

## Call for elimination program of Malaria among children under 5 years old living in refugee camps in eastern Democratic Republic of Congo

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### ARTICLE INFO

Handling Editor: Patricia Schlagenhauf

#### Keywords:

Antimalarial drugs  
Elimination program  
Children  
Democratic Republic of Congo  
Malaria

### ABSTRACT

Malaria is a significant public health challenge in the Democratic Republic of the Congo (DR Congo), with a high prevalence and mortality rate, particularly among children under five years old. This study examines the impact of malaria in eastern DR Congo, where armed conflict and humanitarian crises have resulted in overcrowded refugee and internally displaced persons (IDP) camps, exacerbating malaria transmission. Malnutrition, limited access to healthcare, and poor living conditions makes children under the age of five particularly vulnerable. Despite attempts by organizations such as the World Health Organization and various non-governmental organizations to supply insecticide-treated bed nets and antimalarial drugs, implementation in refugee camps is impeded by war, resource constraints, and insufficient healthcare facilities. A focused elimination approach that includes integrated vector control, enhanced diagnostic access, healthcare professional training, and community engagement is critical. Surveillance and research are critical for determining malaria prevalence and resistance patterns. Effective malaria treatment in refugee camps necessitates broad strategies to protect vulnerable children and lower disease burdens.

### 1. Introduction

Malaria is considered a public health problem in the Democratic

Republic of the Congo (DR Congo), which remains among the countries with a high malaria burden in the world. Globally in 2022, there were an estimated 249 million malaria cases and 608,000 malaria deaths in 85

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<https://doi.org/10.1016/j.nmni.2024.101508>

Received 13 August 2024; Received in revised form 10 October 2024; Accepted 10 October 2024

Available online 11 October 2024

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countries [1]. According to the World Health Organization (WHO), Four African countries accounted for just over half of all malaria deaths worldwide: Nigeria (26.8 %), DR Congo (12.3 %), Uganda (5.1 %) and Mozambique (4.2 %) [1]. Eastern DR Congo, including North Kivu, South Kivu, and Ituri, has experienced long-lasting armed conflict, political instability, and recurrent humanitarian crises. All these hardships have provoked the displacement of millions of people, and therefore, the establishment of many refugees and internally displaced persons (IDP) camps [2]. The crowded and dirty conditions of these camps multiply the risk of malaria transmission. The ongoing conflict and instability further complicate efforts to manage and mitigate the spread of malaria, posing severe public health challenges and limiting access to essential medical interventions [3]. Children under five are especially vulnerable to malaria because of their immature immune systems. In the context of refugee camps, general susceptibility to the disease in the child population is enhanced by factors like malnutrition, poor health service availability, and living in overcrowded conditions. If uncomplicated malaria in young children is not timely detected and treated, it may easily progress to severe morbidity and death [4]. The vast majority of organizations that engage in the fight against malaria in DR Congo include WHO and other Non-Governmental Organizations (NGOs). They distribute insecticide-treated bed nets, spray, and give antimalarial medications. However, adopting these measures into the refugee camps is a challenge [5,6]. The insecurity of the country, caused by conflict, restricts entry into the majority of the areas and poses risks for healthcare workers in the field. Also, resource constraints in terms of finances and supplies hinder the implementation of prevention and treatment interventions on an effective, comprehensive scale [7,8]. Many camps do not have proper healthcare facilities and trained personnel to manage malaria infections.

Given the high burden of malaria among children under five in refugee camps in eastern DR Congo, there is a compelling need for a targeted elimination program. Such a program should incorporate integrated vector management, including the widespread distribution, and environmental management to reduce mosquito breeding sites [9]. Also, improving diagnostic access, training healthcare workers, strengthening local health systems, ensuring medication supply, and community engagement are essential for effective malaria management [10,11]. This can be achieved through surveillance systems and research to track malaria incidence and resistance patterns [12]. The high prevalence of malaria among this age group in refugee camps underlines the necessity for targeted health interventions to protect these children and decrease the burden of disease.

## 2. Main text

### 2.1. The current state of malaria in children under 5 years in DR Congo

The DR Congo, a central African nation with an estimated population of 96 million, faces malaria as a significant public health crisis, ranking as the leading cause of disability and mortality combined [13,14]. The DR Congo has the second-highest prevalence and mortality rate of malaria globally, contributing to 12 % of the global burden [15], with 96.7 % of households in the DRC affected by malaria [16] and a prevalence rate of 13,246 cases per 100,000 population over the past two decades [17].

Children under five years old and school-age children (5–15 years) are particularly vulnerable to both symptomatic and asymptomatic malaria infections. The WHO's recommendations for malaria control, elimination, and eradication have only been partially implemented in the DR Congo. For more effective malaria control and eventual elimination, integrating all population groups into the national malaria control program is essential. Therefore, it is crucial to include schools and school-age children in the DR Congo's malaria control interventions [18].

