



Socioeconomic and environment determinants as predictors of severe malaria in children under 5 years of age admitted in two hospitals in Koudougou district, Burkina Faso: A cross sectional study



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ABSTRACT

Burkina Faso has a high incidence and death rate of severe malaria, especially for children under 5 years of age. Although the malaria elimination program is a high-priority public health project, finding an effective strategy for managing the problem is a major challenge. Understanding the various factors that contribute to the severity of malaria is essential in designing an effective strategy. In this study, parental and environmental factors associated with severe malaria in Burkinabè children were investigated in two hospitals in Koudougou Health District, Burkina Faso. Between July and September 2012, a cross-sectional study was used to test 510 children under 5 years of age (mean age: 23.5 months) admitted with suspected malaria. Each child was screened using a blood smear to identify whether he or she had severe malaria based on the criteria established by the World Health Organization (WHO). When a child was diagnosed with malaria, either severe or not severe, the parents were interviewed by a trained interviewer using a structured questionnaire. A logistic regression was used to identify the determinants of severe malaria and associated deaths. Of the 510 children having malaria, 201 (39.4%) had severe malaria. Most of the patients (54.9%) lived in rural areas. The main factors associated with severe malaria were low education level of the father, low socioeconomic status [odds ratio (OR) = 4.11, 95% confidence interval (CI) = 1.44–11.75], delayed treatment [OR = 4.53, 95% CI = 1.76–11.65], treating children at home as a typical practice when the child has a fever [OR = 3.24, 95% CI = 1.40–7.51], living in rural area [OR = 6.66, 95% CI = 3.36–13.22], and living beside a water gathering pond [OR = 1.67, 95% CI = 1.02–2.74]. Parental and environmental context associated with severe malaria for children under 5 years of age remains a serious public health problem that affects malaria outcomes in resource-limited areas. Promotion of early care is urgently required. Parents should be given information on the risks of not consulting a health facility when children exhibit symptoms of malaria.

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1. Introduction

Malaria infections cause numerous deaths in malaria-endemic countries with limited health care facilities. The World Health Organization (WHO, 2011) estimates that 300–500 million individuals are infected with malaria annually, primarily in sub-Saharan Africa, resulting in over one million deaths annually, of which over 75% are children under 5 years of age.

In some sub-Saharan African countries, child survival is related to the economic status of various tribal groups (Brockhoff and Hewett, 2000). Although malaria is transmitted by mosquitoes,

several of these communities believe otherwise, for example, by curses. These beliefs, coupled with other societal factors, cause parents to not engage in health-seeking behaviors that enable their children to receive prompt treatment when they contract malaria. This worsens the condition of these children and may cause death (Okeke and Okafor, 2008). Epidemiological studies indicate that malaria is present in either symptomatic, uncomplicated, or severe clinical forms in endemic areas.

The severe form is primarily caused by *Plasmodium falciparum* and is responsible for most deaths, particularly among children under 5 years of age in Burkina Faso. Approximately 2% of the clinical cases of malaria in African children are severe (Greenwood et al., 1991). Falciparum malaria is considered a medical emergency, and a child dies every 45 s from malaria in Africa (Kreuels et al., 2008).

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In Burkina Faso, eliminating malaria is one of the key objectives of the government. Although this is a major public health priority, implementing an effective strategy for combatting malaria may be challenging in practice due to geographical or economic reasons (Byakika-Kibwika et al., 2009). Risk factors for severe malaria are poorly documented, although studies have established that malaria is most frequently diagnosed (42%) with peak mortality rates in infants aged 6–11 months (Greenwood et al., 1991; Hammer et al., 2006). Few studies have investigated the influence of society or parent socioeconomic factors on the incidence of malaria (Müller et al., 2003; Drabo et al., 2004). Most of these studies are outdated (Hammer et al., 2006; Müller et al., 2003; Sanou et al., 1997) and only focus on the central Haut Bassin and the Mouhoun regions of Burkina Faso. Relying on obsolete studies is problematic for case management and budget planning, and for finding an effective strategy for solving the present malaria problem. Based on previous studies, we hypothesize parents with lower socioeconomic status, poorer knowledge on malaria and practicing farming are associated with severe malaria.

