



# Decomposing Wealth-Based Inequalities in Under-Five Mortality in West Africa

*Aristide Romaric BADO, \*Sathiya Susuman APPUNNI*

*Dept. of Statistics and Population Studies, Faculty of Natural Sciences, University of the Western Cape, Cape Town, South Africa*

**\*Corresponding Author:** Email: sappunni@uwc.ac.za

(Received 23 Dec 2014; accepted 17 Apr 2015)

## Abstract

**Background:** This study aimed to analysis the inequalities of mortality of children under 5 years in West Africa by examining the determinants and contributing factors to the overall inequality concentration in these countries.

**Method:** Data used came from the DHS surveys conducted in the six countries in West Africa: Burkina Faso (2010), Benin (2006), Cote d'Ivoire 2011), Ghana (2008), Mali (2006), Nigeria (2008) and Niger (2012). The concentration index (CI) and Generalized Linear Model (GLM) with logit link were used to access inequality.

**Results:** The results show that in all countries, the poorest Q1 have the highest proportions of deaths: Nigeria (31.4%), Cote d'Ivoire (30.4%) and Ghana (36.4%), over 30% of deaths of children under 5 years are among the children of the poorest (Q1) and the absolute differences of proportions Q1-Q5 are more than 20 points (25.8 in Ghana and 23.6 in Nigeria). The contributing factors of inequalities of child mortality were birth order, maternal age, parity and household size. Our findings also showed that the intensity of inequality varies from one country to another.

**Conclusion:** The most important conclusion of this study is to reduce mortality in children under 5 years, it is needed to reduce economic and social inequalities and improve the country's economic and social condition. There is a need for monitoring and assessment inequalities by leading causes of death and morbidity among children in the region in order to advance in understanding the gaps and finding a way to reduce them in West Africa countries.

**Keywords:** Concentration index Infant mortality, Child mortality, Under five mortality, Family planning

## Introduction

The Millennium Development Goals (MDGs) are the world's biggest promise; that is a global agreement to reduce poverty and human deprivation at historically unprecedented rates through collaborative action (1). Of its many goals, the fourth goal (MDG 4) specifically calls on the international community to reduce mortality in children under 5 (U5) by two thirds between 1990 and 2015 (1). Therefore, the health of children under-five years in general and mortality in particular are a major priority for developing countries. Recent studies indicate that under-five mortality has decreased much during these last decades both in developed and developing countries (2–5). But the fourth MDG goal will not be met by 2015 in many sub-

Saharan countries in Africa in the light of progress made (6). Despite the fall in the regional and global child mortality rate, deaths remain alarmingly concentrated in the poorest regions of the world and most notably, sub-Saharan Africa has the highest regional rate of child mortality amongst under-fives. One child out of nine dies before their fifth birthday(5). Similarly, inequalities exist and remain between countries, within each country, between different sub-groups and socio-economic groups (7–12), between place of residence (13,14), between ethnicity (12,15,16), between parental characteristics (8) and children (11). Socio-economic inequalities in childhood mortality are a major public health problem in develop-

ing countries. Childhood mortality is systematically and considerably higher among lower socioeconomic groups within countries (2). Reducing these inequalities by improving child survival up to the level of more advantaged groups within countries would substantially improve population health (2). Specific attention is being devoted into the research on child health inequalities in developing countries (2,13,15,17–28). Some of these researches focused on sub-Saharan Africa by conducting regional and multi-country studies on this topic. But in the case of West Africa to be specific, the literature consulted indicates that research remains low even where this part of Africa has the highest rates of under-five mortality in the world and these countries are among the world's poorest countries(29). What are the determinants of inequalities in mortality among under-five in West Africa? Are there some variations between and within countries?

The objective of this study is to analyze the inequalities of mortality of children under 5 years in West Africa by examining the determinants and contributing factors to the overall inequality concentration in these countries.

### *Study Design*

Previous research' results found several factors that explain child health inequalities in developing countries. These factors are related to: 1) individual's characteristics of parents and children; 2) the living conditions of households; 3) the geographical factors and; 4) national policies and reforms especially in the health sector.

Prior research found that a mother's characteristics such as her education, age during child delivery, parity, food habits and health status could influence the survival of the child(3,15,30–32). Mother's education level was found in the literature to be strongly associated with child survival and was a determinant factor of inequalities in child health in sub-Saharan Africa(8,33).

Houweling and Kunst (2) argued that maternal education is thought to exert its influence through increased status and decision making power of mothers within the household, increased willingness and ability to travel outside the community,

more timely use of health care, greater negotiating power with health care providers, increased knowledge, skills and identification with modern health systems and responsiveness to new ideas. Maternal education is estimated to be accounted for by its association with household wealth, and probably the associated better living conditions and ability to pay for health services.

