

Malaria Morbidity and Mortality among Patients Admitted at a Tertiary Hospital in Congo DRC and their Correlates: A Cross-Sectional Study

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ABSTRACT

International financial support to global malaria elimination in the last two decade helped eliminate malaria in few endemic countries, while others made remarkable progress. In Congo DRC, one of the world high burden malaria areas, the status of Roll Back Malaria (RBM) impact indicators is still unclear. We studied 870 patients admitted at the Kinshasa Referral General Hospital in 2017 and 2018 to determine RBM missing impact indicators.

Malaria distribution by cause of admission was analysed; morbidity, mortality, case-fatality-rates, and correlates of morbidity/mortality were estimated. Morbidity rate was higher in 2018 than in 2017. Mortality and case-fatality-rates were comparable for the two years. Socioeconomic Status (SES) was the most important correlate of malaria morbidity/mortality; lower SES inpatients were more than twice at risk than higher SES inpatients. Malaria morbidity/mortality in DRC was still high at the time of this study, affecting mostly lower SES populations.

INTRODUCTION

The development of Dichloro-Diphenyl-Trichloroethane (DDT) in the 1940s fostered the elimination of malaria in the wealthiest parts of the world [1]. Developing countries were left behind. Eventually, the anopheles developed resistance to DDT making it difficult to those countries to benefit from the chemical [2]. Thus, many countries in endemic areas are still facing malaria-related calamity, particularly where falciparum malaria transmission is holoendemic or hyperendemic [3]. Scientists think that even in regions where transmission is hypoendemic or mesoendemic, malaria outbreaks happen from time to time. This perhaps is attributable to the lack of prolonged exposure of populations to mosquito bites and, therefore, lack of immunity [4]. Malaria prevention and control can be costly and challenging in countries where these four transmission patterns overlap like in DRC.

However, for more than two decades, there has been a strong global political will and momentum to eliminate malaria in the world [5,6]. Up to 2013, the Global Fund for Malaria, AIDS and Tuberculosis and other international organizations were yearly disbursing enough resources to help fight malaria in endemic areas [7,8]. Starting in 2014, investments in malaria prevention and control in high-burden countries began to decline [9]. As a result, malaria cases increased globally from 217 million in 2014 to 231 million in 2017 before slightly declining to 228 million in 2018 [9-11].

Despite this, some countries have improved their Roll Back Malaria (RBM) impact indicators towards malaria elimination in their territories and contributed to the global goal of eliminating malaria [12]. Comprehensive guidelines have been developed to speed up the elimination and eventual eradication process [13]. Some of the countries like Algeria have been certified malaria-free. Others are remarkably doing well towards elimination, as reflected by their RBM impact indicators [14].

Until now, in the DRC, RBM impact indicator status is still unclear. Although some reports of favourable RBM indicator performance in the DRC are found in the literature, most report process indicators [15]. It is important to note that the DRC is one of the high malaria-burden countries globally, second only to Nigeria. Hence it is a critical battleground in the war against malaria in the world.

MATERIALS AND METHODS

The study's objective was to determine malaria morbidity and mortality at Kinshasa Referral General Hospital (KRGH) or to investigate the status of RBM impact indicators, and factors associated with them.

Study design and area

This was a cross-sectional study of patients admitted at KRGH between January 2017 and December 2018, a period of two years. The facility was selected because it is the first and biggest referral hospital in the country. The hospital receives clients from all parts of Kinshasa and DRC. It has a capacity of 1,101 beds and an average of 8,468 admissions per year.

KRGH is located in Kinshasa, the capital city of DRC. Kinshasa's planned urban structures were completed in the late seventies when its population was less than 1,200,000. Today, it has an estimated 14,340,000 inhabitants in an area of 9,965 km² with only 600 km² of that urbanized. The upper socioeconomic class of Kinshasa lives in this

urban and planned area. Dwellings are modern, roads are paved and access to safe water, electricity and sanitation is relatively better.

The outskirts of the city of Kinshasa, mainly inhabited by the lower socioeconomic class, are not urbanized/planned. Dwellings are substandard and often similar to slum communities [16]. Roads and sanitary systems are in a disrepair state or non-existent, vehicle wrecks and puddles are scattered all over the area, a situation conducive for mosquito breeding and malaria outbreaks.

Sample size, sampling approach and data collection

The sample size was calculated using a sampling error of 0.05 and a beta level of 0.20 [17]. The proportion of baseline malaria morbidity/mortality among inpatients was assumed to be 20% [18]. The expected magnitude of association between malaria morbidity/mortality and exposure factors of interest (SES and residential area) was set at 1.68 odds ratio. This led to an estimated sample size of 808, which was increased by 20%. This brought the sample size to 969 participants to allow for any exclusion.

