



Socioeconomic factors associated with the incidence of childhood malaria in the western Amazon

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Summary

Childhood malaria in the Western Amazon is a public health problem amplified by socioeconomic and environmental factors. Poverty, social exclusion, and a lack of adequate infrastructure contribute to the proliferation of the disease vector, primarily affecting the most vulnerable populations, such as children under 5. This age group has the highest rates of mortality and serious complications, including cerebral malaria, anemia, and kidney failure. Furthermore, rapid urbanization, internal migration, and large infrastructure projects, such as hydroelectric dams and highways, have exacerbated the incidence of the disease.

Objective: The objective of this study is to analyze the influence of socioeconomic and environmental factors on the incidence of childhood malaria in the Western Amazon, focusing on identifying the main determinants that contribute to children's vulnerability. Furthermore, it seeks to understand how these conditions impact child health and propose effective intervention and control strategies, aiming to reduce malaria-associated morbidity and mortality in the region. **Method:** The research method used in this study consisted of an exploratory literature review with a qualitative approach, conducted from September to December 2024. Data collection involved secondary sources available in digital databases, with searches conducted on platforms such as Google Scholar, SciELO, and PubMed. **Results:** The study identified that childhood malaria in the Western Amazon is aggravated by socioeconomic factors, such as poverty and social exclusion, and by environmental conditions related to intense economic activities. Children under 5 years of age are the most vulnerable, highlighting the need for integrated interventions to prevent and control the disease. **Conclusion:** Malaria continues to be a significant public health problem in the Western Amazon, especially among children. Socioeconomic factors play a crucial role in the incidence of the disease, with poverty, social exclusion, and precarious living conditions directly determining the proliferation of the disease vector and the exposure of children to severe forms of malaria.

Keywords: Malaria, Children, Infantile, Epidemiology, Incidence;

Summary

Childhood malaria in the Western Amazon is a public health issue exacerbated by socioeconomic and environmental factors. Poverty, social exclusion, and inadequate infrastructure contribute to the proliferation of the disease vector, disproportionately affecting vulnerable populations, particularly children under five. This age group experiences the highest mortality rates and severe complications, including cerebral malaria, anemia, and kidney failure. Furthermore, rapid urbanization, internal migration, and large-scale infrastructure projects, such as hydroelectric plants and highways, have intensified the

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disease's incidence. **Objective:** This study aims to analyze the influence of socioeconomic and environmental factors on the incidence of childhood malaria in the Western Amazon, focusing on identifying key determinants contributing to children's vulnerability. It also seeks to understand how these conditions impact child health and propose effective intervention and control strategies to reduce malaria-related morbidity and mortality in the region.

Method: The research method used in this study involved an exploratory bibliographic review with a qualitative approach, conducted from September to December 2024. Data collection relied on secondary sources available in digital databases, using platforms such as Google Scholar, SciELO, and PubMed. **Results:** The study found that childhood malaria in the Western Amazon is exacerbated by socioeconomic factors such as poverty and social exclusion, along with environmental conditions linked to intense economic activities. Children under five are the most vulnerable, highlighting the need for integrated interventions to prevent and control the disease. **Conclusion:** Malaria remains a significant public health challenge in the Western Amazon, particularly among children.

Socioeconomic factors play a crucial role in the disease's incidence, with poverty, social exclusion, and precarious living conditions being direct determinants of the vector's proliferation and children's exposure to severe malaria forms.

Keywords: Malaria, Children, Childhood, Epidemiology, Incidence.

