Ten-year trend of mortality among patients hospitalized with Malaria in Ghana,

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Abstract

Background Multiple interventions have been implemented over the years to decrease malaria morbidity and mortality in Ghana. After years of rolling out these interventions, assessing its effect on the trends for decision making is key. The objective of this study was to understand the trends of malaria related deaths in the country from 2005 to 2014.

Methods Between September 2016 and June 2017, abstraction of retrospective data covering January 1st 2005 to December 31st, 2014 was conducted in 93 sampled health facilities providing AIDs/HIV, Tuberculosis and Malaria (ATM) services in Ghana. This paper is written out of a bigger study which looked at the mortality of ATM in Ghana. Abstraction form was used to retrieve socio-demographic and admission outcome of patients from facility registers, death certificates and inpatients registers. Data was entered using EpiData 3.1 statistical software package then exported to STATA 11 version for analysis. Bivariate analysis with Chi-square test and multiple logistic regression were done to assess factors associated with malaria related mortality at a 5% level of significance.

Results A total of 667,186 admissions records related to malaria were retrieved in 93 hospitals from 2005 to 2014 with majority of the admissions being females (53.9%) and children under 5 years (47.8%). A total of 10,433(1.6%) of the admitted malaria cases were reported to have died with males and children under five years accounting for 51.0% and 26.6% respectively. Malaria case fatality rate showed an increasing trend from 2.2% in 2005 to 3.0% in 2007 and decreased to 1.1% in 2014. Malaria mortality declined by approximately 59% over the ten-year period with an average annual decline of 7%. Year of admissions, age, sex, insurance status and ownership of facility was significantly associated with mortality ($p < 0.001$). Sub-regional level hospitals have a decreased likelihood of malaria related mortality. A non-insured client increases the likelihood of mortality by 2.4 times (Odds Ratio = 2.4 $p < 0.001$).

Conclusion Malaria mortality declined over the ten-year period with an average annual decline of 7%. An increase in age and not having health insurance among malaria-related admissions increases the likelihood of mortality.

Background

Malaria is endemic in Ghana with the entire population at risk with the most vulnerable being children under five years, pregnant women and the immuno-compromised. The World Health Organization (WHO) estimated about 198 million cases of malaria and 584 000 deaths globally in 2013. Malaria mortality rates have fallen by 47% and 54% globally and in Africa respectively since 2000 [1]. Most of the malaria deaths occurred among children living in Africa where a child dies every minute from malaria. Malaria mortality rates among children in Africa by 2013 have been reduced by an estimated 58% since 2000[1]. Data from the District Health Information Management System for Ghana (DHIMS-II) 2014, revealed that malaria was a major cause of hospital attendance, comprising about 30% of Out-Patient Department

(OPD) visits, 27.9% in-patients and 7.2% deaths [2]. The total number of deaths attributable to malaria in 2014 was 2,200 out of which 1,060 (48.2%) occurred among children under 5 years [2].

There has been the roll out of several interventions in the country throughout the years to ensure reduction in malaria mortality and morbidity. These interventions such as the insecticide treated nets, seasonal malaria chemoprevention, intermittent preventive treatment in pregnant women are aimed at preventing the occurrence of the malaria disease. Strategies such as test, treat and track at the health facility and community levels also help diagnose and treat malaria cases appropriately. After several years of carrying out these interventions, it is important to assess the trends of malaria related morbidity and mortality in the context of increasing interventions. The objective of this paper is to describe the trends in the malaria-related deaths in the country from 2005 to 2014.

Methods

Study design

This study was done as part of a bigger one which looked at the mortality of AIDS/HIV, TB and malaria. A retrospective data analysis from a representative sample of health facilities providing services for the three diseases (ATM) was conducted.

Study Site

The study was conducted in all ten regions across the country. The study included teaching hospitals, regional hospitals, district hospitals and other primary level hospitals that provide inpatient services for AIDS/HIV, TB and Malaria (ATM).

Study Period

Data was collected from September 2016 to June 2017.

