

Original Research Article

Complications of Falciparum Malaria Infections among Ghanaian Children; from the Healthcare Personnel's perspective.

ABSTRACT

Background and Aim: Malaria is known to be the most widespread tropical disease and a chief cause of morbidity and mortality in Africa. This study seeks to determine some common complications of *falciparum* malaria in children from the perspective of healthcare personnel in Kumasi, Ghana.

Materials and Method: This questionnaire-based cross sectional study was carried out at Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. The study population includes the health care workers working at the children's unit the hospital. About 80 healthcare personnel were recruited to partake in a survey for eliciting views on malaria. Questionnaires were used to capture some symptoms and complications of malaria from the health workers point of view.

Results: More than half of the healthcare personnel were males (52.5%). The majority of the participants were medical officers. The study participants elaborated on some common malaria symptoms among children. Fever recorded the highest frequency of symptoms, represented by 98.8%, followed by general malaise (97.4%), nausea and vomiting (93.8%), chills (78.8%) and headaches (72.5%). Prostration (45.0%), hyperpyrexia (38.75%) and hypoglycemia (13.75%) were the most frequently reported complications by the respondents. The majority of the participants reported cerebral malaria (30.0%), severe anemia (23.75%), acute respiratory distress (17.5%), repeated generalized convulsions (16.25%) to be the most lethal feature of complicated malaria infection in children. The overwhelming majority of the respondents (90.0%) use the WHO 2014 standard (page2) as guide for determining complicated malaria.

Conclusion: Prostration with hyperpyrexia and hypoglycemia were the most common features of *falciparum* malaria from the perspective of healthcare personnel in Kumasi.

Keywords: Malaria, children, complications, perspective, healthcare personnel, Ghana.

1.0 INTRODUCTION

Currently, malaria is known to be the most widespread tropical disease and a chief cause of morbidity and mortality, particularly in Africa [1, 2], where an estimated 90% of all malaria deaths occurred, and in children aged under 5 years, who accounted for more than two thirds of all deaths [3]. More than 300 million people in West Africa are at risk of malaria, with the greatest risk to children under the age of five and pregnant women. [4].

There are 4 parasite species that cause malaria in humans, and two of these species – *P. falciparum* and *P. vivax* – pose the greatest threat. *P. falciparum* is the most prevalent malaria parasite on the African continent and the most lethal [5]. In Ghana, malaria is estimated to cause 8% of all certified deaths and ranks as the commonest cause of death in children under 5 years of age. and *falciparum* malaria accounting for 44% of all reported outpatient department (OPD) cases of in the hospitals for the year 2015 [6]. Most of suspected malaria cases especially those with children under 5 years are been brought to hospitals or clinics to be diagnosed and treated the by healthcare workers. Healthcare professionals come into contact with these malaria patients. These patients depend on them for survival therefore they need to have in depth knowledge on malaria pathophysiology such as its complications to help improve diagnoses and treatment [7]

There are several complications of *P. falciparum* malaria in children, but the most widespread and essential ones in children below twelve years are cerebral malaria, severe anemia, respiratory distress and hypoglycemia [1]. Even though it is the same *P. falciparum* parasite, due to metabolic differences in children and adults, there exist some differences in the manifestation of malaria between these two groups.

Ghana is a malaria-endemic nation and as such has malaria as a major cause of death in the hospitals. However, there is no known study in Ghana that has focused on the common features to look for during complicated malaria infection in children. Therefore this study seeks to determine some common complications of *falciparum* malaria reported by the healthcare personnel. This will help the caregivers in proper diagnosis and treatment as well as assist health policy makers and other stakeholders in decision making, better teaching of the disease and for better drug provisions to enhance diminishing death rate.

2.0 MATERIAL AND METHOD

Study Design/Study Site

The study was a cross sectional one carried out in Komfo Anokye teaching hospital (KATH) in Kumasi, Ashanti Region, Ghana. Ashanti Region is located in south Ghana and is third largest of 10 administrative regions, occupying a total land surface of 24,389 km² (9,417 sq mi) or 10.2 per cent of the total land area of Ghana. In terms of population, however, it is one of the most populated region with a population of 4,780,380 according to the 2011 census, accounting for 19.4% of Ghana's total population [8]. KATH is located in Kumasi, the capital of Ashanti Region. Kumasi is a malaria endemic zone, transmission of malaria in the area is intense and perennial with some seasonal variations. [8].

Study population

The study population were included the health care workers working at the children's unit at KATH. Sample population in the hospital who are not willing to participate in the study were excluded. Healthcare personnel were recruited to partake in a survey for eliciting views on malaria.