Socioeconomic environment of households was also found as an important factor of child health inequalities. In fact, the living conditions of households have a direct influence on children's health through the quality of drinking water and hygiene in the household, the use of health services, food and health practices, fashion life (2,34,35). The poverty level of the household(25,35–37), size and household composition (31), the gender of the head of the households(34) have an impact on child mortality.

With regard to community factors, research results show that the contextual effects have an influence on children's health. Indeed, the availability and access to health centers, the availability of qualified staff are often lacking in rural and poor areas thus creating favorable factors to population health inequalities (2,9,35,38). Good hygiene practices are relatively difficult to be met under local conditions where water supply and sanitation are poor. Communities often have common values and norms, like peer pressure, contribute significantly to shaping the health behaviors. At the community level as well as at the household level, the poor may be disadvantaged. Thus they are more likely to live in remote places, far from health centers thus making accessibility very low in case of health problem(36). Several studies examine the effect of the type of residence (urban/rural) on childhood mortality inequalities(13,14,16,30,34). These studies showed that the location of residence (urban vs rural) had a significant influence on the child survival and so residing in rural areas increased the probability of a child dying before the fifth birthday. Houweling and Kunst (2) study showed that at the country level, several factors can impact on the magnitude of mortality inequalities through multiple pathways. Indeed, these authors showed that policies

at the country level can increase or decrease the inequalities between social groups and influence health policy for the poor. West Africa is one of the poorest parts of the world where health indicators are still poorly reported. Under-five mortality remains high in the region and MDG's fifth (5<sup>th</sup>) goal will not be met in many West African countries. Common causes of child mortality and morbidity include diarrhea, acute respiratory infections, measles, and malaria. Studies have shown that many children in Nigeria mainly die from malaria, diarrhea, neonatal tetanus, tuberculosis, whooping cough and broncho-pneumonia (39).

## Materials and Methods

We used data from Demographic and Health Surveys (DHS) run in six countries in West Africa including Burkina Faso (DHS, 2010), Benin (DHS, 2006), Cote d'Ivoire (DHS, 2011), Ghana (DHS, 2008), Mali (DHS, 2006), Nigeria (DHS, 2008) and Niger (DHS, 2012).

Data sharing statement Data available for public through internet <http://www.measuredhs.com>

The outcome variable used was the risk of under-five death (0–59 months), which is defined as the probability of dying between birth and the fifth birthday. Variable socioeconomic status built from household assets is used as the main variable for measuring inequalities in mortality.

### Selected variables

Child's sex: Male and Female

Birth order: 1st birth, 2nd-6th birth and 7th & +

Mother's age: 15-19, 20-24, 25-29, 30-34, 35-39, 40-44 and 45-49

Mother's Occupation: Not working, skilled manual and other occupation

Mother's education: No education, Primary, Secondary

Parity: 1-3, 4-6, 7 & +

Father's occupation: Agriculture, Sales, Skilled Manual and Other Occupation

Father's education: No education, Primary, Secondary, Higher and DK

Household's size: 1-3, 4-6, 7 & +

Household head's sex: Male and Female

Location of residence: Urban and Rural

Wealth index: Q1 (Poorest), Q2 Poorer, Q3 Middle Q4 Rich and Q5 Richest

The socio-economic variable was categorized into 5 categories: Q1 being the Poorest, Q2, Q3, Q4 and Q5 as the Richest. The independent variables included: sex of the child, birth order (1st, 2-6th, 7th and above), the mother's age at delivery (15-19), parity (1-3, 4-6, 7 and above), educational level (no education, primary, secondary and high) and occupation (not working, agriculture, sale, manual, other occupation) of the mother, educational level (no education, primary, secondary, highest and do not know (DK) and the occupation of the father (agriculture, skilled manual, other occupation), household size (1-3, 4-6, 7 and above), sex of household head and the middle of residence (urban vs. rural).

### Statistical analysis

The concentration index (CI) is employed in this paper to measure under 5 mortality inequalities.

CI quantifies the degree of income-related inequality in a health variable, and is becoming a standard tool for the measurement of income-related health inequality (Liu, Gao & Yan, 2014).

Detailed information about the methodological tools used is presented in some publications (37,41–44).

$$C = \frac{2}{n\mu} \left( \sum_{i=1}^n h_i R_i \right) - 1$$

Where  $b_i$  is the variable of interest for the  $i$ th person;  $\mu$  is the mean or proportion of  $b$ ;  $n$  is the number of persons; and if the  $n$  individuals are ranked according to their socioeconomic status, beginning with the most disadvantaged, then  $R_i$  is their relative rank,  $i-0.5/n$ . When there is no inequality (or when inequality is balanced and opposite for equal fractions of the income-ranked population), the concentration index equals 0. If the variable of interest is concentrated at a lower (or higher) socioeconomic level, the concentration index becomes negative (or positive).