Sample size and sampling procedure

For a facility to be eligible for inclusion in the sampling frame, the study used the following eligibility criteria:

A facility should provide diagnosis and treatment as well as inpatient services for at least one year during the study period for the three diseases: AIDS/HIV, TB and Malaria. Out of the total number of health facilities in the country, 198 health facilities provided diagnosis and treatment services for HIV/AIDS, TB, and Malaria of which 169 facilities provided additional in-patient services. These 169 facilities were used as the sampling frame. Of the total 169 health facilities which qualified the study criteria (provided admission for ATM) 100 (59.2%) were selected for the study. Facilities were stratified into regions and the number of health facilities in each region was allocated based on the total number of health facilities in that region.

In each region, all teaching and regional hospitals were purposively sampled and the remaining facilities were selected randomly using excel generated random numbers proportionate to the number of ART sites as shown in Table 1 (With all region having a minimum of 50% of the eligible).

Table 1: Distribution of eligible health facilities and selected health facilities for ATM mortality study

Region	Total eligible facilities	Number of facilities selected	Number of Facilities assessed
Ashanti	29	16	16
Brong-Ahafo	19	11	10
Central Region	11	7	6
Eastern Region	20	12	11
Greater Accra	22	13	12
Northern	15	9	8
Volta	20	12	12
Western	20	12	11
Upper East	7	4	3
Upper West	6	4	4
Total	169	100	93

Data collection procedure

A data abstraction form was used to retrieve data from facility registers, death certificates, inpatients registers and records covering the period January 1st 2005 to December 31st, 2014.

Extraction of data from the registers and various data forms were carried out by trained Research Assistants.

Data entry and analysis

Data was entered using a predesigned database format using EpiData 3.1 statistical software package and then exported to Stata (v11, Stata Corporation, USA) and SPSS (v20, IBM Corporation, USA) for analysis. Frequencies, proportions, and ratios were calculated to describe basic characteristics of study

subjects. Trends in malaria-related mortality were determined. Bivariate analysis with Chi-square test was done to assess factors associated with ATM related mortality. A p-value of less than 5% was considered statistically significant. In order to explore the relative influence of each independent variable or factor on mortality and to test significance of association, we conducted a binary logistic regression analysis using a multivariate model.

Meta-analysis was used to evaluate the trends in death rates among inpatients over time and to have a pooled estimate of death rate. Death rate in malaria-related admission for each year was determined at 95% CI. The point estimate of death rate, upper and lower value of the 95% CI were fed to the Meta-analysis syntax command. Weighting using random effect was applied since we expected heterogeneity across cohorts.

Limitations of the study

It did not fully assess risk factors for disease specific mortality because of limited data found in the records on variables.

Results

From the total 100 facilities selected for this study, we able to collect data from 93 (93%) of facilities. A total of 667,186 admissions records related to malaria were retrieved in 93 hospitals from 2005 to 2014, with majority of the admissions [359,311(53.9%)] being females. Admissions were highest in children under 5 years (47.8%) followed by children between the ages 5 to 14 years old (15.6%) while patients aged 65 to 74 years recorded the lowest (2.5%). During the period under review, 19,779 (3%) of the admissions were in pregnant women.

Northern region recorded the highest number of malaria admissions constituting 17.9% followed by Volta region (15.5%) with Upper East region recording the lowest malaria admissions (1.3%). Malaria admissions increased from 3.6% in 2005 to 17.8% in 2014 with district hospitals recording the highest (79.7%) and Teaching Hospitals, the lowest (3.4%). Among all the malaria cases abstracted, 411,732(61.7%) were insured either on NHIS or Private Health Insurance Scheme. Among the admitted malaria cases, 85.4% had malaria as the principal diagnosis with 14.2% having malaria as additional diagnosis to other principal diagnosis. About 93.0% of all the recorded malaria cases admitted were discharged home. Of the total malaria related admissions, 10,433(1.6%) of them were reported dead with males accounting for 51.0%; the highest proportion was recorded in children under five years 2,771(26.6%) while the lowest was recorded in patients aged 75years and above (12.0%). Malaria deaths among admissions (case fatality rate) increased from 2.2% in 2005 to 3.0% in 2007 and declined from 3.0% in 2007 to 1.1% in 2014(Figure 1). Malaria mortality declined by approximately 59% over the ten-year period with an average annual decline of 7 %.

