child deaths in Ghana.

Out of the 5884 children in the data, 289 (4.91%) of them died. The empirical estimates show that children born in households in the upper 20 percent are less likely to die before their fifth birthday. Other confounding factors associated with under-five child deaths were region of residence, maternal age, number of children living in the household in the last 5 years, and postnatal care attendance.

This study particularly focuses on examining the effect of the differentials in household wealth on under-five child deaths in Ghana. Despite government interventions, household wealth still plays a critical role in child survival. Certainly, the health and overall well-being of children are undeniably influenced by the households they live in. As such, the opportunities, risks, and resources accessible to children throughout their lives are largely shaped by their household environments [45]. This is essential in the cumulative drive towards achieving the SDG target of U5MR. The current study reinforces earlier research endeavors that explored under-five mortality in developing nations, particularly within Sub-Saharan Africa and specifically in Ghana [10, 26–28, 30]. Children born to mothers residing in Western, Central, Volta, Ashanti, Brong Ahafo, Northern, Upper East, and Upper West regions, as well as mothers aged above 24 years, are linked with higher odds of under-five child deaths. Conversely, children from mothers in the highest wealth quintile and those increasing number of children living with them, as well as those who attend postnatal care, particularly within the first six weeks, exhibit decreased odds of under-five child deaths.

Under-five childhood mortality is notably lower among children born to mothers in the richest quintile compared to those in the poorest quintile. Except for the Eastern region in the south, the probability of under-five child deaths rises with children born in all other regions compared to those born in the Greater Accra region in the south. These findings are consistent with previous research [10, 12]. The Northern region records the highest rate of under-five child deaths at 111 per 1000 live births, followed by the Upper West region with 92 per 1000 live births (see Appendix 1). In contrast, the lowest rate is observed in the Greater Accra region at 47 per 1000 live births. This study aligns with prior research indicating that the geographical locations of children influence their health outcomes [30, 46]. The allocation of political power and socioeconomic resources significantly affects the health status of populations across various levels, including local, regional, and national scales. In Ghana, substantial regional disparities exist in the distribution of socioeconomic resources, particularly in healthcare delivery, availability of health personnel, and wealth. This discrepancy arises from a lack of strong political commitment to implement comprehensive and equitable health and economic policies uniformly across all regions [47]. Moreover, the discrepancies in under-five mortality rates across regions may be attributed in part to differences in the implementation of national health policies and programs, as well as to insufficient healthcare services and substandard living conditions within households. This further corroborates our hypothesis as evidenced in other studies [12, 28, 30, 48].

Consequently, the disparities in under-five child deaths are notably more pronounced in the poor northern regions compared to the relatively affluent southern areas. This is despite the substantial concentration of government interventions in the northern regions aimed at improving the welfare of vulnerable households, such as the Livelihood Empowerment Against Poverty (LEAP) program, the National Health Insurance Scheme (NHIS), and initiatives by the Northern Development Authority. A thorough reassessment of current policies is imperative to achieve optimal outcomes.

Table 3 Logistic regression estimates for under-five child deaths in Ghana

VARIABLES	Under-five child death	
	Logit coefficient	Odds ratio
Wealth (Ref: Poorest)		
Poorer	0.361	1.435
	(0.312)	(0.447)
Middle	− 0.058	0.943
	(0.362)	(0.341)
Richer	− 0.518	0.596
	(0.440)	(0.262)
Richest	− 0.900*	0.407*
	(0.524)	(0.213)
Regional location (Ref: Greater Accra)		
Western	1.248**	3.482**
	(0.602)	(2.095)
Central	1.385**	3.994**
	(0.602)	(2.404)
Volta	1.119*	3.061*
	(0.659)	(2.016)
Eastern	0.251	1.285
	(0.638)	(0.820)
Ashanti	1.574***	4.824***
	(0.581)	(2.805)
Brong Ahafo	1.103*	3.014*
	(0.600)	(1.807)
Northern	1.843***	6.317***
	(0.614)	(3.879)
Upper East	1.605**	4.980**
	(0.660)	(3.289)
Upper West	1.296*	3.656*
	(0.666)	(2.433)
Residential Location (Ref: Urban)		
Rural	− 0.306	0.736
	(0.260)	(0.191)
Education (Ref: No education)		
Primary	− 0.272	0.762
	(0.321)	(0.244)
Secondary and above	− 0.031	0.969
	(0.273)	(0.265)
Employment (Ref: Not working)		
Working	0.169	1.185
	(0.267)	(0.316)
Age (Ref: 15–19 years)		
20–24 years	0.597	1.816
	(0.564)	(1.025)
25–29 years	1.027*	2.793*
	(0.570)	(1.593)
30–34 years	1.585***	4.878***
	(0.595)	(2.900)
35–39 years	2.824***	16.850***
	(0.597)	(10.062)
40–44 years	3.676***	39.473***