Generalized Linear Model (GLM) specifying binomial distribution and identity link was used to perform multivariate analysis. The coefficients from GLM were used subsequently to decomposing and computing the contribution of independent variable to the concentration index. The method used is detailed somewhere (41).

## Results

Table 1 presents the proportions of deaths by poverty status and country. The results show that in all countries, the poorest Q1 have the highest proportions of deaths: Nigeria (31.4%), Cote d'Ivoire (30.4%) and Ghana (36.4%), over 30% of deaths of children under 5 years are among the children of the poorest (Q1) and the absolute dif-

ferences of proportions Q1-Q5 are more than 20 points (25.8 in Ghana, 23.6 in Nigeria and Cote d'Ivoire has 19.3). For Burkina Faso (14.5), Benin (15.7) and Mali (12), the absolute differences of the proportions of deaths of children under-five years between the poorest and the richest is more than 10 points. Niger appears to have the low gaps between poorest and richest with an absolute difference of less than 1 (0.7). The overall concentration index was -0.12 for Burkina Faso in 2010, -0.07 for both Benin in 2006 and for Cote d'Ivoire in 2011. The concentration index was -0.03 for Ghana in 2008 and -0.10 for Mali in 2006. It was -0.12 and -0.07 respectively for Nigeria in 2008 and Niger in 2012.

**Table 1:** Proportion of deaths in children under 5 years by socioeconomic quintile and country

Country	Q1(Poorest)	Q2	Q3	Q4	Q5(Richest)	Q5-Q1	(Q5-Q1)/Q1	C(95%CI)	N1	N2
Benin	25.56	22.47	23.91	18.23	9.83	15.72	-0.62	-0.07(-0.10;-0.04)	16075	1393
Cote d'Ivoire	30.39	25.41	19.61	13.54	11.05	19.34	-0.64	-0.07(-0.14;-0.01)	3644	362
Ghana	36.36	17.68	19.19	16.16	10.61	25.76	-0.71	-0.03(-0.11;0.05)	2992	198
Mali	22.77	24.43	21.82	20.21	10.77	11.99	-0.53	-0.10(-0.13; -0.08)	14238	1801
Nigeria	31.38	27.39	19.84	13.66	7.74	23.64	-0.75	-0.12(-0.14; -0.10)	28653	3206
Niger	17.36	22.7	20.5	22.8	16.63	0.73	-0.04	-0.07(-0.10; -0.03)	12558	956

N1=Number of births; N2=Number of deaths: Source: data from Demographic and Health Surveys (DHS) run in six countries in West Africa including Burkina Faso (DHS, 2010), Benin (DHS, 2006), Cote d'Ivoire (DHS, 2011), Ghana (DHS, 2008), Mali (DHS, 2006), Nigeria (DHS, 2008) and Niger (DHS, 2012). Q1Poorest; Q2 Poorer; Q3 Middle; Q4 Richer Q5 Richest

In all the countries concerned by this study, the value of the concentration index is negative and thus shows that mortality is concentrated among children from poor households (Q1=Poorest) than among children of wealthy households (Q5=Richest). Inequalities in mortality are higher in Burkina Faso, Nigeria and Mali whose concentration index was lower than -0.10. Inequalities in child mortality are less pronounced in Ghana, Niger and Cote d'Ivoire than elsewhere.

Figure 1 presents the proportions of deaths of children under-five years by quintile of socioeconomic and by country. The results of the graph show that the poorest are those with the highest death proportions.

### Factors associated with child mortality

Table 2 shows the proportions of deaths for each determinant factor associated with child mortality. The results on factors associated with the mortality of children under the age of 5 years for each country are presented in Table 3. Birth order was significant in all countries in the study. Children with 7<sup>th</sup> and above were more likely to die before their fifth year than the first child. The variable sex of the child is significant for Nigeria and Cote d'Ivoire and the results showed that girls had less probability to die before their fifth birthday than boys.