Ethical considerations

Ethical clearance for the study was obtained from the Committee on Human Research, Publication and Ethics (CHRPE) at the KNUST School of Medical Sciences/ Komfo Anokye Teaching Hospital in Kumasi-Ghana (Reference Number: CHRPE/AP/078/17). Permission was also given by the various Medical Directors/Superintendents or Heads of Departments of the study facilities. Consent was also obtained from health workers who were recruited into this study.

Data collection

A detailed questionnaire was then used to collect gender and designations of study participants. Questionnaire also captured some complications and symptoms of *falciparum* malaria from the health workers point of view.

Definition of Complicated malaria

The World Health Organization (2014) defines complicated malaria in children as in the presence of *P. falciparum* but no other confirmed cause for signs and symptoms and vital organ dysfunction with clinical features such as impaired consciousness, prostration, multiple convulsions, acidotic breathing, acute

pulmonary edema and acute respiratory distress, shock, acute kidney injury, and or clinical jaundice plus one or more of laboratory findings such as hypoglycemia (less than 2.2 mmol/L), metabolic acidosis (plasma bicarbonate less than 5 g/dl), severe normocytic anemia (less than 5 g/dl and packed cell volume less than 15 %), hemoglobinuria, hyperlactatemia (greater than 5 mmol/L), pulmonary edema (radiological) and renal impairment (serum creatinine greater than 265 μ mol/L). Modifications were made where necessary to suit this study. Complicated malaria was defined in this study as in the presence of *P. falciparum* asexual parasitemia and in the absence of an identified cause; Hemoglobin concentration below 5 g/dl or a hematocrit of less than 15% in children below 12 years of age [3].

Data Analysis

Data were entered into Microsoft Excel 2013 and cleaned before being subjected to analysis. Statistical analyses were performed using SPSS version 20.0 and Graph Pad version 6 to determine frequencies and percentages of certain variables.

3.0 RESULTS

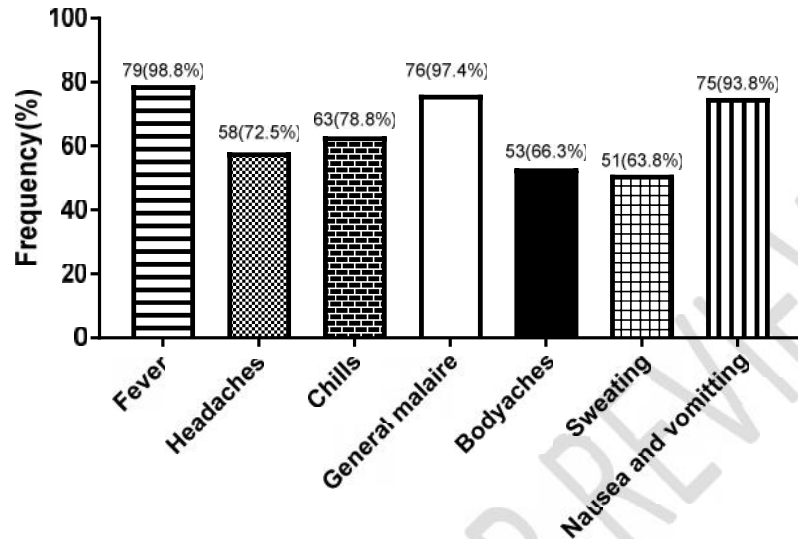
Gender and designations of study participants.

This study constituted a total of 80 study participants. More than half of the healthcare personnel were males (52.5%). The majority of the participants were medical officers. Results are illustrated in Table 1.

Table 1: Frequency distribution of respondents by gender and designations.

Variables	Frequency (n=80)	Percentages (%)
Gender		
Male	42	52.50%
Female	38	47.50%
Designations		
Consultant	1	1.25%
Medical Assistant (MA)	1	1.25%
Medical Sup	1	1.25%
Paediatrician	1	1.25%
Senior Pharmacist	1	1.25%
SPA	1	1.25%
House Officer	2	2.50%
Nurse	3	3.75%
Specialist	4	5.00%
Intern	5	6.25%
SMO	5	6.25%
Resident	7	8.75%
Physician Assistant (PA)	22	27.50%
Medical Officer	26	32.50%

SMO=Senior Medical Officer, SPA= Superintendent Physician Assistants



signs and symptoms of malaria in children from the study participants

Figure 1 Signs and symptoms identified by study participants as suspected of complicated malaria

Figure 1 shows the distribution of malaria symptoms in children according to healthcare personnel. Fever recorded the highest frequency of the symptoms, represented by 98.8%, followed by general malaise (97.4%), nausea and vomiting (93.8%), chills (78.8%) and headaches (72.5%).

Comment [RGK1]: Would it be possible to remove the legend at the bottom inside the figure (signs and symptoms of malaria in children from study participants) and leave only the title of figure 1?

