



Original Research

Trends in under-five mortality rate disaggregated across five inequality dimensions in Ghana between 1993 and 2014

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ABSTRACT

Objectives: Globally, there has been a considerable decline in under-five mortality in the past years. However, it remains a critical issue among low- and middle-income countries, especially in sub-Saharan Africa. In Ghana, under-five mortality is a critical public health issue that requires national interventions. In the present study, we examined the trends of under-five mortality in Ghana from 1993 to 2014.

Methods: Using the World Health Organization's Health Equity Assessment Toolkit, we analyzed data from the 1993–2014 Ghana Demographic and Health surveys. We disaggregated the under-five mortality rate by five equity stratifiers: wealth index, education, sex, place, and region of residence. We measured the inequality through summary measures, namely difference, population attributable risk, ratio and population attributable fraction.

Results: In 1993, under-five mortality among children in poor households (172.90, uncertainty intervals [UIs] = 153.21–194.53) was more than twice the proportion of children from the richest households who died before their 5th birthday (74.96; UI = 60.31–92.81) and this trend continued until 2008. However, in 2014, the poorest had the lowest rate (30.91, UI = 78.70–104.80). Children of women with no formal education consistently recorded the highest burden of under-five mortality. Although in 2014 the gap appeared to have narrowed, children of mothers with no formal education record the highest under-five mortality rate (91.61; UI = 79.73–105.07) compared with those with secondary or higher education (54.34; UI = 46.24–63.77). Under-five mortality was higher among rural residents throughout the years. Men repeatedly had the greatest share of under-five mortality with the highest prevalence occurring in 1993 (137.52; UI = 123.51–152.85) and the lowest occurring in 2014 (77.40; UI = 69.15–86.54). The Northern region consistently accounted for the greatest proportion of under-five mortality.

Conclusion: Ghana has experienced a decline in under-five mortality from 1993 to 2014. Context-specific appropriate interventions are necessary for various disadvantaged sub-populations with risks of health disparities.

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Introduction

Globally, there has been a considerable decline in under-five mortality over the past few years. However, it remains a critical issue among low- and middle-income countries (LMICs), especially in sub-Saharan Africa (SSA), where the rates have been higher, compared with those of other regions.^{1,2} In 2018, the global under-five mortality rate (U5MR) was 39 deaths per 1000 live births, which represented a 59% global reduction from 93

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deaths per 1000 live births in the 1990s.³ Differences exist in this reduction across countries. However, the Sustainable Development Goal three (SDG 3) targets two aims at reducing the rates of under-five mortality to 25 or fewer deaths per 1000 live births by the year 2030.^{3–5}

There has been a significant reduction in global under-five mortality, but the rate is still high in SSA. In SSA, the U5MR was 78 deaths per 1000 live births in 2018.³ This means that one of every 13 under-five children in SSA died before their fifth birthday.³ Ghana's U5MR declined from 110 deaths per 1000 live births in 1993 to 70 deaths per 1000 live births in 2014.⁶ However, this decline failed to meet the target action set in Ghana by Under-Five Child Health Policy 2007–2015 that aimed at reducing under-five mortality to 40 deaths per 1000 live births by 2015.⁶

U5MR has received scholarly attention in the past two decades in SSA and Ghana.^{1,7–10} The focus of previous studies from Ghana on U5MR was on predictive modelling and identification of relevant correlates.^{1,7–10} These studies have identified the following socio-economic, demographic and biological factors as significant predictors of U5MR: child age and sex, maternal age and education, place and region of residence, household level factors such as wealth index, sources of drinking water and type of toilet facilities.^{1,7–10} From these studies, the correlates that consistently explained the variability in U5MR were gender of the child, urban-rural residence, household wealth quantile, maternal education and region of residence.^{1,7–10} Given that modifying the effects of these variables on U5MR may lead to significant reduction, development partners, NGOs, and the government of Ghana invest in policies and programs to reduce the risk conditions. Given the limited resources that are available, it is important to know the sub-population that has the highest burden of U5MR and equitably distribute the resources to reduce the burden. However, studies that examined the inequalities in the determinant of U5MR are sparse. Therefore, the present study used the World Health Organization's (WHO) Health Equity Assessment Toolkit (HEAT) software to estimate and highlight the magnitude of inequalities in the following U5MR determinants in Ghana from 1993 to 2014: gender of the child, maternal education, household wealth quantile, urban-rural residence and region of residence. Findings from this study will strengthen and inform appropriate national strategies, interventions, programs and policies to reduce the burden of under-five mortality in Ghana.