INTRODUCTION

Malaria is an infectious disease caused by protozoa of the genus *Plasmodium*, occurring more frequently in tropical and subtropical areas. Although it is a disease treatable and has a good prognosis when appropriate health measures are taken implemented, it remains a significant public health concern worldwide, according to the WHO. In Brazil, almost all cases of malaria (99.8%) are concentrated in the Amazon region, where factors such as internal migration, expansion agriculture, road construction, hydroelectric plants, as well as mining and mining, have facilitated the spread of the disease. These factors, combined with the location close to forests, favor the proliferation of the transmitting mosquito. The prevalence of malaria is influenced by both environmental and socioeconomic conditions and access and the quality of available health services. (SANTA ROSA, I. M, et al., 2020)

Malaria is a significant global public health disease, with most of cases in Brazil concentrated in the Amazon region, representing 99.9% of the total. It is caused by protozoa of the genus *Plasmodium* and transmitted by mosquitoes of the genus *Anopheles*, with *A. darlingi* being the most common due to its affinity for humans and ability to transmit the parasite. The disease, which manifests mainly with fever, is diagnosed through thick gout and treated with medications provided by the system public health. Its transmission depends on the interaction between the mosquito, the parasite and the human being.

human, in addition to being influenced by factors such as temperature, humidity and conditions life. High humidity and temperatures between 20°C and 30°C accelerate the transmission cycle. Furthermore, malaria is strongly influenced by environmental factors such as deforestation, inappropriate land use and construction of hydroelectric plants, in addition to factors climate. (LOPES TMR, 2019)

Malaria shows global variations in prevalence and severity, with factors such as climate change, population displacement and drug resistance driving its resurgence in some regions. Understanding these factors is essential to develop appropriate control strategies. The pathophysiology of the disease is complex, involving the interaction of the parasite with the immune system, especially in severe *Plasmodium falciparum* infections, such as cerebral malaria. Advances in diagnostics, such as rapid tests and PCR, have improved early detection, but diagnosis of non-falciparum forms still faces challenges that require specialized techniques. (VALADARES, GMM, 2024)

Malaria affects children early, which increases the risk of further consequences. serious, in addition to the possibility of multiple infections throughout life, since the first contact with the disease occurs in childhood. From a clinical and child development, malaria is influenced by biological factors, such as immunity, and cultural factors, such as housing conditions and access to health services. This This condition increases the risk of complications in children, favoring the emergence of other types of malaria. In response, the Brazilian Ministry of Health created a national plan to eliminate malaria caused by *Plasmodium vivax* and other species, focusing on areas with high rates transmission and prioritizing early diagnosis and treatment. The goal is to prevent serious consequences and deaths in children. Communication between health services, especially in isolated areas, depends on internet access, and health professionals must be trained to identify the main signs of the disease, in addition to being prepared for the management of malaria in severe cases and during pregnancy, thus ensuring the health of the mother and child, preventing the transmission of malaria during pregnancy. (SILVA, ACL, et al., 2023)

1. RESEARCH METHOD

The research method used in this study consisted of a bibliographic review exploratory, with a qualitative approach, conducted from September to December 2024.



For data collection, secondary sources available in databases were used.

digital, with the search carried out on platforms such as Google Scholar, SciELO and PubMed.

The material selection process followed three main criteria: relevance of the titles and abstracts in relation to the topic, availability of full texts and alignment with the objectives of the study. The search terms "malaria", "children" and "epidemiology" were used as keywords to direct searches. Careful analysis of the results made it possible to choose articles, books and protocols that served as a basis for the preparation of the study, ensuring the inclusion of relevant and comprehensive sources.

2. RESULTS

2.1. Malaria and the influence of socioeconomic factors

Malaria is one of the most relevant parasitic diseases for humanity, being caused by six species of the protozoan *Plasmodium* that infect humans. Among these, *Plasmodium falciparum* is responsible for most deaths. In 2016, The World Health Organization (WHO) has recorded 216 million cases and 445,000 deaths from the disease. Despite the reduction observed in previous years, malaria has increased again alarmingly in 2021 in Northeast Brazil, causing economic costs significant. (FREITAS, CM, et al, 2023)

In Brazil, malaria remains a significant concern, especially in the Amazon region, where almost all cases (99.9%) are recorded. The incidence of disease is measured by the Annual Parasite Incidence (API), which classifies areas into different levels of risk: very low, low, medium and high. During the period analyzed, Amazonas, Acre and Amapá remained at a medium risk level, while Pará, Rondônia and Roraima presented variations between medium and low risk. However, within these states, some municipalities have high levels of risk, especially in areas associated with economic activities such as mining and logging, which are related to environmental degradation and increase the transmission of malaria. (UENO, TMR L, 2022)