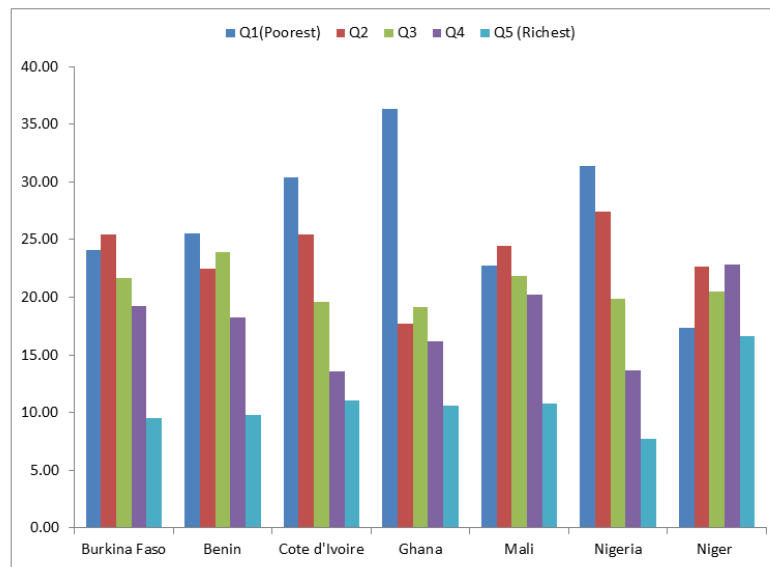


Fig. 1: Proportion of deaths in children under 5 years by socioeconomic quintile and country

The demographic characteristics of the mother such as age and parity have proved significant in the countries in the study and it appeared that the children of elderly mothers and mothers with high parity are more likely to die before their fifth birthday than those of the young mothers (15 and 19 years) who have low parity. The mother's occupation is only significant in Mali and Cote d'Ivoire. Contrary to our expectations, the mother's education level was not significant in some countries concerned as observed in the analysis. In Mali and Nigeria, the mother's education was significantly associated with child mortality of under 5 years.

According to the father's characteristics, results showed that the father's occupation is significantly associated with under-five mortality in Benin and Nigeria, while father's educational level is significant in Ghana, Mali and Niger. Thus, children whose fathers are educated had lower probability of dying than those whose fathers were not going to school.

Household size seemed to be a determinant of under-five year's mortality in the countries concerned in our analysis. In all countries, the results showed that the probability of dying before the age of five year increased with household size. Thus, children living in large households are more

likely to die before their fifth birthday. The results were similar in all countries. Exceptions are in Ghana and Cote d'Ivoire, where the variable sex of the household head was significantly associated to under-five mortality and the results showed that children in households headed by women had a higher probability of dying before their fifth birthday than those belonging to households headed by a man.

Table 4 presents the concentration index for each health outcome by country. The proportions (presented in Table 2 above) are used to calculate the concentration index related to each factor (Table 4). A negative  $C_k$  means that the determining factor is more prevalent among the poorest households. To the values of the concentrations of variables, we see that the birth order, maternal age, parity, and household size are potential contributing factors to inequalities in mortality among children under five years.

The mortality of children under five years appears to be higher among children of high birth rank ( $C_k = -0.36$  for Ghana,  $-0.20$  for Burkina and Benin and  $-0.21$  for Cote d'Ivoire), among children whose mothers had high parity among children whose mothers are older and among children belonging to in large households.