Table 3 (continued)

VARIABLES	Under-five child death	
	Logit coefficient	Odds ratio
	(0.661)	(26.077)
45–49 years	4.846***	127.266***
	(0.714)	(90.924)
Distance to health facility (Ref: big problem)		
Not a big problem	− 0.212	0.809
	(0.225)	(0.182)
Number of children living	− 0.912***	0.402***
	(0.092)	(0.037)
Postnatal attendance (Ref: No)		
Yes	− 1.698***	0.183***
	(0.218)	(0.040)
Constant	− 2.894***	0.055***
	(0.852)	(0.047)
Observations	4284	4284

Standard errors in parentheses

Source: Author's computation from the 2014 GDH

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Relatively wealthy households possess greater purchasing power, enabling them to afford essential household necessities such as healthcare services, food, water, and a secure living environment. Even if both the rich and poorer households have insurance coverage, the rich further enjoy a comparative advantage due to their ability to afford additional non-medical requirements such as transportation costs and modern facilities associated with accessing and utilizing healthcare services. As a result, children from poorer households become more vulnerable to negative health outcomes.

Our results are also consistent with the panel study by Lartey et al. [13] which argues that a child under five years is less likely to die when the child is from a household of high wealth status. Ghana's high number of under-five deaths experienced over the years has its sources rooted in the circumstances of the poorest/poor households. Under-five mortality levels are influenced by poverty, accessibility, and quality of health services [49]. Hence, high rates of under-five deaths could be attributed to the poor household's inability to pay for extra medical bills beyond what the National Health Insurance Scheme (NHIS) provides, poor human and infrastructural resources at health facilities, the lack of technical quality that serve the poor and the universality nature of some of the government's programmes and policies.

Also, our study shows that as females get older, they are more likely to encounter under-five child deaths especially, females above 24 years compared to their teenage counterparts (15–19 years). Although our results were inconsistent with Lartey et al. [13], this is very consistent with Grossman's postulation [50] that, as the age of the woman increases, her health stock deteriorates. Therefore, if investment in the health of the female is not made, it is very likely she will be subject to more medical risks which could include pregnancy-related cases leading to child death or her inability to properly take care of the child when the baby is born [50].

The likelihood of child survival decreased with an increasing number of children ever born to the female in the household. The unexpected finding that the risk of under-five child deaths decreased with an increase in the number of children alive in a household could be a reverse causality, which is inconsistent with previous studies [46]. Further research may be needed to establish the true direction of the association. However, our finding supports the study by Otupiri et al. [51] in the Builsa District in the Upper East Region of Ghana which found out that, the more children a mother had alive, the less likely her children below five years were to die. This is most likely resulting from the past birth experiences of the mother in taking care of young ones. Her experiences with both childbirth and parental care reduce the chances of future child deaths. In addition to this, this could also be attributed to the formal or informal health education gained from previous visits to health facilities where the standard practices and procedures in taking care of younger children are taught. For example, as shown in Joish et al. [52], women of childbearing age who had received earlier education on folate supplementation are less likely to have child deficiencies that could increase the risk of child death.

Another significant contributor to reducing under-five deaths emanating from this study was the attendance of postnatal care services (PNC) by women after child delivery. This is an important contributory factor to maternal and

child survival. PNC is crucial in curbing the risk factors that could cause early child death. The WHO has defined postnatal services as a set of healthcare packages that women receive for six weeks after childbirth. However, though this period is critical, it is the most neglected period for the provision of quality care [53]. This is consistent with the arguments by Kayode et al. [54] which assert that postnatal services help to manage childhood illnesses and promote community and family childcare practices. In this regard, there is the necessity to further streamline the government's programmes beyond safe delivery but to also include post-delivery policies is key.

Under-five mortality is an urgent public health concern in Ghana and this study has provided key information for understanding and addressing under-five child deaths. The key finding in this study is the crucial role that household wealth still plays in reducing under-five child deaths in the face of ongoing government programmes aimed at achieving the SDG target. Programmes and establishments such as the LEAP and the Northern Development Authority, respectively, are universal and indirect to uniquely tackle under-five child deaths. Government and other stakeholders responsible for the health of children and mothers should target meeting the household resource needs of women as part of an overall strategic approach aimed at reducing under-five mortality towards the national and global SDG level. Finally, policies and interventions targeted at bridging the wealth gap and inclusive postnatal education should be intensified.

7.4 Study limitations

The study's strength lies in the fact that it is a nationally representative population-based study with good quality and reliable data on children, their households, and the communities in which they reside. The study also has a large sample size drawn randomly nationwide, making it possible to generalize findings to the population of Ghanaian children aged below 5 years and to other similar populations.