Client hospital registration numbers were used to create the sampling frame. The records included patient files, referral/discharge summaries and mortuary records. Using the computer table of random numbers, 969 patients were randomly selected. Information on the following variables was collected from the patients: age, gender, date of admission, date of discharge, mode of discharge (alive, dead, referred, or escaped), SES and residential area. In addition, information on the top causes of admission at the hospital was also collected. After excluding 99 patients for missing data and discrepancies between different data sources, the study sample size was finally brought to 870.

Data analysis

IBM SPSS version 21 (Chicago, IL) was used for analysis of the data. The distribution of inpatients by illness was computed to obtain the profile of major causes of admission at KRGH in 2017 and 2018. Malaria-specific morbidity and mortality rates were estimated for both years. And, case fatality rates calculated. Comparisons between groups/subgroups were made using Chi-square test for trend, Chi-square test with correction of Yates or Fisher exact test. Using malaria morbidity/mortality as the dependent variable, and year of admission, age, gender, socioeconomic status, and residential area as independent variables a logistic regression model was developed to identify correlates of malaria-related morbidity/mortality; odds ratios and their 95% confidence intervals were estimated.

All likely confounders available in the patient records were investigated. Variance Inflation Factor (VIF) diagnostic was performed for redundancy and multicollinearity of covariates. How well the model fits the data was estimated using the Hosmer-Lemeshow test of goodness of fit.

RESULTS

Of the 870 inpatients investigated in both 2017 years, 260 (29.9%) had malaria diagnosis. Of the 461 admissions in 2017, 119 (25.8%) were admitted for malaria and of the 409 admission in 2018, 141 (34.5%) had malaria. Data presented in malaria as the first cause of admission at KRGH in 2017 and 2018, while tuberculosis and HIV/AIDS ranked third and fifth respectively are shown in [Table 1](#).

Table 1. Major causes of admission at Kinshasa Referral General Hospital in 2017 and 2018 (N=870).

Illness	2017		2018		Total	
	n ₁	%	n ₂	%	n ₃	%
-						
Malaria	119	25.8	141	34.5	260	29.9
ARI	40	8.6	42	10.4	82	9.4
TB	15	3.3	40	9.8	55	6.3
Diarrhea	26	5.6	16	4	42	4.8
HIV/AIDS	17	3.6	17	4.2	34	3.9
Malnutrition	19	4	12	3	31	3.6
Cancer	16	3.6	13	3.1	29	3.3
STI	7	1.5	6	1.4	13	1.5
Other diseases	203	44	122	29.6	325	37.4
Total	461	100	409	100	870	100
Note: ARI: Acute Respiratory Infections; STI: Sexually Transmitted Infections; HIV: Human Immunodeficiency Virus; TB: Tuberculosis						

Malaria morbidity rate in 2018 was significantly ($p < 0.05$) higher than in 2017, while malaria-specific mortality and case fatality rates were comparable between the two years (See Appendix 1). In both 2017 and 2018, malaria morbidity rates were similar between participants with high SES and low SES (See Appendix 2). High SES inpatients had significantly ($p < 0.05$) lower mortality and case fatality rates than those with low SES. The same pattern is observed between inpatients in the urban areas and those dwelling in the city outskirts in 2017 and 2018.

In that patients with low SES had 2.5 times more risk of malaria morbidity/mortality than those with high SES. Similarly, city outskirts dwellers had 2.1 times more risk of malaria morbidity/mortality compared to city residents are shown in [Table 2](#).

Table 2. Correlates of malaria-related hospital morbidity/mortality among inpatients at Kinshasa Referral General Hospital in 2017 and 2018 (N=870). Dependent variable=Malaria hospital morbidity/mortality.

Independent variables	n(%)	Unadjusted OR	95% CI	AdjustedOR	95% CI
Year of admission	-	-	-	-	-
2017	461(52.9)	1	-	1.0 [‡]	-
2018	409 (46.1)	0.7*	0.2 -0.9	0.4	0.3 - 3.9
Age groups (years)	-	-	-	-	-
5.1-42	436 (50.1)	1.0 [‡]	-	1	-
0-5	270 (31.0)	2.8*	1.3 -4.5	1.7**	1.5 - 2.6
>42	164 (18.8)	1.9*	1.6 -3.7	2.1	0.8 - 5.0
Socioeconomic status	-	-	-	-	-
High	208 (23.9)	1	-	1	-
Low	662 (76.1)	1.6	0.9 - 5	2.5**	1.7 - 4.3
Residential area	-	-	-	-	-
Urban (city)	409 (47.0)	1	-	1	-
City outskirts	461 (53.0)	3.1*	1.7 -6.2	2.1*	1.2 - 6.3
Sex	-	-	-	-	-
Male	444 (51.1)	1	-	1	-
Female	426 (48.9)	1.6*	1.1 -7.6	1.4	0.9-7.0
Note: OR: Odds Ratio; 1.0 [‡] =reference group; CI: Confidence Interval; *p<0.05; **p<0.001					