Table 2: Repartition of death by Explanatory variables and countries

Variables	Burkina		Benin		Ghana		Mali		Nigeria		Niger		Cote d'Ivoire	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
<b>Child' sex</b>														
Male	715	53.84	725	52.05	106	53.54	945	52.47	1,735	54.12	513	53.66	198	54.70
Female	613	46.16	668	47.95	92	46.46	856	47.53	1,471	45.88	443	46.34	164	45.30
<b>Birth order</b>														
1st	250	18.83	281	20.17	44	22.22	371	20.60	584	18.22	154	16.11	101	27.90
2nd-6th	834	62.80	884	63.46	121	61.11	1,031	57.25	1,895	59.11	537	56.17	201	55.52
7th & +	244	18.37	228	16.37	33	16.67	399	22.15	727	22.68	265	27.72	60	16.57
<b>Mother's age</b>														
15-19	74	5.57	62	4.45	4	2.02	148	8.22	188	5.86	43	4.50	49	13.54
20-24	283	21.31	266	19.10	39	19.70	440	24.43	675	21.05	203	21.23	91	25.14
25-29	365	27.48	440	31.59	41	20.71	421	23.38	818	25.51	250	26.15	83	22.93
30-34	261	19.65	282	20.24	41	20.71	361	20.04	612	19.09	204	21.34	49	13.54
35-39	203	15.29	219	15.72	46	23.23	255	14.16	508	15.85	158	16.53	59	16.30
40-44	95	7.15	96	6.89	19	9.60	131	7.27	257	8.02	69	7.22	23	6.35
45-49	47	3.54	28	2.01	8	4.04	45	2.50	148	4.62	29	3.03	8	2.21
<b>Mother's Occupation</b>														
Not working	246	18.52	152	10.91	23	11.62	608	33.76	1,020	31.82	695	72.70	90	24.86
Sales	211	15.89	562	40.34	68	34.34	334	18.55	1,017	31.72	176	18.41	117	32.32
Agriculture	706	53.16	577	41.42	80	40.40	-	-	635	19.81	27	2.82	121	33.43
Manual	132	9.94	84	6.03	12	6.06	126	7.00	355	11.07	35	3.66	4	1.10
Other occupation	33	2.48	18	1.29	15	7.58	733	40.70	179	5.58	23	2.41	30	8.29
<b>Mother's education</b>														
No education	1184	89.39	1110	79.68	86	43.43	1,598	88.73	1,871	58.36	824	86.19	249	68.78
Primary	107	8.06	232	16.65	53	26.77	161	8.94	721	22.49	92	9.62	94	25.97
Secondary & +	37	2.79	51	3.66	59	29.80	42	2.33	614	19.15	40	4.18	19	5.25
<b>Parity</b>														
1-3	497	37.42	530	38.05	84	42.42	693	38.48	1,170	36.49	286	29.92	171	47.24
4-6	494	37.20	552	39.63	70	35.35	580	32.20	1,074	33.50	321	33.58	113	31.22
7 & +	337	25.38	311	22.33	44	22.22	528	29.32	962	30.01	349	36.51	78	21.55
<b>Father's occupation</b>														
Agriculture	1039	78.24	877	62.96	111	56.06	1,275	70.79	1,535	47.88	567	59.22	-	-
Sales	108	8.13	231	16.58	17	8.59	186	10.33	550	17.16	-	-	-	-
Skilled Manual	111	8.36	130	9.33	32	16.16	152	8.44	398	12.41	255	26.67	-	-
Other Occupation	70	5.27	155	11.13	38	19.19	188	10.44	723	22.55	134	14.02	-	-
<b>Father's education</b>														
No education	1145	87.14	804	58.30	83	42.56	1,495	83.15	1,500	47.41	815	85.25	-	-
Primary	113	8.60	308	22.34	21	10.77	183	10.18	672	21.24	83	8.68	-	-
Secondary	48	3.65	175	12.69	71	36.41	78	4.34	714	22.57	35	3.66	-	-
Higher	3	0.23	16	1.16	9	4.62	11	0.61	223	7.05	6	0.63	-	-
DK	5	0.38	76	5.51	11	5.64	31	1.72	55	1.74	17	1.78	-	-
<b>Household's size</b>														
1-3	217	16.34	250	17.95	57	28.79	339	18.82	597	18.62	148	15.48	42	11.60
4-6	441	33.21	562	40.34	83	41.92	677	37.59	1,246	38.86	349	36.51	123	33.98
7 & +	670	50.45	581	41.71	58	29.29	785	43.59	1,363	42.51	459	48.01	197	54.42
<b>Household head's sex</b>														
Male	1249	94.05	1237	88.80	147	74.24	1,690	93.84	2,920	91.08	858	89.75	72	19.89
Female	79	5.95	156	11.20	51	25.76	111	6.16	286	8.92	98	10.25	290	80.11
<b>Location of residence</b>														
Urban	198	14.91	424	30.44	67	33.84	403	22.38	634	19.78	122	12.76	123	33.98
Rural	1130	85.09	969	69.56	131	66.16	1,398	77.62	2,572	80.22	834	87.24	239	66.02
<b>Socio-economic status</b>														
Q1 (Poorest)	320	24.10	356	25.56	72	36.36	410	22.77	1,006	31.38	166	17.36	110	30.39
Q2	338	25.45	313	22.47	35	17.68	440	24.43	878	27.39	217	22.70	92	25.41
Q3	288	21.69	333	23.91	38	19.19	393	21.82	636	19.84	196	20.50	71	19.61
Q4	255	19.20	254	18.23	32	16.16	364	20.21	438	13.66	218	2.80	49	13.54
Q5 (richest)	127	9.56	137	9.83	21	10.61	194	10.77	248	7.74	159	16.63	40	11.05
N	1,328	8.83	1,393	8.67	198	6.62	1,801	12.7	3,206	11.19	956	7.61	362	9.93

Source: Demographic and Health Surveys (DHS) different countries in West Africa including Burkina Faso (DHS, 2010), Benin (DHS, 2006), Cote d'Ivoire (DHS, 2011), Ghana (DHS, 2008), Mali (DHS, 2006), Nigeria (DHS, 2008) and Niger (DHS, 2012). Q1 Poorest; Q2 Poorer; Q3 Middle; Q4 Richer Q5 Richest