The highest case fatality rate (3.0%) was recorded in Central region with Ashanti region having recorded the lowest (1.0%). Even though children under five accounted the highest number of malaria mortalities

(2,771), that age group together with those aged 5-14years recorded the lowest (0.9%) malaria case fatality rate while patients above 74 years recorded the highest CFR (7. 4%). The Regional Hospitals recorded the highest case fatality rate (3.0%). Case fatality rate was lower for insured patients (1.1%) compared with non-insured patients (2.9%).

Table 2: Factors Associated with Malaria Mortality in Ghana from 2005 to 2014

Independent variables	Patient died on Admission			
	Yes, # (%)	No, # (%)	Total	P value
Year of admission				0.000
2005	510(2.2)	22391(97.8)	22901	
2006	626(2.6)	23054(97.4)	23680	
2007	836(3.0)	26961(97.0)	27797	
2008	909(2.3)	38527(97.7)	39436	
2009	1010(2.0)	49804(98.0)	50814	
2010	1295(1.9)	67509(98.1)	68804	
2011	1275(1.6)	77210(98.4)	78485	
2012	1403(1.4)	99663(98.6)	101066	
2013	1362(1.3)	107332(98.7)	108694	
2014	1207(1.1)	112605(98.9)	113812	
Total	10433(1.6)	625056(98.4)	635489	
Sex of Patient				
Male	5317(1.8)	287470(98.2)	292787	0.000
Female	5088(1.5)	335689(98.5)	340777	
No Information	28(1.5)	1897(98.5)	1925	
Age group				0.000
<5	2771(.9)	301417(99.1)	304188	
5-14	858(.9)	98368(99.1)	99226	
15-24	642(1.0)	66329(99.0)	66971	
25-34	949(1.8)	52723(98.2)	53672	
35-44	1132(3.3)	33423(96.7)	34555	
45-54	1012(4.1)	23763(95.9)	24775	
55-64	831(5.2)	15282(94.8)	16113	
65-74	915(5.8)	14861(94.2)	15776	
75+	1249(7.6)	15182(92.4)	16431	
Regions				0.00

Greater Accra	968(2.1)	44250(98.9)	45218
Ashanti	788(1.0)	81968(99.0)	82756
Brong Ahafo	815(1.2)	68591(98.8)	69406
Eastern	1490(1.9)	78484(98.1)	79974
Northern	1072(0.9)	112360(99.1)	113432
Upper East	77(0.9)	8758(99.1)	8835
Upper West	558(2.2)	25212(97.8)	25770
Western	963(1.7)	54254(98.3)	55217
Volta	2102(2.1)	99294(97.9)	101396
Central	1600(3.0)	51885(97.0)	53485
Type of facility			0.000
Teaching Hospital	502(2.3)	21792(97.7)	22294
Regional Hospital	1567(3.0)	50722(97.0)	52289
District Hospital	7807(1.5)	503009(98.5)	510816
Other Hospital	557(1.1)	49533(98.9)	50090
Facility Ownership			0.000
Government	8256(1.9)	435412(98.1)	443668
Quasi-Government	329(1.0)	31262(99.0)	31591
Private	26(0.5)	5077(99.5)	5103
Faith-based	1822(1.2)	153305(98.8)	155127
Health insurance Status			0.000
Yes	4435(1.1)	391511(98.9)	395946
No	3552(2.9)	117287(97.1)	120839
No Information	2446(2.1)	116258(97.9)	118704

Year of admissions, age, sex, insurance status, type and ownership of facility were significantly associated with mortality ($p < 0.001$) (Table 2). The regional hospitals have about 24% (Odds Ratio=1.24, $p<0.001$) increased odds of mortality compared to teaching hospitals. Cases of malaria admitted into Private, Faith-based and Quasi-government facilities had a decreased likelihood of dying compared to government facilities (Table 3). A unit increase in age among malaria related admissions had a 0.3 increased odds of mortality (Odds Ratio=1.029, $p<0.001$).