Malaria in Brazil is most prevalent in the Amazon region, where factors socioeconomic and environmental factors contribute significantly to the increase in cases. poverty and poor infrastructure are determining factors in the spread of the disease. Many areas of the Amazon region, such as those occupied by indigenous farmers and



riverside communities, lack access to adequate health services, which makes diagnosis difficult and early treatment. The lack of adequate protection against mosquitoes, with housing simple, such as wooden ones, also facilitates the transmission of the disease, especially in hard-to-reach places, such as mining areas. (GAMA, JKB, 2021)

The study by Samesima (2019) revealed that malaria is more prevalent in municipalities with unfavorable socioeconomic and environmental conditions. Of the 641 municipalities analyzed in their study, 68 presented high levels of incidence Annual Parasitic Incidence (IPA), suggesting a direct relationship between poverty conditions and the increase in malaria cases. The lack of adequate access to health services, poor infrastructure and poor living conditions are crucial factors that contribute to the persistence of disease transmission. Furthermore, statistical analysis emphasized the relevance of these variables for understanding the epidemiological profile of malaria and for the development of more effective control strategies.

The transmission and distribution of malaria, even in endemic regions, can vary significantly due to the interaction of several factors, such as environmental ones, sociocultural, economic and political factors, in addition to the quality of health services. The way of land use and landscape characteristics also play important roles this variation. Climatic factors, such as precipitation and temperature, influence directly the occurrence of the disease, since rain creates the necessary aquatic environments for the mosquito life cycle, impacting vector density. However, the way how precipitation affects malaria can vary depending on the particularities geographic characteristics of each region. (WOLFARTH-COUTO, B., et al., 2020)

The environment, in turn, plays a crucial role in the spread of malaria. geography and climate of the Amazon region, with its dense vegetation and large amount of still waters are factors that favor the creation of breeding grounds for mosquitoes transmitter of the disease. These natural environments, combined with the lack of infrastructure and low socioeconomic level, create a continuous cycle of malaria spread. The interaction of these factors make the region one of the most affected by the disease, both in Brazil and globally, with infection rates close to the number of deaths recorded in other parts of the world. (GAMA, JKB, 2021)

Malaria control is intrinsically linked to development goals

sustainable, which seek to eradicate extreme poverty, especially in rural areas of developing countries. Poverty is a determining factor in the spread of infectious diseases, such as malaria, which is one of the main causes of morbidity and mortality in tropical and subtropical areas. In Brazil, populations living in areas endemic to malaria, often in situations of extreme poverty and with limited infrastructure inadequate, are the most vulnerable to the disease. Reducing these inequalities socioeconomic measures can be essential to combat malaria, in addition to ensuring access to health and well-being. (SAMESIMA, C., 2019)

The global and regional reduction in the incidence of malaria in recent decades reflects the advances in disease control, but the persistence of cases in endemic areas demonstrates the influence of environmental and social factors. The exploitation of natural resources and practices economic in these regions intensify exposure to the vector, highlighting the need for targeted actions to mitigate the impact of these activities. (UENO, TMR L, et al., 2022)

2.2. Incidence of childhood malaria

Malaria affects approximately 3.3 billion people worldwide, with 1.2 billion of them are at high risk of contracting the disease. Mortality is especially high among children under 5, who account for 78% of deaths. Factors socioeconomic and environmental factors, such as poverty, social exclusion and living conditions inadequate, aggravate the incidence of the disease in children. In Brazil, internal migration, large infrastructure projects, such as the construction of highways and hydroelectric plants, and mining activities favor the spread of the malaria vector, which increases the exposure of vulnerable populations, especially in the Amazon Region. (SILVA, FN et al., 2019)

Around 914 million adolescents, between the ages of 10 and 19, live in low-income countries. income, being exposed to the risk of malaria, but this group rarely receives measures specific control measures. The World Health Organization (WHO) classifies malaria as the second leading cause of death in adolescence, representing 4% of global deaths in this age group age group. The impact is even greater among adolescents aged 10 to 14, where malaria stands out as the main cause of death, surpassing diseases such as tuberculosis and HIV/AIDS. (ARAUJO, OCL, et al., 2019)