Methods

Description of data source

In this study, we used data from five rounds of the 6 Ghana Demographic and Health Surveys (GDHSs) conducted in 1993, 1998, 2003, 2008 and 2014. The 2014 version is the most recent GDHS data set. The Demographic and Health Surveys (DHSs) is conducted across several LMICs across the globe by taking varied information such as under-five mortality, child feeding practices and contraceptive use from women aged 15–49 and their children. The survey adopts a dual-stage sampling approach to select the unit of analysis. The first stage involves the systematic selection of clusters/enumeration areas within rural and urban settings of Ghana. The next stage involves the selection of households within the enumeration areas, selected at stage one. All women and their children within the selected households are deemed eligible to be part of the survey. A detailed description of the survey methodologies can be found in the final reports.^{6,11–14} A total of 36,937 child-women pairs participated in this study. Thus, 7194 in 1993, 6290 in 1998, 6991 in 2003, 5617 in 2008 and 10,937 in 2014.

Variables

Dependent variable

The dependent variable was U5MR which is defined as the probability (expressed as a rate per 1000 live births) of a child dying within the first five years of life.

Measures

U5MR was measured for the five-year periods by adopting four (economic status, education, place of residence and region of residence) equity stratifiers. Economic status, a proxy measure using wealth status, is captured by aggregating household assets and computing it into five levels (poorest, poor, middle, rich, and richest) with principal component analysis. The educational level of the mother was measured as the highest level of education attained, which was classified as no formal education, primary education, and secondary and higher education. Place of residence was captured as rural vs urban. Sex of the child was either male or female. Region of residence was made up of the then ten administrative regions of Ghana which included the Western, Central, Greater Accra, Volta, Eastern, Ashanti, Brong Ahafo, Northern, Upper East and Upper West Region. Ghana currently has sixteen¹⁶ administrative regions after recreating 6 new regions from the 10 previously existing regions. The new 16 regions are Oti, Brong Ahafo, Bono East, Ahafo, North East, Savannah, Western North, Western, Greater Accra, Central, Eastern, Upper East, Upper West, Volta, Northern and the Ashanti Region.

Analysis

All the analyses were carried out with the 2019 updated version of WHO's HEAT software (version 3.1) via the WHO Health Equity Monitor database.¹⁵ This was carried out by following two major steps. The first step involved the disaggregation of the U5MR by the four equity stratifiers for each of the survey years (refer Table 1). The second step involved the assessment of inequality using four principal summary measures. These are ratio (R), difference (D), population attributable fraction (PAF) and population attributable risk (PAR). The WHO has stipulated that relative and absolute inequality measures may lead to different and sometimes contrasting conclusions. Therefore, failing to showcase these different scenarios can potentially bias informed decisions, hence the adoption of both absolute and relative summary measures (WHO, 2020). The segment of the equity stratifier with the highest burden of under-five mortality across the four waves was chosen as the reference. For economic status, education, and residence, D was computed by subtracting U5MR among children of poorest women (quintile 1) from the U5MR prevalence among children of richest women (quintile 5), no education group from the secondary/higher education group, and rural minus urban group. The D for the region variable was calculated as the region with the maximum prevalence of U5MR minus the region with the minimum prevalence across the respective survey waves. In computing R, it was calculated as the ratio of two different populations, i.e. $R = Y_{\text{high}}/Y_{\text{low}}$. In the case of a residence, R denoted a place of residence where Y_{high} stood for urban and Y_{low} stood for the rural population. With education, Y_{high} implied children of women with secondary or higher education where Y_{low} represented children of women with no education. For wealth quintile, Y_{high} was the richest quintile whilst Y_{low} was the poorest quintile. In the same manner, Y_{high} represented males or females, depending on the category with the highest prevalence in a particular survey. PAR was computed as the difference between U5MR estimate for the reference subgroup, yref, and the national average of U5MR. In this study, yref referred to the following to calculate U5MR inequality for PAR: urban setting

Table 1
Trends in under-five mortality rate, disaggregated across five inequality dimensions, 1993–2014.