Table 3: Multivariate analysis of factors associated with mortality among malaria admissions, Ghana from 2005 to 2014.

Variable	B	Sig.	Exp(B)	95% C.I.	
				Lower	Upper
Age	.028	0.000	1.029	1.028	1.029
Male		.000			
Female	-.447	.000	.639	.614	.665
No Information	-.220	.355	.802	.503	1.280
2005		.000			
2006	.197	.001	1.217	1.079	1.373
2007	.243	.000	1.275	1.137	1.431
2008	.192	.001	1.212	1.082	1.357
2009	.102	.071	1.108	.991	1.238
2010	.117	.033	1.124	1.009	1.251
2011	-.034	.541	.967	.868	1.077
2012	-.180	.001	.836	.750	.931
2013	-.251	.000	.778	.698	.867
2014	-.362	.000	.696	.624	.777
Teaching Hospital		.000			
Regional Hospital	.211	.000	1.235	1.111	1.373
District Hospital	-.429	.000	.651	.592	.717
Other Hospital	-.868	.000	.420	.358	.492
Government		.000			
Quasi-Government	-.474	.000	.622	.532	.728
Private	-1.067	.000	.344	.225	.526
Faith-based	-.273	.000	.761	.719	.806
Health Insurance		0.000			
No Health Insurance	.893	.000	2.442	2.328	2.561
No Information	.696	.000	2.005	1.897	2.119
HIV/AIDS		0.000			
TB	-.500	.001	.607	.449	.820

Malaria	-2.178	.000	.113	.098	.131
Other	-1.484	.000	.227	.196	.262
No Information	-1.233	.001	.291	.145	.584
Constant	-2.409	.000	.090		
Model R2= 0.018, X2=11469.710, df=24, P=0.000					

Among malaria-related admissions, Patients with malaria as principal diagnosis have decreased odds (OR=0.11, $P<0.001$) of dying compared to HIV/AIDS as principal diagnosis. All other disease as principal diagnosis with HIV/AIDS as reference also had decreased likelihood. Females have a significant 36% decreased odds of malaria mortality (Odds Ratio=0.64, $p<0.001$) compared to males and being a non-insured client increased the likelihood of mortality by 2.4 times (Odds Ratio=2.4 $p<0.001$). (Table 3).

Discussion

Assessing trends of malaria morbidity and mortality is one of the important tools in measuring the impact of interventions over the years and data capturing gaps. Over the years, the National Malaria Control Programme has implemented multiple interventions with the help of Global Fund to decrease the malaria morbidity and mortality in Ghana. This is manifested in survey findings which shows that households who owned at least one ITN increased from 18.7% in 2003[3], to 73% in 2016[4]. Health-seeking behaviour has improved over the years with advice or treatment sought for 49.4% of children with fever in the 2 weeks before the survey in 2011[5] increasing to 72% in 2016[4].

In this study, mortality among malaria admissions (Case Fatality Rate) showed an upward trend from 2.2% in 2005 to 3.0% in 2007 and a downward trend from 3.0% in 2007 to 1.1% in 2014. National Health Insurance Scheme (NHIS) in Ghana was introduced in 2003 which made health care more accessible to people thereby increasing the number of people who sought care and were admitted. Though Artemisinin Combination Therapies (ACTs) were introduced in 2005, coverage was low and increased over time. It was in 2007 that the impact of all the interventions especially the use of ACTs started manifesting. This coupled with increased number of NHIS clients and increasing sub-district facilities across the country may have contributed to decreasing delays in care seeking by patients and a further decrease in presenting with very fatal forms of the disease. The trend could also be due to improved quality of malaria case management by health workers as case management trainings have increased over the years [6, 7] with increase in country donor support. The cumulative effect may have started manifesting after the year 2007 as seen in other researches [8–10].