Malaria is a disease that has a significant impact on children, with a particularly high mortality rate in this group. Between 2015 and 2019, the Americas recorded a 79% increase in cases of the disease, highlighting the urgency of implement more effective methods of prevention, diagnosis, and treatment. Children under five years of age represent the majority of deaths from malaria, due to the greater predisposition to serious complications such as cerebral malaria, anemia, dyspnea caused due to metabolic acidosis and seizures. In addition, the difficulty in diagnosis and the risk high rate of complications makes children more susceptible to death. In Brazil, it was implemented in 2015 a plan to eradicate malaria, aligned with the Millennium Development Goals UN Sustainable Development, with the goal of reducing cases by 90% by 2030. Investments are being made in new technologies, including chemoprophylaxis, antimalarial drugs and methods to control disease vectors. In the country, where initiatives such as agrarian reform and infrastructure projects aim to combat the factors socioeconomic factors that favor the transmission of malaria, children continue to be the most affected, mainly because they live in precarious conditions. (LIMA, CA, et al., 2024)

The two most prevalent *Plasmodium* species in the region are *P. vivax* and *P. falciparum*. While *P. vivax* infection usually presents with milder symptoms, *P. falciparum* infection can progress to severe forms, such as acute renal failure (IRA), especially in children. Children under 5 years of age are particularly vulnerable to infection and the risk of death, representing the majority of deaths caused by malaria. Although global infant mortality rates declined between 2000 and 2015, malaria still remains a serious public health problem, especially in developing countries, with more than 90% of cases concentrated in regions tropical and subtropical. (SILVA, FN et al., 2019)

In Brazil, malaria is a major public health challenge, with most cases (99%) occurring in the Amazon region, mainly in rural areas. Between 2003 and 2014, children and adolescents were responsible for about 47% of cases, with infants, preschoolers and schoolchildren are the most affected. Although it has been acquired quite a lot knowledge about malaria in children, attention to the disease in adolescence has been limited. (ARAUJO, OCL, et al., 2019)

3. CONCLUSION



Malaria continues to be a significant public health problem in the Amazon Western, especially among children. Socioeconomic factors play a crucial role in the incidence of the disease, with poverty, exclusion social and precarious living conditions are direct determinants of the proliferation of the vector of the disease and the exposure of children to severe forms of malaria. Analysis of the rates mortality and morbidity reveals that children under 5 years of age are the most affected, representing the majority of deaths caused by the disease, largely due to the greater susceptibility to serious complications such as cerebral malaria, severe anemia, acidosis metabolic and seizures.

Additionally, factors such as internal migration, large infrastructure projects, such as the construction of highways and hydroelectric plants, and activities such as mining, contribute to alter the dynamics of malaria transmission. These changes in ecosystems places favor the proliferation of the transmitting mosquito, increasing the exposure of vulnerable populations, especially in rural areas of the Amazon region. The lack of access to adequate health services and the difficulty in early diagnosis are also elements that aggravate the situation, resulting in high rates of therapeutic failure and infant mortality.

The data show that despite advances in global mortality rates among children, malaria remains one of the main causes of child deaths, especially in developing countries. In Brazil, the National Elimination Plan Malaria, launched in 2015, aims to significantly reduce cases and deaths by 2030, with the implementation of new technologies to control the disease. However, it is It is essential that investments in chemoprophylaxis, new therapies and effective control of the vector are accompanied by public policies that address inequalities socioeconomic, ensuring that the most vulnerable populations, such as children in Western Amazon, have access to quality healthcare and more dignified living conditions.

Therefore, for effective control of childhood malaria in the region, it is imperative to integrate efforts to mitigate the socioeconomic and environmental factors that contribute to high incidence of the disease, prioritizing the most affected populations. The combination of public health interventions, social policies and infrastructure investments will be crucial to reduce the burden of malaria and improve the living conditions of children in Western Amazon.

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