Dimension	1993 (132.80) N = 7194		1998 (109.92) N = 6290		2003 (109.88) N = 6991		2008 (84.13) N = 5617		2014 (69.92) N = 10,937	
	n	R [UI]	n	R [UI]	N	R [UI]	n	R [UI]	n	R [UI]
Economic status										
Q1	1453	156.2 3 [134.48–180.77]	1739	134.98 [117.84–154.18]	1760	128.15 [109.69–149.21]	1412	102.21 [86.53–120.36]	2470	30.91 [78.70–104.80]
Q2	1638	172.90 [153.21–194.53]	1327	120.83 [99.59–145.86]	1581	104.37 [86.45–125.49]	1247	77.87 [63.07–95.78]	2338	73.04 [61.38–86.71]
Q3	1548	138.69 [153.21–194.53]	1231	119.94 [100.35–142.74]	1419	111.84 [92.72–134.33]	1102	102.80 [81.85–128.37]	2229	60.74 [48.47–75.87]
Q4	1355	104.20 [87.39–123.80]	1093	98.85 [79.83–121.81]	1197	108.05 [89.35–130.08]	1031	67.02 [51.11–87.42]	2009	54.98 [43.54–69.20]
Q5	1199	74.96 [60.31–92.81]	899	46.34 [32.95–64.81]	1033	87.64 [67.26–113.43]	825	59.63 [42.42–83.20]	1889	64.00 [49.28–82.73]
Education										
No education	3232	165.68 [148.75–184.12]	2549	131.02 [116.03–147.61]	2952	125.72 [111.76–141.15]	1951	102.15 [88.25–117.95]	3296	91.61 [79.73–105.07]
Primary	3560	108.63 [97.90–120.38]	1288	112.33 [92.23–136.16]	1536	121.13 [103.52–141.26]	1331	86.15 [69.63–106.13]	2206	72.55 [59.26–88.54]
Secondary+	402	69.29 [46.45–102.17]	2452	85.78 [73.54–99.84]	2502	83.48 [70.20–99.02]	2335	67.23 [56.58–79.72]	5435	54.34 [46.24–63.77]
Place of residence										
Rural	5226	149.18 [135.72–163.73]	4707	121.66 [110.40–133.89]	4657	118.64 [107.56–130.70]	3556	89.67 [78.61–102.10]	6099	74.36 [66.41–83.18]
Urban	1968	89.89 [76.41–105.48]	1583	75.74 [62.41–91.63]	2334	92.61 [78.49–108.97]	2061	74.84 [62.41–89.50]	4838	64.23 55.01–74.87]
Sex										
Female	3544	127.94 [115.44–141.57]	3097	106.41 [94.32–119.85]	3402	108.10 [96.35–121.08]	2733	74.95 [64.64–86.75]	5363	62.13 [55.21–69.85]
Male	3650	137.52 [123.51–152.85]	3193	113.33 [101.98–125.76]	3589	111.60 [100.17–124.15]	2884	93.20 [80.94–107.09]	5574	77.40 [69.15–86.54]
Region										
Western	624	131.80 [108.38–159.39]	772	110.04 [87.01–138.26]	678	110.21 [83.50–144.12]	545	63.74 [42.84–93.82]	1102	55.35 [41.14–74.09]
Central	696	128.03 [102.57–158.70]	783	141.64 [108.36–183.04]	580	89.11 [63.88–123.01]	544	108.18 [78.88–146.62]	1194	68.25 [53.34–86.95]
Greater Accra	634	100.20 [73.77–134.73]	672	63.57 [44.60–89.84]	722	73.74 [51.69–104.17]	646	50.83 [33.66–76.08]	1671	47.85 [36.02–63.31]
Volta	762	116.35 [96.90–139.11]	658	94.93 [71.52–124.99]	571	113.30 [90.20–141.40]	517	47.48 [28.53–77.98]	869	61.88 [45.90–82.93]
Eastern	788	93.24 [71.14–121.31]	841	89.59 [70.98–112.49]	740	95.90 [73.30–124.54]	498	81.04 [52.97–122.05]	1042	69.00 [54.02–87.73]
Ashanti	1217	97.56 [79.56–119.10]	954	75.90 [58.56–97.84]	1354	116.56 [96.81–139.72]	1072	80.18 [62.22–102.76]	2047	79.09 [61.88–100.58]
Brong Ahafo	728	94.62 [77.11–115.60]	508	129.88 [94.20–176.43]	717	90.73 [70.94–115.35]	501	75.17 [52.82–105.94]	946	57.03 [44.94–72.11]
Northern	929	236.97 [205.54–271.56]	446	170.09 [136.00–210.63]	952	154.76 [126.83–187.51]	816	138.65 [119.11–160.82]	1307	109.06 [86.90–136.06]
Upper West	295	187.71 [133.12–257.99]	205	NR	246	NR	160	NR	450	72.93 [54.69–96.63]
Upper East	520	180.11 [150.96–213.48]	447	154.71 [124.58–190.54]	430	78.97 [51.69–118.82]	314	74.20 [53.85–101.42]	306	90.12 [71.59–112.86]