Table 3: Adjusted associations between infant mortality and its dominants

Variables	Burkina		Benin		Ghana		Mali		Nigeria		Niger		Cote d'Ivoire	
	Coef.	Pvalue	Coef.	Pvalue	Coef.	Pvalue	Coef.	Pvalue	Coef.	Pvalue	Coef.	Pvalue	Coef.	Pvalue
<b>Child' sex (Male)</b>	-0.138	0.019	-0.098	0.086	-0.106	0.491	-0.082	0.110	-0.150	0.000	-0.134	0.051	-0.230	0.042
<b>Birth order (1st)</b>														
2nd-6th	-0.064	0.565	-0.292	0.004	-0.453	0.076	-0.378	0.000	-0.022	0.748	-0.404	0.003	-0.259	0.150
7th & +	-0.893	0.000	-0.980	0.000	-1.180	0.014	-1.014	0.000	-0.665	0.000	-0.892	0.000	-0.816	0.026
<b>Mother's age (15-19)</b>														
20-24	-0.040	0.794	-0.105	0.507	1.057	0.094	0.250	0.024	0.185	0.055	0.645	0.001	-0.402	0.046
25-29	-0.005	0.976	-0.178	0.279	0.866	0.178	0.075	0.553	-0.051	0.616	0.520	0.011	-0.666	0.005
30-34	-0.472	0.011	-0.537	0.003	0.993	0.137	0.127	0.356	-0.216	0.051	0.366	0.095	-1.102	0.000
35-39	-0.499	0.012	-0.426	0.024	1.073	0.113	0.007	0.961	-0.211	0.073	0.429	0.064	-0.846	0.004
40-44	-0.709	0.001	-0.560	0.008	0.831	0.244	0.001	0.996	-0.265	0.042	0.308	0.226	-1.128	0.001
45-49	-0.066	0.795	-0.833	0.002	0.478	0.540	0.031	0.887	-0.129	0.373	0.449	0.135	-1.249	0.009
<b>Mother's Occupation (Not working)</b>														
Sales	-0.244	0.016	0.174	0.080	0.001	0.998	0.195	0.010	0.046	0.357	-0.062	0.500	0.317	0.039
Agriculture	-0.216	0.009	0.055	0.592	-0.267	0.346			-0.021	0.721	-0.308	0.135	0.063	0.684
Manual	0.111	0.353	0.059	0.688	-0.350	0.364	0.208	0.052	0.079	0.248	0.201	0.279	0.289	0.609
Other occupation	0.206	0.333	0.200	0.475	-0.116	0.752	0.213	0.001	0.080	0.393	0.081	0.733	0.373	0.111
<b>Mother's education (No education)</b>														
Primary	-0.179	0.117	0.057	0.498	0.205	0.327	0.000	0.998	-0.085	0.133	0.119	0.321	0.133	0.325
Secondary & +	-0.266	0.209	-0.302	0.080	0.089	0.710	-0.351	0.051	-0.195	0.005	0.209	0.288	-0.240	0.370
<b>Parity (1-3)</b>														
4-6	0.741	0.000	0.805	0.000	0.772	0.001	0.483	0.000	0.607	0.000	0.701	0.000	0.828	0.000
7 & +	1.945	0.000	1.776	0.000	2.176	0.000	1.530	0.000	1.745	0.000	1.673	0.000	2.054	0.000
<b>Father's occupation (agriculture)</b>														
Sales	-0.267	0.020	-0.133	0.166	0.175	0.603	-0.278	0.003	0.119	0.042	-0.437	0.677		
Skilled Manual	0.122	0.279	-0.206	0.069	-0.070	0.790	-0.116	0.260	0.090	0.177	-0.073	0.396		
Other Occupation	-0.197	0.238	-0.297	0.008	-0.273	0.312	-0.076	0.430	0.125	0.031	-0.013	0.906		
<b>Father's education (No education)</b>														
Primary	-0.201	0.064	-0.133	0.083	-0.254	0.348	-0.046	0.601	-0.024	0.674	-0.280	0.023		
Secondary	-0.092	0.617	-0.045	0.661	-0.863	0.000	-0.363	0.007	-0.027	0.671	-0.531	0.006		
Higher	0.124	0.845	-0.278	0.336	-0.968	0.028	-0.635	0.056	-0.150	0.105	-1.059	0.022		
DK	-0.157	0.738	-0.097	0.459	-0.018	0.959	0.053	0.791	0.072	0.631	0.232	0.378		
<b>Household's size (1-3)</b>														
4-6	-1.037	0.000	-0.849	0.000	-1.102	0.000	-0.940	0.000	-1.009	0.000	-1.135	0.000	-0.648	0.002
7 & +	-1.215	0.000	-1.128	0.000	-1.409	0.000	-1.320	0.000	-1.332	0.000	-1.534	0.000	-0.895	0.000
<b>Household head's sex (Male)</b>	0.312	0.019	0.270	0.005	0.140	0.472	0.359	0.001	0.241	0.001	0.295	0.015	-0.156	0.282
<b>Location of residence(Urban)</b>	0.122	0.247	0.085	0.217	-0.121	0.597	-0.009	0.909	0.210	0.000	0.522	0.000	0.082	0.581
<b>Socio-economic status (Q1 (Poorest))</b>														
Q2	0.036	0.674	0.008	0.920	-0.102	0.667	-0.022	0.776	-0.005	0.920	0.337	0.002	-0.122	0.429
Q3	-0.101	0.255	0.129	0.128	0.259	0.356	-0.207	0.008	-0.064	0.293	0.241	0.032	-0.167	0.342
Q4	-0.143	0.127	0.058	0.560	0.157	0.642	-0.172	0.042	-0.184	0.017	0.321	0.004	-0.277	0.195
Q5 (richest)	-0.329	0.025	-0.089	0.513	0.251	0.540	-0.290	0.021	-0.385	0.000	0.183	0.224	0.024	0.922
<b>Intercept</b>	-1.608	0.000	-1.743	0.000	-2.276	0.001	-1.351	0.000	-1.700	0.000	-2.822	0.000	-1.038	0.001