The hospital in Koudougou is located between two major cities and, thus, is representative of regional hospitals in the country. In the Koudougou Health District, the prevalence of severe malaria, *P. falciparum*, in children under 5 years of age is over 44.86%. Most health facilities in the country treat malaria patients without being able to access pediatric intensive care units (Day, 2007). Reliable malaria data are a prerequisite for understanding the factors that cause malaria and for planning health interventions, yet these data are unavailable. This lack of research has resulted in an absence of in-depth analyses that are necessary for understanding the socioeconomic and cultural factors that determine the severity of malaria in children. This is detrimental to sustainable human development because of the effect of malaria on life expectancy (premature death), child education (school absence and neurological sequelae), and productivity (reduced work force and absenteeism). Therefore, the parental societal context that predisposes children under 5 years of age to severe malaria was examined in this study. Methods that can use this knowledge to improve the health and well-being of these children were also investigated. This study aims to provide societal and parental factors related to severe malaria in Burkina Faso (Koudougou District). Our results may help guide research and discussions on malaria and malaria intervention.

2. Methods

2.1. Study setting

This study was conducted from July to September 2012, which is the rainy season in Burkina Faso, during which high levels of malaria transmission are typically observed. There are 49 peripheral health centers and five district hospitals in the Koudougou District. Our study subjects were recruited from one first level hospital (peripheral health centers) and one second-level hospital (district hospitals). The region is characterized by a large rural population (77.3%), a high fertility rate (6.2 children per woman), rapid population growth, and a large household (6.3 people per household).

The District Hospital in this study is one of the 63 central hospitals in Burkina Faso comprising the second-level of care in the National Health System. The District Hospital of Koudougou is the referral hospital for the five health districts in the Koudougou Health Region and for all of the small health centers located in the district of Koudougou. The peripheral health center in this study is one of 49 peripheral health centers in Koudougou district comprising the first-level of care in the National Health System. This

Table 1

Definitions of the syndromes used in this study for severe malaria diagnosis.

(1) Severe malaria criteria	
Prostration	Extreme weakness, instability to sit without assistance for those >8 months
Impaired consciousness	Inability to localize painful stimulation; Blantyre coma score of ≥ 3
Coma	Unarousable unconsciousness and Blantyre coma score of <3
Convulsions	Repeated or prolonged seizures without signs of meningitis by CSF examination
Respiratory distress	Tachypnea or deep breathing with use of accessory muscles of respiration and chest recession
Severe anemia	Hemoglobin level <5 g/dL
Hypoglycemia	Blood glucose level of <40 mg/dL
Jaundice	Serum bilirubin >3 mg/dL
Renal failure	Urine output of <.5 mL/kg per hour and serum creatinine level >1.5 g/dL
Shock	Systolic blood pressure of <70 mm Hg in the presence of cool clammy skin
Malnutrition	Body weight <2 SDs for age and gender
Hyperparasitemia	>10% of red blood cells showing a parasitized asexual form of <i>Plasmodium falciparum</i>
(2) Uncomplicated malaria criteria	
Fever	Axillary temperature greater than or equal to 37.5° or history of hot body in the last 72 h
Detection of Plasmodium in the blood by microscopic examination or using a rapid diagnostic test	
No sign of gravity	As listed for severe malaria

All of the clinical symptoms in the table were classified based on the criteria of the World Health Organization (WHO, 2000) and the Ministry of Health in Burkina Faso. CSF indicates cerebrospinal fluid.

hospital is the referral hospital for 49 peripheral health centers (small health centers)

The District Hospital has a capacity of 194 beds. The pediatric facilities at this regional hospital include a small emergency office (12 m²), six cramped pavilions for hospitalization, (70–80 m²), a center for nutrition and education, a small nursing station (12 m²), a duty room, and a physician's office. The pediatric facility capacity is 35 beds. The staff comprises one support, two medical doctors, and 19 personal care staff members. The peripheral health center has the capacity of the district hospital is 30 beds.

2.2. Inclusion and exclusion criteria

On admission, all children aged 0–5 years who had been diagnosed with clinical signs of malaria or produced paraclinical assessment results were potential participants of the study ($n=732$). Patients who died ($n=5$) during the first hour before admission formalities were completed were excluded. Children with caregivers who had not given formal consent were then excluded. The remaining children were screened using a blood smear to determine whether they had severe malaria, based on the WHO severe malaria criteria (WHO, 2000) (Table 1). Those who did not fulfill the WHO criteria for either severe or uncomplicated malaria were then excluded. The final sample comprised 510 participants. The primary caregivers of these 510 children were interviewed.

2.3. Data collection

Each child was screened to identify whether she or he had severe malaria based on the World Health Organization (WHO, 2000) criteria. The characteristics of each child were collected from the patient admission records. When a child was identified as having either severe or uncomplicated malaria, a face-to-face interview with the primary caregiver was conducted by trained interviewers

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