In the DR Congo, malaria is the leading cause of illness and death

among children under five, accounting for an estimated 40 % of outpatient visits and 40 % of overall mortality in this age group [19]. Malaria remains a major public health issue in Kinshasa, the capital city, which has been studied since colonial times [20]. Kinshasa is Africa's third-largest city, with a population exceeding 10 million [21]. Several factors contribute to the high burden of malaria in young children. The vast majority (97 %) of the DR Congo's population resides in areas conducive to malaria transmission, where high temperatures and stagnant water provide ideal breeding grounds for mosquitoes [22]. Access to preventive measures like insecticide-treated bed nets (ITNs) remains a challenge. Although coverage has improved, a 2017–2018 UNICEF survey revealed that only slightly over half (51 %) of children under five reported sleeping under an ITN the previous night [22].

Despite these challenges, there have been positive developments. The National Malaria Control Strategic Plan (2016–2020) targeted high-burden areas with interventions such as ITNs and improved access to diagnosis and treatment [23]. According to the President's Malaria Initiative (PMI), there has been a 34 % decrease in the mortality rate for children under five since 2010 [24].

### 2.2. The health implications and call for elimination program of Malaria children under 5 years old living in refugee camps

Malaria is a complex and deadly disease with an estimation of 249 million malaria cases and 608,000 malaria deaths in 85 countries. The WHO African Region carries a disproportionately high share of the global malaria burden with children less than 5 years of age accounting for about 78 % of all malaria deaths in the Region [25].

One of the factors influencing the dynamics of infectious disease transmission is human movement. This affects the rate of exposure of susceptible to infected individuals or introduce the agent to susceptible groups, or both [26]. The United Nations Refugee Agency estimated that globally, there were 89.3million forcibly displaced people [6], with almost two-thirds of them living in malaria endemic regions [27]. The high burden of malaria among the displaced communities in Africa constitutes an emerging challenge for humanitarian response [28]. Vector borne and other infectious diseases present many challenges in refugee settlements due to inequalities, limited access to healthcare services, and crowded environments which enable rapid disease transmission [29]. Children under 5 years of age are one of the population subgroups that are considered at a high risk of contracting malaria. According to data from the UNHCR, in high-transmission areas of sub-Saharan Africa malaria incidence in refugee children younger than 5 years old exceeds 1 case per child per year and accounts for 26 %–31 % of deaths [30]. When immunologically naive people who have never been infected with malaria move to areas with higher transmission intensities, their chance of contracting the disease may likely increase [27]. Refugees are more susceptible to contracting malaria infections by their lack of protective immunity, increased concentration of people in endemic settings, limited resources their poor exposed living conditions, limited distribution of ITNs, inadequate IRS, insufficient rapid clinical diagnostic tests and treatment responses. Other risk factors include outdoor night activities, inadequate body coverings or clothes, residing in unfinished houses, poor drainage and acute malnutrition among the children due to inadequate food rations [31]. Malaria elimination programmes are geared towards interrupting the transmission cycle of malaria parasite species in a defined geographical zone but can be hampered by the influx of refugees from endemic countries. This gives room for importation of malaria from these endemic zones which can contribute to secondary transmission and the spread of drug resistance and thus, threatening long-term elimination goals [32]. Interventions towards elimination should be continued and persistent efforts focused on the local realities and knowledge of factors that affect malaria distribution around the refugee camps. Hence, data and knowledge of the current prevalence of malaria among the under-fives and its associated factors in these refugee camps are needed to design appropriate and

effective intervention programs [25]. The success of any elimination program implemented is largely dependent on the strength of the national health system in providing cheap, adequate and accessible services, the political will towards investing in malaria elimination strategies and other factors, including biological determinants, the environment and the social, demographic, political and economic realities of a particular country [1].

2.3. The preventions strategies and recommendations to fight malaria in children under 5 years old living in refugee camps in eastern Democratic Republic of Congo

WHO recommends the use of insecticide-treated mosquito nets (ITNs) specifically the long-lasting insecticide nets (LLINs) as an intervention in protecting populations at risk of malaria, including in areas where the risk of reintroduction remains [33]. ITNs are the only vector control widely implemented in DR Congo for the prevention of malaria, and with emphasis on children under five and pregnant women. From 2010 to 2018, the parameters of household ITN ownership, ITN use among children under five years of age and pregnant women increased from 30 %, 38 % and 43 %, to 44 %, 51 %, and 52 %, respectively [34].

WHO recommends indoor residual spraying IRS using a product prequalified by WHO for the prevention and control of malaria in children and adults living in areas with ongoing malaria transmission [35]. The Tenke Fungurume Mining (TFM) vector control component includes indoor residual spraying (IRS) of insecticides twice a year on interior wall surfaces and eave areas, initial and periodic mass redistribution of LLINs, and selective larva monitoring and control using environmental management practices and/or larvicidal agents as appropriate [36]. A minimum of three doses of IPTp (IPTp3+) with universal coverage of at least 80 % of pregnant women is recommended by WHO [37].