Source: Demographic and Health Surveys (DHS) different countries in West Africa including Burkina Faso (DHS, 2010), Benin (DHS, 2006), Cote d'Ivoire (DHS, 2011), Ghana (DHS, 2008), Mali (DHS, 2006), Nigeria (DHS, 2008) and Niger (DHS, 2012). Q1 Poorest; Q2 Poorer; Q3 Middle; Q4 Richer Q5 Richest

Table 4: Decomposition analysis of concentration index of infant mortality by socioeconomic status

Variables	Burkina		Benin		Ghana		Mali		Nigeria		Niger		Cote d'Ivoire	
	C <sub>k</sub>	Contr C	C <sub>k</sub>	Contr C	C <sub>k</sub>	Contr C	C <sub>k</sub>	Contr C	C <sub>k</sub>	Contr C	C <sub>k</sub>	Contr C	C <sub>k</sub>	Contr C
Child's sex (Female)	-0.006	0.004	-0.022	0.011	-0.006	0.005	0.005	-0.002	0.006	-0.004	0.002	-0.001	-0.002	0.002
Birth order (1st)														
<b>2nd-6th</b>	0.009	-0.004	0.000	0.001	-0.007	0.029	0.017	-0.030	0.021	-0.002	0.001	-0.004	0.005	-0.007
<b>7th &amp; +</b>	-0.209	0.389	-0.203	0.343	-0.357	1.131	-0.149	0.264	-0.182	0.246	-0.076	0.246	-0.215	0.292
Mother's age (15-19)														
<b>20-24</b>	0.056	-0.005	0.018	-0.004	-0.032	-0.108	0.039	0.019	-0.058	-0.020	0.043	0.078	0.031	-0.031
<b>25-29</b>	0.034	-0.001	0.025	-0.015	0.029	0.084	0.038	0.005	0.052	-0.006	0.007	0.013	0.029	-0.045
<b>30-34</b>	-0.003	0.004	0.020	-0.023	0.106	0.353	-0.035	-0.007	0.068	-0.025	-0.026	-0.026	0.028	-0.042
<b>35-39</b>	-0.063	0.054	-0.032	0.022	-0.025	-0.101	-0.063	0.000	0.018	-0.005	0.000	0.000	0.001	-0.002
<b>40-44</b>	-0.118	0.068	-0.060	0.024	-0.124	-0.159	-0.105	0.000	-0.044	0.008	-0.015	-0.004	-0.153	0.111
<b>45-49</b>	-0.105	0.003	-0.185	0.033	-0.261	-0.081	-0.155	-0.001	-0.184	0.010	-0.104	-0.019	-0.025	0.007
Mother's Occupation (Not working)														
<b>Sales</b>	0.239	-0.105	0.200	0.148	0.271	0.002	0.193	0.055	0.103	0.013	0.146	-0.022	0.214	0.221
<b>Agriculture</b>	-0.111	0.144	-0.319	-0.077	-0.459	0.799		0.000	-0.307	0.011	-0.143	0.016	-0.373	-0.079
<b>Manual</b>	-0.142	-0.018	0.248	0.009	0.115	-0.039	0.109	0.013	0.082	0.006	0.029	0.003	0.025	0.001
<b>Other occupation</b>	0.466	0.027	0.590	0.016	0.391	-0.055	-0.188	-0.129	0.480	0.019	0.504	0.013	0.405	0.126
Mother's education (No education)														
<b>Primary</b>	0.335	-0.055	0.296	0.030	0.000	0.000	0.253	0.000	0.062	-0.011	0.288	0.043	0.069	0.024
<b>Secondary &amp;+</b>	0.742	-0.062	0.656	-0.076	0.330	0.141	0.632	-0.041	0.458	-0.153	0.698	0.080	0.490	-0.062
Parity (1-3)														
<b>4-6</b>	-0.050	-0.155	-0.062	-0.207	-0.083	-0.364	-0.020	-0.024	-0.009	-0.016	-0.029	-0.090	-0.015	-0.040
<b>7 &amp;+</b>	-0.205	-1.147	-0.208	-0.868	-0.366	-2.852	-0.146	-0.516	-0.177	-0.828	-0.078	-0.623	-0.232	-1.036
Father's occupation (agriculture)														
<b>Sales</b>	0.416	-0.102	0.371	-0.086	0.439	0.106	0.386	-0.088	0.188	0.034	0.986	0.000		
<b>Skilled Manual</b>	0.263	0.030	0.341	-0.069	0.273	-0.050	0.381	-0.029	0.249	0.025	0.178	-0.045		
<b>Other Occupation</b>	0.579	-0.068	0.388	-0.135	0.344	-0.290	0.378	-0.024	0.306	0.077	0.345	-0.008		
Father's education (No education)														
<b>Primary</b>	0.304	-0.060	0.116	-0.036	-0.185	0.082	0.111	-0.004	0.013	-0.001	0.221	-0.071		
<b>Secondary</b>	0.681	-0.026	0.430	-0.026	0.201	-1.018	0.523	-0.065	0.279	-0.015	0.530	-0.135		
<b>Higher</b>	1.000	0.003	0.798	-0.027	0.540	-0.390	0.762	-0.023	0.529	-0.050	0.962	-0.084		
<b>DK</b>	0.295	-0.002	0.212	-0.012	0.019	0.000	0.263	0.002	0.002	0.000	0.300	0.016		
Household's size (1-3)														
<b>4-6</b>	0.029	-0.115	0.026	-0.094	0.061	-0.457	0.046	-0.130	0.059	-0.208	-0.015	0.082	-0.025	0.056
<b>7 &amp;+</b>	-0.036	0.249	-0.052	0.255	-0.205	1.366	-0.047	0.214	-0.072	0.362	0.007	-0.068	0.005	-0.023
Household head's sex (Female)	0.099	0.021	0.042	0.001	0.123	0.071	-0.216	-0.038	-0.200	-0.038	-0.176	-0.070	-0.282	0.355
Location of residence (Rural)	-0.155	-0.183	-0.178	-0.111	-0.298	0.385	-0.014	0.001	-0.011	-0.016	0.019	0.112	-0.003	-0.002