Teaching and Regional hospitals have increased likelihood for malaria-related mortality compared to the lower facilities. This could be resulting from the fact that regional and teaching hospitals are referral levels where complicated cases (with high risk of dying) are sent to be managed. Malaria-related admissions in government facilities had an increase likelihood of dying compared to the other types of ownership. Though the private sector and some public sector (district and sub-district hospitals) health facilities are known to be the first point of call for cases especially malaria [11–13], cases tend to be referred to the higher facilities (Regional and Teaching Hospitals) which are often public. It is worthy of note that all the regional and teaching hospitals are public/government facility. The findings may have therefore have resulted from improved quality of care in the non-governmental facilities or admission of relatively non-severe cases in the lower and private facilities compared to the regional facilities. This increases the likelihood of the government facilities having potentially fatal cases.

In the bivariate analysis, region of admission was significantly associated with mortality. The Central Region recording the highest CFR (3.0%) while Upper East and Northern Regions recorded the lowest (0.9%). This could be due to varying case management challenges across the regions, late reporting of cases and uneven distribution of capacity to manage such cases across the country. This is on the backdrop that Central Region is not the region with the worst Doctor: Patient ratio [14] and not the poorest in Ghana [15] which are variables that could worsen CFR rate yet the region recorded the highest CFR.

Increase in age has a significant 0.2% increased likelihood of malaria-related mortality. This could have resulted from the high attention given to the management of fevers in children over the years and possible delays in seeking health care by adults as compared to taking their children to the health facility when the need arose. The theory of older ages becoming more vulnerable to malaria than before due to a gradual loss of partial immunity as malaria burden decreased following intensified malaria control measures could also be the reason. This has been documented in some researches [16–18].

Among malaria-related admissions, patients with malaria as principal diagnosis have decreased odds (OR = 0.11, $P < 0.001$) of dying compared to having HIV/AIDS as principal diagnosis. Having any other disease as principal diagnosis using HIV/AIDS as reference also showed a decreased likelihood of dying. This may have resulted because patients admitted with HIV/AIDS as principal diagnosis may be severely ill and in an immune-compromised state which may get complicated with other diseases therefore increasing the odds of dying.

Finally, not having health insurance increases the likelihood of malaria-related mortality by 2.34 times. This could be linked to the fact that insurance holders are more likely to seek health care early and in an appropriate place and are therefore less likely to present with severe forms of the disease. They are also likely to be provided with all the resources for their management especially if there is the need for management of concomitant diseases. This health insurance finding is supported by similar trends seen in some researches [19, 20].

Conclusion

Declines in malaria cases and deaths were higher in children under five years old than in all age groups. Malaria mortality declined by approximately 59% over the ten-year period with an average annual decline of 7%. The likelihood of dying after malaria-related diagnosis in regional hospitals and government hospitals was higher than in the other type and ownership of facilities respectively. An increase in age and not having health insurance among malaria-related admissions increases the likelihood of mortality. Targeted interventions among elderly and an intervention to increase health insurance coverage may help the malaria control program to reduce malaria-related mortality in the country.

List Of Abbreviations

ATM	AIDS, Tuberculosis and Malaria
DHMIS	District Health Management Information System
ERC	Ethical Review Committee
GFATM	Global Fund to Fight AIDS Tuberculosis and Malaria
GHS	Ghana Health Service
NMCP	National Malaria Control Programme
OPD	Out Patient Department
WHO	World Health Organization

Declarations

Ethics approval and consent to participate

Ethical approval was obtained from the Ghana Health Service Ethical Review Committee (ERC) with approval number GHS-ERC 12/05/16. Permission was sought from all the Regional Health Directorates, Chief Executive Officers of the various Teaching Hospitals, Medical Directors and Medical Superintendents of all the selected health facilities included in the study. All the information obtained from this study was kept confidential.

Consent for publication

Not applicable

Availability of data and materials

Data used in this study is available and will be provided by the lead author upon request.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

KLM, FAB, SAA, MS, DL, ES designed the study. **KLM** participated in the data collection, statistical analysis and drafted the manuscript. **NYP, NAB, WH, MJ ZA** participated in data collection, statistical analysis and reviewed the manuscript for intellectual content. **CBP** reviewed the manuscript for intellectual content. All authors read and approved the final version of the manuscript.

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Figures

Figure 1

Trends of mortality rate among Malaria related admissions in Ghana from 2005 to 2014