R, rate; UI, uncertainty interval; NR, not reported – estimate is based on fewer than 250 unweighted person-years of exposure to the risk of death.

for a place of residence, female for sex, secondary education for education and richest subgroups for economic status. With this, (μ): $PAR = y_{ref} - \mu$ with μ being the national mean of U5MR. Similarly, PAF denoted the relative inequality dimension of PAR, and it was derived as $PAF = (PAR/\mu) \times 100$. The greater absolute value of PAR indicated a higher level of inequality while zero indicated the absence of inequality. The change in U5MR over time was examined by referring to the 95% uncertainty intervals (UIs) of the different survey years. When the UIs did not overlap, there was a statistically significant difference in U5MR between any two consecutive years. If the UIs overlapped, then no inequality existed.

Ethical issues

We used publicly available data from the DHSs. Ethical procedures were the responsibility of the institutions that commissioned, funded or managed the surveys. All DHS surveys were approved by ICF international as well as an Institutional Review Board in the respective country to ensure that the protocols complied with the U.S. Department of Health and Human Services regulations for the protection of human subjects. In Ghana, ethical approvals for all the rounds of the GDHS are granted by the Ghana Health Service and the Ethical Review Board of the Measure DHS. Both written and verbal consent was obtained from all participants before participating in the surveys, and the data were anonymised before being public.

Results

Table 1 shows the trends in disaggregated U5MR in Ghana spanning from 1993 to 2014. Generally, there was a decline in U5MR from 1993 to 2014. Specifically, U5MR decreased from 109.9 per 1000 live births in 1993 to 69.9 per 1000 live births in 2014. Analysis of U5MR by economic status demonstrated an inverse relationship from 1993 to 2008. Thus, in 1993, U5MR among poor

under-fives (172.90, UI = 153.21–194.53) was more than twice the proportion of richest children who died before their 5th birthday (74.96, UI = 60.31–92.81), and this trend continued until 2008. However, in 2014, the poorest had the lowest rate (30.91, UI = 78.70–104.80). Throughout the period, children of women with no formal education recorded the highest rate of under-five mortality. In the case of 1993, 165.68 (UI = 148.75–184.12) U5MR occurred among children of women with no formal education whilst 69.29 (UI = 46.45–102.17) U5MR was observed among children of women with a secondary or higher level of education.

In 2014, 91.61 (UI = 79.73–105.07) and 54.34 (UI = 46.24–63.77) U5MR occurred among children of women having no education and secondary/higher education, respectively. The analysis also revealed that U5MR was higher among rural residents throughout the years. Nonetheless, the variation in 2014 was not wide.

Men persistently had the greatest share of U5MR with the highest prevalence occurring in 1993 (38.22; UI = 35.68–40.82) and the lowest occurring in 2014 (77.40, UI = 69.15–86.54). In terms of regional variations, the Northern region consistently accounted for the greatest proportion of U5MR. In 1993, 1998 and 2003, for instance, Northern region was leading with 236.97 (UI = 205.54–271.56), 170.09 (UI = 136.00–210.63), and 154.76 (UI = 126.83–187.51), respectively (Table 1).

