

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

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Authors' contributions

This work was carried out in collaboration among 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 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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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 was conducted to determine some common complications of falciparum malaria in children, from the perspective of healthcare personnel in Kumasi, Ghana.

Materials and Methods: This questionnaire-based cross-sectional study was carried out at the Komfo Anokye Teaching Hospital (KATH) in Kumasi, Ghana. The study population included health care professionals working at the children's unit of the hospital. About 80 healthcare personnel were recruited to partake in the survey for eliciting views on malaria. Questionnaires were used to

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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%), and majority of the participants were medical officers. The study participants elaborated on some common malaria symptoms among children. Fever recorded the highest frequency, 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. Majority of the participants reported cerebral malaria (30.0%), severe anemia (23.75%), acute respiratory distress (17.5%) and 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, Ghana.

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

1. 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 occur. This incidence is common in children under 5 years, which accounts 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 main 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, with *falciparum* malaria accounting for 44% of all reported outpatient department (OPD) cases in the hospitals for the year 2015 [6]. Most of suspected malaria cases especially in children under 5 years are reported to hospitals or clinics for diagnosis and treatment by healthcare workers. Healthcare professionals thus often come into contact with such malaria cases. These patients depend on them for survival, therefore health workers need in-depth knowledge on the pathophysiology of malaria, such as its complications to help improve diagnosis 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]. Due to metabolic

differences in children and adults, some differences exist in the manifestation of malaria between these two groups, albeit the same causative *P. falciparum* parasite in all age groups.

Ghana is a malaria-endemic nation and as such has malaria as a major cause of death in hospitals. However, there is no known study in Ghana that has focused on the common features to look out for during complicated malaria infection in children. Therefore this study was conducted to determine some common complications of *falciparum* malaria reported by 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 reduce mortality.

2. MATERIALS AND METHODS

2.1 Study Design / Study Site

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

2.2 Study Population

The study population included the health care workers working at the children's unit at KATH. Health workers from the targeted population in the hospital who were not willing to participate in the study were excluded. Eligible healthcare personnel were recruited to partake in the survey for eliciting views on malaria.

2.3 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 the health workers recruited into this study.

2.4 Data Collection

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

2.5 Definition of Complicated Malaria

The World Health Organization (2014) defines complicated malaria in children as 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 µmol/L). Modifications were made where necessary to suit this study. Complicated malaria was defined in the current study as the presence of *P. falciparum* asexual parasitemia 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].

2.6 Data Analysis

Data was 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. RESULTS

3.1 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.

Fig. 1 shows the distribution of malaria symptoms in children according to the 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%).

3.2 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 features 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%) and repeated generalized convulsions (16.25%) to be the common lethal features of complicated malaria infection in children. The overwhelming majority of the respondents use the WHO 2014 standard guide for determining complicated malaria.

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		
Medical Officer	26	32.50%
Physician Assistant (PA)	22	27.50%
Resident	7	8.75%
Intern	5	6.25%
SMO	5	6.25%
Specialist	4	5.00%
Nurse	3	3.75%
House Officer	2	2.50%
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%

SMO=Senior Medical Officer, SPA= Superintendent Physician Assistants

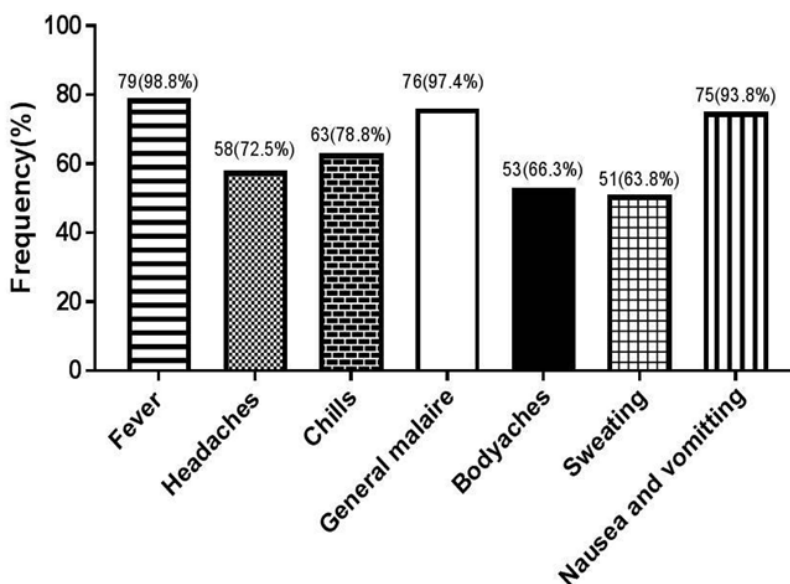


Fig. 1. Signs and symptoms identified by study participants as suspected of complicated malaria

3.3 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 questionnaire. Table 3 provides a list of such malaria complications.

4. 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 a 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 be 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 regarding the features of complicated malaria was very encouraging.

Table 2. Frequency distribution of complications of complicated malaria infections

Variables	Frequency	Percentages (%)
Complications which participants considered almost always present		
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		
Missing	46	42.5%
Hyperpyrexia	14	17.5%
Prostration	10	12.5%
Impaired consciousness	7	8.75%
Cerebral Malaria	6	7.5%
Thrombocytopenia	4	5.0%
Repeated Generalized Convulsions	4	5.0%
Severe Anemia	1	1.25%
Complications which are most lethal		
Cerebral Malaria	24	30.0%
Severe Anemia	19	23.75%
Hypoglycemia	16	20.0%
Acute respiratory distress	14	17.5%
Repeated Generalized Convulsions	13	16.25%
Impaired consciousness	6	7.50%
Thrombocytopenia	5	6.25%
Hyperpyrexia	1	1.25%
Complications which leads to misdiagnosis		
Acute respiratory distress	19	23.75%
Repeated Generalized Convulsions	17	21.25%
Hyperpyrexia	15	18.75%
Thrombocytopenia	13	16.25%
Impaired consciousness	13	16.25%
Prostration	12	15.00%
Cerebral Malaria	8	10.00%
Severe Anemia	4	5.00%
Hypoglycemia	2	2.50%
Standards for determining complicated malaria		
WHO 2014 Standard	72	90.00%
Standard Treatment Guideline	8	10.00%

Fever, general malaise, nausea and vomiting were 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. From the current study, headache was also common in 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 in another study [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 other studies by

Reyburn [11] and Gwer et al. [10], only 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. According to the participants, this complication occupied 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 study reports on the lethality of complicated malaria [13].

The knowledge of health participants as it relates to 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].

Table 3. Frequency of other complications of malaria

Variables	Frequency	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%

About 23.7% of the participants believed the prevalence of acute respiratory distress to be a major malaria complication which may lead to misdiagnosis in Ghanaian children (Table 2). 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 severe malaria patients.

5. CONCLUSION

Medical personnel especially the doctors should participate in refreshing continuous medical education courses on the importance of properly identifying signs/symptoms suspicious of falciparum malaria. Higher number of study participants should be recruited into similar study to validate some of the findings in this study.

6. LIMITATIONS OF THE STUDY

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

CONSENT AND 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.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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