Comment [WU2]: Legend deleted

Clinical manifestations of complicated malaria infections in children

Table 2 shows the frequency distribution of clinical manifestations of complicated malaria. Prostration (45.0%), hyperpyrexia (38.75%) and hypoglycemia (13.75%) were the most frequently reported complications. Complications which were distinctive feature of complicated malaria infection in children reported by healthcare personnel were hyperpyrexia (17.5%), prostration (12.5%), impaired consciousness (8.75%) and cerebral malaria (7.5%). The majority of the participants reported cerebral malaria (30.0%), severe anemia (23.75%), acute respiratory distress (17.5%), repeated generalized convulsions (16.25%) to be the most lethal feature of complicated malaria infection in children. The overwhelming majority of the respondents use the WHO 2014 standard guide for determining complicated malaria.

Table 2: Frequency distribution of complications of complicated malaria infections

Variables	Frequency	Percentages (%)
Complications which participants considered almost always present		

Comment [RGK3]: For comparison, state what are the signs/symptoms used by WHO as a standard guide and then in the Discussion make the respective comment as to whether the Ghanaian health workers do know the WHO standards with accuracy.

Comment [WU4]: The signs/symptoms used by WHO as a standard guide were clearly stated in the methodology section

Comment [RGK5]: Would the authors like to consider following order in this first group? Prostration 36, hyperpyrexia 31, hypoglycemia 11, severe anemia 8 and so on?

Comment [WU6]: Corrected

Prostration	36	45.0%
Severe Anemia	8	10.0%
Hypoglycemia	11	13.75%
Impaired consciousness	2	2.5%
Repeated Generalized Convulsions	3	3.75%
Hyperpyrexia	31	38.75%
Thrombocytopenia	0	0
Complications which participants believe are distinctive feature		
Thrombocytopenia	4	5.0%
Prostration	10	12.5%
Severe Anemia	1	1.25%
Cerebral Malaria	6	7.5%
Impaired consciousness	7	8.75%
Repeated Generalized Convulsions	4	5.0%
Hyperpyrexia	14	17.5%
Missing	46	42.5%
Complications which are most lethal		
Thrombocytopenia	5	6.25%
Acute respiratory distress	14	17.5%
Severe Anemia	19	23.75%
Cerebral Malaria	24	30.0%
Hypoglycemia	16	20.0%
Impaired consciousness	6	7.5%
Repeated Generalized Convulsions	13	16.25%
Hyperpyrexia	1	1.25%
Complications which leads to misdiagnosis		
Thrombocytopenia	13	16.25%
Acute respiratory distress	19	23.75%
Prostration	12	15.0%
Severe Anemia	4	5.0%
Cerebral Malaria	8	10.0%
Hypoglycemia	2	2.5%
Impaired consciousness	13	16.25%
Repeated Generalized Convulsions	17	21.25%
Hyperpyrexia	15	18.75%
Standards for determining complicated malaria		
WHO 2014 Standard	72	90.0%
Standard Treatment Guideline	8	10.0%

Comment [RGK7]: Same as above: hyperpyrexia 14, prostration 10, impaired consciousness 7 and so on?

Comment [WU8]: . Corrected

Comment [RGK9]: If I may suggest in this order: cerebral malaria 24, severe anemia 19, hypoglycemia 16, acute respiratory distress 14, repeated generalized convulsions 13, and so on?

Comment [WU10]: Corrected

Comment [RGK11]: Cerebral malaria is not a symptom, is the condition one is trying to identify.

Comment [WU12]: Cerebral malaria here is not been considered as a symptom but rather complication

Comment [RGK13]: Acute respiratory distress 19, repeated generalized convulsions 17, thrombocytopenia 13, impaired consciousness 13, etc....

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Other complications of malaria from the healthcare personnel's point of view.

The data collection tool employed also required the healthcare personnel to report other malaria complications their patients have experienced which were not part of the list of complications on the questionnaires. Table 3 provides a list of such malaria complications.

Table 3: Frequency of other complications of malaria

Variables	Frequency (n=47)	Percentages (%)
Acute hemoglobinuria	1	1.25%
Arthralgia	1	1.25%
Bitter taste	1	1.25%
Excessive vomiting	1	1.25%
Coma	1	1.25%
Polydipsia	1	1.25%
Neurological effect	1	1.25%
Opisthotonus	1	1.25%
Cerebral palsy	2	2.50%
Intravascular hemolysis	2	2.50%
Oliguria	2	2.50%
Acute renal failure	3	3.75%
Splenomegaly	3	3.75%
Metabolic acidosis	4	5.00%
Shock	5	6.25%
Jaundice	8	10.00%
Jaundice	8	12.50%