In DR Congo, IPTp3+ implementation is less than the universal coverage and the most of women who attend at least four antenatal care visits receive less than three doses of IPTp [38]. Infants are not covered by preventive chemotherapy strategies (IPTi) as recommended by the WHO. Preventive chemotherapy would help children under five years of age (IPTc) as they are more at risk of malaria morbidity and mortality,

and among school-age children (IPTsc) who are a large reservoir of asymptomatic carriers for disease transmission [39]. It has been revealed that IPTc, given every four months combined with timely treatment of febrile malaria illness, has greatly reduced childhood morbidity and mortality related to malaria [40]. In regions with moderate to high transmission, RTS, S/AS01 should be provided to children as part of a comprehensive malaria control strategy in four-dose schedule from 5 months of age [35]. In order to adhere to malaria preventive measures, the promotion of social and behavioural change through education and training to increase the awareness and knowledge of populations such as parents (especially mothers), caregivers, teachers, and healthcare professionals, concerning malaria transmission risks, case management and prevention is essential [41]. The DR Congo’s National Strategic Plan 2020–2023 aims to improve the DR Congo population’s health status by improving the coverage of epidemiological surveillance and monitoring and evaluation activities. Also, to collaborate with the Direction des Soins de Santé Primaires to make functional and strengthen the capacities of community participation structures in the planning and implementation of malaria control activities, strengthen the behavior change communication for malaria control, and promote the community use of health services [42]. Fig. 1 show the prevalence of Children 6–59 months of age who tested positive for malaria by microscopy (43). Fig. 2 show the Democratic Republic of Congo Malaria Map [44].

3. Conclusion

The persistent malaria problem in eastern DR Congo’s refugee camps necessitates a rapid, broad response. Armed conflict, relocation, and poor living conditions have all contributed to an increased risk of malaria transmission, which disproportionately affects children under the age of five. While organizations such as the World Health Organization and numerous non-governmental groups have attempted to prevent malaria by distributing insecticide-treated nets and drugs, their efforts have fallen short due to the region’s instability and a lack of resources. Addressing this crucial issue necessitates a multifaceted approach that includes vector control, improved diagnosis and treatment capabilities,

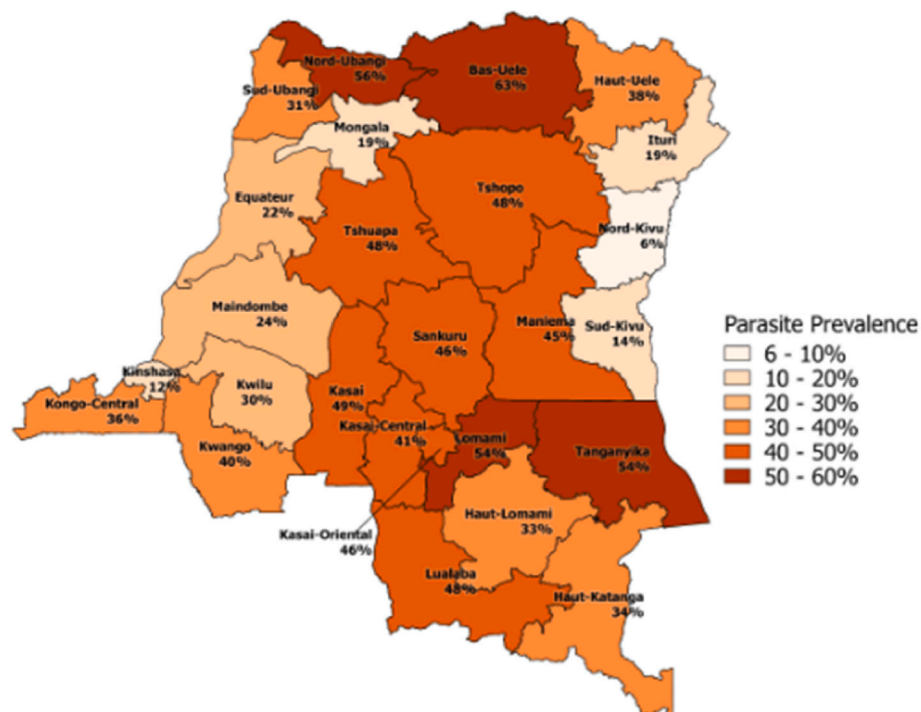


Fig. 1. Prevalence of Children 6 to 59 months of age who tested positive for malaria by microscopy [43].



Fig. 2. Democratic Republic of Congo Malaria Map [44].

and strengthened local health systems. This technique relies heavily on training healthcare personnel, guaranteeing a regular supply of anti-malarial medications, and engaging the local population. Furthermore, effective surveillance and research are required to track disease frequency and resistance tendencies. By implementing these targeted interventions, we can protect the most vulnerable children, reduce malaria-related morbidity and mortality, and go closer to eradicating this regional public health problem.

**Ethics approval and consent to participate**

Not applicable.

**Consent for publication**

Not applicable.

**Availability of data and material**

Not applicable.

**Funding**

The authors did not receive any financial support for this work. No funding has been received for the conduct of this study.

**Provenance and peer review**

Not commissioned, externally peer reviewed.

**CRediT authorship contribution statement**

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## Declaration of competing interest

The authors declare that there no conflict of interest.

## Acknowledgements

The authors would like to thank the direction of Medical Research Circle (MedReC) of Democratic Republic of the Congo for the realization of this present paper.

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