Inequality indices estimates of the factors associated with U5MR prevalence, 1998–2014

We presented the indices of the inequality estimates of factors associated with U5MR in Table 2. Concerning economic status, only the simple summary measures (D, R) showed significant inequality in U5MR. For instance, both D (81.27; 95% CI = 53.10–109.45) and R (2.08; 95% CI 1.54–2.63) revealed substantial economic variation in U5MR, and the same trend was noted across all the survey years (1993–2014). The complex summary measures (PAF and PAR)

Table 2
Inequality indices estimates of the factors associated with under-five mortality rate, 1993–2014.

Dimension	1993			1998			2003			2008			2014		
	Est	LB	UB	Est	LB	UB	Est	LB	UB	Est	LB	UB	Est	LB	UB
Economic status															
D	81.27	53.10	109.45	88.65	64.69	112.61	40.52	1031	70.72	42.59	16.37	68.80	2.91	5–0.85	47.97
PAF	–43.60	–45.13	–42.07	–57.91	–60.67	–55.15	–20.35	–21.85	–18.86	–29.19	–32.82	–25.56	–8.16	–10.97	–5.36
PAR	–57.94	–59.98	–55.91	–63.76	–66.79	–60.72	–22.40	–24.04	–20.75	–24.58	–27.64	–21.53	–5.69	–7.64	–3.73
R	2.08	1.54	2.63	2.91	1.85	3.97	1.46	1.02	1.91	1.71	1.07	2.36	1.42	1.00	1.84
Education															
D	96.36	63.85	128.92	45.23	24.74	65.73	42.24	21.73	62.75	34.92	16.17	53.67	37.27	21.92	52.62
PAF	–47.53	–50.79	–44.27	–21.70	–22.24	–21.16	–23.83	–24.55	–23.10	–19.81	–21.41	–18.2	–21.52	–22.85	–20.20
PAR	–62.77	–67.07	–58.46	–23.77	–24.36	–23.18	–26.11	–26.90	–25.32	–16.61	–17.95	–15.27	–14.91	–15.83	–13.98
R	2.39	1.41	3.37	1.53	1.23	1.82	1.51	1.19	1.82	–1.52	1.18	1.86	1.69	1.33	2.04
Place of residence															
D	59.29	39.16	79.42	45.92	27.25	64.59	26.04	6.96	45.11	14.83	–3.02	32.68	10.13	–2.82	23.08
PAF	–32.39	–32.56	–32.23	–31.21	–32.68	–29.75	–15.77	–16.01	–15.54	–11.15	–12.80	–9.49	–8.09	–9.49	–6.68
PAR	–43.07	–43.29	–42.85	–34.37	–35.98	–32.76	–17.34	–17.60	–17.08	–9.39	–10.78	–8.00	–5.65	–6.63	–4.67
R	1.66	1.35	1.97	1.61	1.26	1.95	1.28	1.04	1.53	1.20	0.93	1.46	1.16	0.94	1.38
Sex															
D	9.59	–10.02	29.20	6.92	–10.48	24.32	3.50	–13.69	20.68	18.25	1.19	35.31	15.27	3.93	26.61
PAF	–3.66	–	–	–3.19	–	–	–1.63	–	–	–11.11	–12.34	–9.898	–11.13	–12.41	–9.85
PAR	–4.86	–	–	–3.51	–	–	–1.80	–	–	–9.37	–10.41	–8.34	–7.78	–8.68	–6.89
R	1.07	0.92	1.23	1.07	0.90	1.23	1.03	0.87	1.19	1.24	0.99	1.50	1.25	1.04	1.45
Region															
D	143.73	102.41	185.05	–	–	–	–	–	–	–	–	–	61.21	33.30	89.11
PAF	–29.68	–30.59	–28.77	–	–	–	–	–	–	–	–	–	–31.78	–34.93	–28.63
PAR	–39.36	–40.56	–38.15	–	–	–	–	–	–	–	–	–	–22.29	–24.50	–20.08
R	2.54	1.78	3.31	–	–	–	–	–	–	–	–	–	2.28	1.46	3.10