Source: Demographic and Health Surveys (DHS) different countries in West Africa including Burkina Faso (DHS, 2010), Benin (DHS, 2006), Cote d'Ivoire (DHS, 2011), Ghana (DHS, 2008), Mali (DHS, 2006), Nigeria (DHS, 2008) and Niger (DHS, 2012)



## Discussion

Results of this study show that the inequalities of the mortality of children under-five remain in West African countries and gaps of under-five mortality between children from wealthy households and those living in poorest household are still important, thus supporting findings of earlier studies (16,37). Findings of the study show that the intensity of inequality varies from one country to another i.e. it is more concentrated in Burkina Faso, Nigeria and Mali and weakly concentrated in Ghana, showing that community or country level conditions can be potential sources of inequalities in mortality and health of children under five years (2,30,31,45). Indeed, Countries involved in this study are all West African countries, where political context, economic development and social policies underway are not the same. These differences could explain differences in inequality of child mortality as observed. Ssewanyana & Kasirye (32) argued that with regard to contextual factors driving health inequalities, political factors are highlighted as major drivers of both income and health inequalities. Findings also showed that socio-economic inequalities of under-five mortality are related to child's characteristics (birth, gender), to mother's characteristics (age, the main occupation, parity), the characteristics of the father (education) and to household's characteristics (size, gender of household head, the standard of living of the household). These variables are been listed in the conceptual frameworks developed for explaining inequality of child mortalities in developing countries (27, 38, 46). Our findings also showed that the birth's order, mother's age, parity, mother's occupation and household's size are major contributors of inequalities of child mortalities by decomposition analysis of concentration index in the countries concerned by the study. Surprisingly, our results do not confirm a strong relationship between the mother's educational level and location of residence and inequalities in under-five mortality in the countries concerned. Such result was also found in recent research (32,47,48).

## Conclusion

The most important conclusion of this study is to reduce mortality in children under 5 years, it is needed to reduce economic and social inequalities and improve the country's economic and social condition. Tackling under-five inequalities of child mortality could therefore be through specific actions in country level and by stressing family planning programs aimed at promoting the reduction of number of births per women and by increasing women empowerment in economic activities.

## Ethical considerations

Ethical issues (Including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc.) have been completely observed by the authors

## Acknowledgements

Authors would like to thank the Macro International for providing latest Demographic and Health Surveys data. Authors would like to thank Tsawe Mluleki, Statistics South Africa for his valuable assistance. The authors declare that there is no conflict of interests.

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