

Overview of Malaria in Pregnancy: Challenges and Strategies for Effective Prevention

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ABSTRACT

Malaria in pregnancy is a significant public health issue in sub-Saharan Africa, with 30 million pregnancies at risk each year. Pregnant women are particularly vulnerable due to immunological changes and the placental environment that facilitates parasite sequestration. The predominant malaria parasite, *Plasmodium falciparum*, is associated with significant maternal and fetal complications. Effective malaria prevention strategies include insecticide-treated nets (ITNs) and intermittent preventive treatment (IPTp) with Sulfadoxine-pyrimethamine. However, adherence to preventive chemotherapy is challenging due to side effects and socioeconomic barriers. Health education programs are crucial for increasing awareness and promoting preventive behaviors. Early diagnosis and prompt treatment are critical for managing severe malaria cases. Environmental and vector control measures, such as indoor residual spraying and larval source management, are vital for reducing mosquito populations and transmission. Nutritional interventions support immune function and overall health. Access to healthcare services, innovative technologies, and cultural and socioeconomic factors are essential for overcoming barriers to malaria prevention and treatment. Continuous monitoring and evaluation are crucial for refining interventions and improving health outcomes.

Keywords: Malaria, Pregnancy, Challenges, Strategies, Effective Prevention

INTRODUCTION

Malaria remains a major public health challenge in sub-Saharan Africa, with pregnant women particularly vulnerable to its severe consequences. Each year, around 30 million pregnancies are at risk, influenced by the endemic nature of malaria in this region. Pregnant women experience increased susceptibility to malaria due to immunological changes and the unique environment of the placenta, which facilitates parasite sequestration [1]. The predominant malaria parasite affecting pregnant women, *Plasmodium falciparum*, is known for causing severe maternal and fetal complications, including anemia, low birth weight, and preterm delivery. Addressing malaria in pregnancy is crucial for reducing maternal and infant mortality rates and improving overall reproductive health outcomes. The risk of malaria in pregnancy is influenced by factors such as regional transmission dynamics, parity, HIV infection, and socioeconomic status [2]. Effective malaria control strategies, including insecticide-treated nets (ITNs), intermittent preventive treatment (IPTp), preventive chemotherapy, and health education, play a vital role in mitigating these risks. Integrating malaria prevention and treatment into routine antenatal care is essential for reaching pregnant women and reducing malaria-related complications. National policies and government initiatives, along with innovative technologies and community-based approaches, are integral to enhancing the effectiveness of malaria prevention efforts [3]. This review will explore the epidemiology of malaria in pregnancy, the importance of addressing this issue, and the various strategies and challenges associated with malaria prevention and control in pregnant women. By understanding these aspects, we aim to highlight effective interventions and provide recommendations for improving maternal and child health outcomes in malaria-endemic regions.

Use of Insecticide-Treated Nets (ITNs)

Insecticide-Treated Nets (ITNs) are bed nets treated with insecticides that repel, kill, or incapacitate mosquitoes, reducing the likelihood of malaria transmission. They have been shown to significantly reduce malaria incidence, especially in high-transmission areas. Consistent use of ITNs can decrease the number of malaria cases by about

50% and child mortality by approximately 20%. For pregnant women, ITNs reduce the risk of malaria infection, which in turn lowers the risk of maternal anemia, placental malaria, and adverse birth outcomes such as low birth weight and preterm delivery [4]. This contributes to healthier pregnancies and better neonatal health outcomes. Widespread use of ITNs can have a community-wide protective effect by reducing the overall mosquito population and interrupting malaria transmission cycles. Distribution programs targeting pregnant women in malaria-endemic regions often provide free or subsidized ITNs to ensure accessibility. However, utilization rates vary by region and are influenced by factors such as awareness, accessibility, and cultural practices. Barriers to ITN use include cultural beliefs and practices, physical and environmental factors, lack of awareness, economic constraints, and maintenance and replacement costs. Strategies to overcome these barriers include community education and engagement, behavior change communication, improving comfort and usability, enhanced distribution mechanisms, subsidies and financial support, and continuous monitoring and feedback mechanisms.

Intermittent Preventive Treatment (IPTp)

Intermittent Preventive Treatment (IPTp) is a strategy that involves administering a full course of antimalarial medication at scheduled intervals during pregnancy, regardless of the recipient's malaria infection. The drug used is Sulfadoxine-pyrimethamine (SP), which works by inhibiting folate synthesis in the malaria parasite, reducing the parasite load, and preventing malaria-related complications in pregnant women [5]. The World Health Organization recommends that all pregnant women in areas with moderate to high malaria transmission receive IPTp with SP during antenatal care visits. IPTp should be given at least three times during pregnancy, with doses spaced at least one month apart. It should not be given to women with a history of allergy to sulfa drugs or those in their first trimester of pregnancy. IPTp has significant impacts on maternal and neonatal health outcomes. It significantly reduces the incidence of malaria in pregnant women, lowering the risk of maternal anemia and other malaria-related complications. Studies have shown that IPTp can decrease the prevalence of peripheral and placental malaria infections. It also contributes to improved maternal health, decreasing the risk of maternal morbidity and mortality. IPTp also has positive effects on fetal growth, preventing placental malaria, which can interfere with fetal growth and development. Long-term benefits extend beyond birth, contributing to better infant health and development in the early months of life. Challenges and future directions include drug resistance, coverage and adherence, and integration with other health interventions [6]. Ensuring widespread adoption and addressing challenges can further enhance IPTp's impact and contribute to reducing malaria-related morbidity and mortality.