D, difference; Est, estimate; LB, lower bound; PAF, population attributable fraction; PAR, population attributable risk (PAR); R, ratio; UB, upper bound.

however showed significant but negative association throughout the survey waves. In terms of educational level, we found significant absolute and relative inequality across the survey waves. For example, in 1993, there was a significant absolute inequality ($D = 96.36$, 95% CI: 63.85, 128.92) and relative ($R = 2.39$, 95% CI: 1.41, 3.37) in U5MR. This pattern showed a decreasing trend in both the simple measures (D , R), as well as the complex measures (PAR , PAF). The study also found absolute and relative urban-rural inequality in U5MR from 1993 to 2014 both by simple (D , R) and complex (PAR , PAF) measures with a decreasing pattern. For example, in 1993, the D measure was 59.29 (39.16, 79.42) and R measure ($R = 1.66$, 95% CI: 1.35, 1.97) which all reduced to $D = 10.13$ (−2.82, 23.08) and $R = 1.16$, CI = 0.94, 1.38, respectively. Our finding also shows absolute (D , PAR) and relative (R , PAF) inequality in U5MR across the regions in Ghana. For example, in 2014 survey, the PAR measure ($PAR = -22.29$, 95% CI: −24.50, −20.08) and the PAF measure ($PAF = -31.78$, 95% CI: −34.93, −28.63) indicate substantial absolute and relative regional inequality, respectively (Table 2).

Discussion

From the study, we observed a decline in U5MR from 1993 to 2014. Specifically, U5MR decreased from 109.9 per 1000 live births in 1993 to 69.9 per 1000 live births in 2014. Even though the 50% reduction over the 21 years is commendable, it still falls short of the global target of at most 25 per 1000 live births.³ Ghana has introduced several programs and health interventions over the years to address specific public health issues including under-five mortality. Examples of such programs targeted at addressing U5MR include free maternal health care, national health insurance with free insurance cover for children, community health planning services, and the utilization of community health nurses for the door-to-door immunization exercises, which have largely been reported as successful.¹⁶ These interventions and programs could plausibly be the reasons behind the significant decline in the U5MR from 109.9 per 1000 live births in 1993 to 69.9 per 1000 live births in 2014.

Findings from the study showed an inverse relationship between economic status and U5MR from 1993 to 2008 where children under-five from poorest households were more likely to die, as compared with under-five children born in richer households. However, the trend changed in 2014 where the poorest now had the lowest U5MR. The trend from 1993 to 2008 is consistent with the findings from previous studies in Ethiopia,^{5,17,18} Kenya,¹⁹ Nigeria²⁰ and Sierra Leone.¹⁰ Even though primary health care in Ghana is free for children younger than 5 years of age, there are still some opportunistic costs and expenses that parents and caregivers incur when they seek quality health care for their under-five children. The costs become unbearable for poorer households especially when there are persistent health problems.¹⁷ Poorer households often have challenges with good and balanced nutrition, hygiene, and safe shelter both for the children and their mothers, which could impact on the survival of under-five children.^{7,21,22} The switch in the trend in 2014 could be as a result of a larger coverage of maternal and child health programs accelerated by the Ministry of Health after the 2008 DHS in a race to achieve the 2015 Millennium Development Goals. For example, policies and programs such as the free maternal health care were introduced during that same period, traditional birth attendants were also given training, and their activities were monitored by the Ghana Health Service. The National Health Insurance Scheme and immunization programs were also revised and expanded within that same period.²³ A further study is needed to investigate the reason

behind the switch in 2014 to inform existing and future policies and interventions towards achieving the 2030 SDG 3.

The literature reveals education as a good predictor of health outcomes. In support with the findings from previous studies,^{17,18,24,25} our study observed that mothers with no formal education recorded the highest U5MR and this persisted throughout the 21 years under observation. The plausible reason could be that educated mothers have greater control over health choices for their children and the ability to use basic health knowledge to manipulate their environment and healthcare providers, and communicate more effectively with health professionals.²⁵ This re-emphasize the importance of girl child education in Ghana and the need for all stakeholders to accelerate efforts ensuring that all girls of school-going age have the opportunity to be in school. Aheto¹ has further explained that 'educated mothers are more likely to develop good health-seeking behaviour for themselves and their children, especially the utilization of health services, feeding and child care practices which in turn will result in better health outcomes for both mothers and their children'.