DISCUSSION

This study put malaria on top of all other causes of admission at KRGH in 2018 and 2017. Undoubtedly, this is not the profile that the world would like to see at this particular point in time after so many years of financial and technical support [8] to help eliminate malaria by 2020 and if not, by 2030 [19]. DRC received from the Global Fund Round 2, 3, 5, 6, 7, 8, 9, and 10 colossal sums totalling the US\$621, 902, 993 to help fight malaria, HIV/AIDS, and TB. The Global Fund support to DRC for years 2017 and 2018 was suspended following fund mismanagement reports [20]. However, other stakeholders continued to bring significant funds and technical support to help the country undertake malaria prevention and control measures and, manage all cases of the disease in the population regardless of their SES or residential settings. Nevertheless, findings from this study suggest that this is not happening. The fact that the prevalence of malaria admissions in 2018 is higher than in 2017 indicates that RBM indicators are not declining. Yet, we expected a decline of these indicators rather than a hike or plateau. These results are supported by the multivariate analysis output showing comparable risks of morbidity/mortality between 2017 and 2018. Of more worry in these results are findings showing that low SES inpatients were at more than twice the risk of morbidity/mortality than high SES inpatients and, similarly, city outskirts dwellers having more than twice the risk of morbidity/mortality than city

residents. The findings are suggestive of inequities in accessing malaria drugs and/or health care since all these groups are in the same facility. Other likely contributors to the outcome of interest are variables that were not investigated herein, i.e., malnutrition, related comorbidities; further studies should try including them. In fact, at KRGH and many other health care facilities of Kinshasa, inpatients are required to buy their prescription drugs and pay for any needed test and/or services before the assistance. Those who cannot afford the cost are many times left in hospital beds with no assistance. Commonly, these patients end up developing unwanted outcomes from conditions that are normally curable like malaria. Africa Renewal report of December 2016 to March 2017 titled, “Dying from lack of Medicines” described how this is common among African countries [21].

The negative health impact of low SES and poor neighbourhood residency has been long documented, and this is in agreement with what we report herein [22]. People with low SES and those living in the city outskirts of Kinshasa have limited access to health care services owing to their low income and are, therefore, prone to morbidity and mortality compared to their counterparts who have a high SES.

What is inquisitive in this study is the poor access of poor populations to malaria drugs and/or health care services. It put them to 2.5 times more at risk of morbidity/mortality than the upper SES class. This cannot be justified. The financial and logistical support rendered to the DRC for the prevention, control, and management of malaria cases should allow access to malaria drugs and health care in general to even those on the lower end of the SES scale. Inequity in health care access should not exist in the DRC for malaria (TB or HIV) as they are externally funded. Indeed, a recent report of the Global Funds identified a financial loss from a grant allocated to the DRC malaria program [23]. This may be compounded by the overlap of four malaria transmission patterns in the country, the high burden of malaria and the minimal urbanization in the DRC. Agencies funding the DRC malaria programs, therefore, need to redefine their priorities and grant approaches. Affirmative action, guided by SES and residential settings in the country, should be a priority for malaria elimination in DRC.

This study’s limitations include the use of secondary data as the analysis couldn’t include other essential variables than those collected by the primary data collectors. Therefore, further studies using primary data are recommended to help to establish the facts better.

CONCLUSION

Malaria morbidity and mortality in DRC were still high at the time of the study, affecting mostly people with low SES. The situation may be consequent to the global decline in financial support for malaria, which occurred in 2014/15, or possibly to funds mismanagement. Funding policies in the health sector need to be adjusted for DRC to address the current situation. Access to malaria health care services including drugs for low SES communities should be given priority. We trust that these results will ring bells to global malaria elimination stakeholders for decision-making and strategies that give priority to low SES communities in the DRC.

ETHICAL APPROVAL

The School of Public Health Ethical Committees provides general oversight and ethical approval in DRC. This committee does not require a formal submission for ethical approval for research using secondary data.

DATA AVAILABILITY

Data from which the findings of this study emanate are not publicly available to maintain patient confidentiality. The data include potentially identifying demographic and clinical care information. However, the data can be requested from the corresponding author, who must first get permission from the hospital different departments where the study was conducted before sharing.

COMPETING INTERESTS

The authors have no conflict of interest to declare.

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AUTHORS' CONTRIBUTIONS

The study was designed by JGT and CIM. JGT and CIM supervised data collection at the KRGH and participated in all stages of this study from proposal preparation to manuscript writing. MGMDM and RT participated in reviewing the study proposal, data analysis, and writing the manuscript. DMN, JKK and JK participated in data analysis and manuscript preparation. All the authors contributed to the writing of the manuscript.

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