The main limitation of this study is its inability to measure causal effects due to the cross-sectional nature of the study. The binary logistic techniques used in the study do not permit causal inferences to be drawn between household wealth and child survival. These approaches at best could only establish association. Hence, any assertion of causality necessitates further interrogation. It is also possible that the socioeconomic circumstances of households during the survey period could be different at the time the child died. Also, the use of ln GNI/p ppp as a wealth proxy measure may not accurately capture the distribution of household wealth within Ghana especially where assets and economic conditions are non-homogenous across groups hence the results are explained with caution. Since our study relied on published articles, it may have missed out on important insights from the grey literature regarding the effectiveness and obstacles of intervention programmes. Furthermore, many articles evaluating these programmes may not have been adequately structured to assess their effectiveness.

The retrospective nature of reporting under-five child deaths might also result in reporting bias. Furthermore, there is incomplete data on some important variables such as children's nutritional status, diarrhoea, and fever episodes, and were not included in the analysis. For example, children who died will not have measurements on their nutritional status as well as on diarrhoea and fever episodes because, in the main survey, questions on these variables will not apply to the children who died before the study period. However, the inclusion of other relevant variables such as place of delivery, ANC follow-up, birth type, and preceding birth interval may influence the estimates and hence can be interrogated in future studies. Future research could also delve deeper into the specific regional policies that could address significant regional disparities in child mortality rates.

8 Conclusion and policy recommendations

This paper sought to investigate the effect of household wealth differential and other contributing factors on under-five child deaths in Ghana in the face of ongoing government interventions that seek to partly address these mortality rates. Ghana's under-five mortality rate is relatively high and our trend analysis reveals that the country may not achieve the global SDG target at the current rate of reduction. The results from our logit estimations indicate that wealth has a significant effect in reducing child under-five deaths, especially for the richest quintile. There are also geographical dimensions to under-five deaths in Ghana. Apart from the Greater Accra and Eastern regions, the other regions are relatively lagging, and this could hinder the nation's cumulative effort in achieving the child health targets set under the SDGs. Though the government has implemented many policies and programmes such as LEAP, and free maternal care under the NHIS, in improving the socio-economic conditions including household wealth, most of these interventions

have been incomprehensive in significantly averting under-five child deaths towards achieving the SDG target. There is, therefore, the need for a robust check and an effective review of the current poverty-alleviating programmes towards reflecting mechanisms to improve child health outcomes, especially for those in the northern regions. In this regard, the paper therefore makes the following recommendations:

First, the existing programmes and policies of childcare should be appraised regularly. Specifically, the government should urgently draw up the next child policy framework to reflect the medium to long-term strategy as a matching up criterion towards the SDG targets on child health. This can be done by undertaking a broad-based stakeholder post-analysis of the elapsed Ghana under-five Child Health Policy (2007–2015). Also, robust systems should be put in place to ensure continual improvement of the policy to set domestic and international targets. This involves effective planning, implementation, monitoring/audit, and instituting corrective measures/actions.

Since most of the under-five child deaths are more likely to occur in the north compared to the south, the government should effectively resource the existing insurance scheme and increase the provision of functional CHPS health facility zones to reduce other indirect costs such as time and distance in accessing healthcare. The government can also consider increasing its flagship social cash transfer (LEAP) amount, especially for those in the northern part of the country as well as broadening the number of beneficiaries by relaxing the inclusion criteria and adjusting the amount to inflation at regular intervals. The government should also critically assess the need for complementary services such as child support healthcare to augment the objectives of the social cash transfer. This will significantly improve the purchase of healthcare services by maternal mothers to reduce the rate of under-five child deaths.

Additionally, mothers should be strongly encouraged and educated to effectively attend postnatal health care services. The government can effectively do this in collaboration with the National Commission for Civic Education (NCCE) and the media platforms available, especially radio and television. Postnatal care facilitates family and group support for the woman as well as provides an avenue to discuss and educate the woman on proper childcare and development including breastfeeding, sleeping under treated mosquito nets, and keeping a healthy home environment, among others. The fact that Ghana records 45 deaths per 1000 live births, coupled with the distressing statistic that 1 out of every 17 children in Ghana does not survive to their fifth birthday, is deeply concerning. However, these figures can be substantially reduced with effective interventions. Hence, these policy recommendations are to complement and strengthen the existing government structures which will go a long way in curbing this intolerable large number of preventable under-five child deaths in Ghana.

Author contributions Conceptualization of the study and data analysis were done by CKO. CKO and ENA contributed to the methodology and the write-up. The final manuscript was read and approved by all the authors.

Data availability The full dataset supporting the research findings can be accessed at https://dhsprogram.com/data/available-datasets.cfm

Declarations

Ethics approval and consent to participate Not applicable.

Consent for publication Not applicable.

Competing interests The authors declare no competing interests.

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