Another important trend observed in our study is that absolute and relative urban-rural inequality in U5MR existed throughout the years from 1993 to 2014. U5MR was high among rural residents while urban areas recorded low U5MR. This is consistent with a study in SSA that found high U5MR in rural areas in Comoros, Lesotho, Namibia, Niger, and Senegal.² However, from this same study by Malderen et al.,² U5MR was reported to be low in rural areas in Congo, Kenya and Tanzania. The rural-urban disparities in U5MR could be because of disparities in health systems, economy and socio-political factors at each study area.²⁶ Urban dwellers in most LMICs have improved financial and geographic access to health care Malderen et al.,² as quality healthcare services and facilities are often skewed towards urban settlements. This could explain why U5MR in Ghana over the past 21 years has been low in urban areas compared with rural areas.

We also observed that the sex of children was significant in influencing under-five mortality in Ghana. Men persistently had the greatest share of U5MR from 1993 to 2014. This finding is not novel, as similar findings have been found in Ethiopia,¹⁷ Ghana¹ and many other sub-Saharan African countries such as Benin, Chad, Congo, Côte d'Ivoire, Gabon, Malawi, Mozambique, Rwanda, Sierra Leone, Uganda and Zambia.^{2,27} Disparities in child survival rates based on their sex have been well established in the literature globally, especially for children younger than five years.²⁸ Even though some scientists have attributed this finding to biological factors such as male children or babies having lower resistance to infection, increased risk of premature birth, larger average body size and head circumference making it difficult for mothers during delivery, others have also mentioned the importance of some socio-cultural factors which could lead to gender discrimination and sex selection or preference.²⁹ Future studies could explore why more males under five years die compared to their female counterpart in Ghana, taking into consideration the Ghanaian socio-cultural factors.

In support with previous studies in Ethiopia,¹⁷ Nigeria^{30,31} and Ghana,^{1,21} our finding also shows absolute (D , PAR) and relative (R , PAF) inequality in U5MR across the regions in Ghana, with the Northern region, which is also predominantly rural, consistently accounting for the greatest proportion of U5MR. Ghana is characterized by persistent regional disparities in the distribution of quality healthcare services, economic resources,¹ and the implementation of national health programs.²³ This could explain the regional variations in U5MR in Ghana and offer plausible ideas on how this disparity could be addressed.

Limitations of the study

Causal inferences cannot be made from this study because of the use of the cross-sectional study design. Furthermore, this study did not use the first version of the GDHS because some of the variables in that survey were not consistent with those used in the subsequent surveys (i.e. 1994 to 2014). The 2014 version is the most recent and though this appears to be quite obsolete, it is important to know that the observations made with the 1993 to 2014 data sets are crucial in providing policy makers with some ideas on which socio-economic groups of the Ghanaian population that must be targeted to reduce under-five mortality to an acceptable level. Despite these limitations, this study provides a nationally representative coverage of under-five mortality in Ghana, and the findings from the study can be generalized for all children younger than five years in Ghana.

Conclusion

Ghana has experienced a decline in under-five mortality from 1993 to 2014. However, are socio-economic and geographical disparities, with a high prevalence of under-five mortality among children in poor households, those born to mothers with low educational level, those in rural areas and children born in Northern regions. Although inequalities varied throughout the years studied, context-specific appropriate interventions are necessary for various disadvantaged sub-populations who continue to suffer from disparities in U5MR.

Author statements

Ethical approval

We used publicly available data from the Demographic and Health Surveys (DHSs). Ethical procedures were the responsibility of the institutions that commissioned, funded or managed the surveys. In Ghana, ethical approvals for all the rounds of the DHS are granted by the Ghana Health Service and the Ethical Review Board of the Measure DHS Both written and verbal consent was obtained from all participants before participating in the surveys, and the data were anonymised before being public. Therefore, the authors are not required to seek ethical approval.

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Competing interest

None declared.

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