4.0 DISCUSSION

The study revealed that the spectrum of healthcare professionals that come into contact with suspected malaria patients were mostly medical officers. This means that there is 60% chance for a child suffering from malaria to come into contact with this cadre of healthcare professionals whenever they visit clinics or hospitals for treatment. It is therefore very necessary for this group of healthcare professionals and other designations of health personnel who may present to assist in place of the medical officer to be always updated on all policies and knowledge on malaria, in order to attain the malaria-free world that WHO has targeted to achieve by 2030 [1]. All healthcare professionals involved in the study followed WHO standards or the accepted Standard Treatment Guidelines, adopted by the Ghana Health Service in treating both complicated malaria and uncomplicated malaria conditions. Their knowledge base regarding the features of complicated malaria is very encouraging.

Fever, general malaise, nausea and vomiting are the most common symptoms of suspected malaria in Ghanaian children below 12 years, according to the healthcare givers. This agrees with a report of WHO (2015) but not entirely with reports from other African studies [1]. For example, fever has been reported by Fordjour (2015) but not general malaise and vomiting. Headaches were also common in these children. Body aches and sweating were the least occurring symptoms, based on the experiences of the healthcare professionals interviewed [6].

Prostration (45.0%), hyperpyrexia (38.75%), hypoglycemia (13.75%) were reported as the three most prevalent manifestations of complicated malaria in children. This does not agree entirely with WHO report on tropical medicine and international health [1], as prostration was the only one highlighted in that report. This makes it clear that the manifestation of complicated malaria is varied, depending on the patients and their environments. Similarly, hypoglycemia was mentioned as one of the most prevalent complications of complicated malaria [9] but not prostration.

The current results agree in part with a complicated malaria study conducted at the Kwame Nkrumah University of Science and Technology (KNUST) Hospital, Ghana, and others in Mozambique [10], Yemen [10] and Burkina Faso [11]. It was revealed in the KNUST study that anemia, prostration, convulsions and fever are the major clinical manifestation of complicated malaria [6]; whilst in the other studies Reyburn (2004) and Gwer *et al.* (2007) prostration was found to be a common indicator of complicated malaria [10, 12]. Prostration was found in the current Ghanaian study and the previous Ghanaian (KNUST) study [6], all in the same region and city. Hence prostration should be given premium attention by healthcare givers in Ghana when treating malaria patients below 12 years. The presence of hyperpyrexia is not surprising as malaria is febrile. All febrile conditions elevate the body temperature, except in very rare cases.

It has been reported elsewhere [9] that respiratory distress is the most lethal complicated malaria complication. This study shows this to occupy the third position. Studies in Kenya revealed that impaired consciousness, together with respiratory distress were extremely lethal as it predicted as high as 84.4% of 64 deaths in 1844 children [13]. Respiratory distress is common to two reports on the lethality of complicated malaria [13].

The finding of this current study on the lethality of the various malaria complications agree with two previous Ghanaian complicated malaria studies. Oduro *et al.* (2007) and Gyapong (2009) have reported the predominant complications of complicated malaria as severe anemia (36.5%), followed by respiratory distress (24.4%), prolonged or multiple convulsions (21.6%) and cerebral malaria (5.4%). Extra care should be taken by healthcare professionals in Ghana especially when any of the above four complications affect a malaria patient as this could be fatal [14, 15].

Another revelation from this current study is that the 23.75% prevalence of acute respiratory distress is a major malaria complication which may lead to misdiagnosis in Ghanaian children (Table 3). This is primarily due to its resemblance in manifestation with other febrile conditions, especially Pneumonia [9]. In addition to acute respiratory distress repeated generalized convulsions (21.25%), hyperpyrexia (18.75%), thrombocytopenia (16.25%) and impaired consciousness can all be misleading especially in a high transmission area like Ghana. Hence, extra care and vigilance should be used in managing these patients.

5.0 CONCLUSION

Medical personnel especially the doctors should be alert on these complications to improve diagnosis of malaria. Higher number of study participants should be recruited into similar study to validate some of the findings in this study.

LIMITATIONS OF THE STUDY

Further study on this topic should focus on a comparative one thus comparing health professionals views on complicated falciparum malaria from different setting of hospitals.

ETHICAL APPROVAL

As per international standard or university standard, written approval of Ethics committee and participant's written consent has been collected and preserved by the authors.

ACKNOWLEDGEMENT

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between all authors. Author BB contributed to the conception of the research idea, data collection. Author BOA contributed to the interpretation, paper drafting and revision of the manuscript. Author SD contributed to data collection and sample analysis. Author DMT

Comment [RGK15]: According to the participants.....

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contributed to patient recruitment and sample collection. All authors approved the final manuscript before publication and agree to be accountable for all aspects of the work

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