Preventive Chemotherapy

Preventive chemotherapy is a crucial strategy in reducing malaria-related complications in pregnant women. There are several types of chemotherapy used, including sulfadoxine-Pyrimethamine (SP), chloroquine, proguanil, doxycycline, mefloquine, and atovaquone-proguanil [7]. These drugs are generally safe when used in the second and third trimesters but not recommended in the first trimester due to potential teratogenic effects. However, adherence to chemoprophylaxis can be hindered by side effects, complex dosing regimens, lack of awareness, limited access to healthcare facilities, economic constraints, and cultural beliefs and misconceptions. Barriers to adherence include side effects, complex dosing regimens, lack of awareness, limited access to healthcare facilities, economic constraints, and cultural beliefs and misconceptions. To improve adherence, strategies include education and counseling, simplified regimens, community health programs, increased access to healthcare, financial support, monitoring and follow-up, and the use of mobile health technologies. Education on the benefits and importance of chemoprophylaxis during antenatal visits, counseling to address side effects and misconceptions, and simplified regimens can help pregnant women maintain their medication schedules. Community health programs and financial support can also help reinforce adherence [8].

Health Education and Awareness Programs

Educating pregnant women about malaria prevention is crucial for increasing awareness and knowledge about the risks of malaria during pregnancy and available preventive measures. This knowledge helps women take proactive steps to protect themselves and their unborn children. Informed pregnant women are more likely to adopt preventive behaviors such as using insecticide-treated nets (ITNs), seeking timely medical care, and adhering to preventive chemotherapy, leading to reduced malaria incidence, lower maternal anemia rates, and better pregnancy outcomes. Education empowers women to make informed decisions about their health and that of their families, boosting confidence in managing their health and encouraging adherence to recommended practices [9]. Preventing malaria in pregnant women contributes to broader community health by reducing the overall burden of malaria. Community-based health education initiatives include community health workers (CHWs), educational campaigns, school-based programs, peer education and support groups, and mobile health initiatives. Healthcare providers play a role in disseminating information through antenatal care visits, personalized counseling sessions, group education sessions, training and capacity building, collaboration with community leaders, and distribution of educational materials.

Early Diagnosis and Prompt Treatment

Early diagnosis and prompt treatment of malaria in pregnancy are crucial for preventing severe complications, reducing maternal mortality, improving fetal health, reducing malaria transmission, and enhancing the quality of life for pregnant women [10]. Rapid Diagnostic Tests (RDTs) are widely used for quick and accurate malaria diagnosis, while microscopy is considered the gold standard. Polymerase Chain Reaction (PCR) is highly sensitive and specific for malaria diagnosis but is more complex and costly [11-13]. Access to diagnostic facilities varies widely, with urban areas having better access than rural regions. Mobile clinics and outreach programs are essential for improving access to diagnostic tools in remote areas. Integrating malaria diagnostic services with antenatal care ensures routine screening for malaria cases [14-16]. Training and capacity building are essential for accurate diagnosis and treatment. Treatment protocols for malaria in pregnancy include quinine in the first trimester, clindamycin in the second and third trimesters, and intravenous artesunate for severe malaria. Close monitoring and follow-up are necessary to ensure symptom resolution and prevent recurrence. Supportive care, including hydration, fever management, and nutritional support, is essential for managing malaria in pregnancy. Patient education and counseling on preventive measures, such as using intravenous antigens (ITNs) and attending regular antenatal visits are also crucial [17-19].

Environmental and Vector Control Measures

Indoor Residual Spraying (IRS) is a method of controlling mosquitoes by spraying their interior walls and ceilings with long-lasting insecticides. It has been proven to significantly reduce malaria transmission by lowering the density of mosquitoes. The effectiveness of IRS can last for several months, depending on the insecticide used. It also helps manage resistance development in mosquito populations [11]. However, it requires substantial financial and logistical resources, trained personnel, and community acceptance. Larval Source Management (LSM) targets aquatic habitats where mosquito larvae develop to reduce mosquito populations before they become adults. It involves techniques like larviciding, habitat modification, and habitat manipulation [20-22]. Environmental modification involves draining or filling areas of standing water and managing irrigation and water storage practices. These measures can significantly reduce breeding sites for mosquitoes, leading to lower mosquito populations. Community participation in vector control activities fosters ownership and responsibility, ensuring the sustainability of interventions [20-22]. Community members possess valuable local knowledge about mosquito breeding sites and effective control measures. Community participation can be done through education and awareness campaigns, community-led initiatives, and collaboration with health workers. Challenges include engagement and motivation, cultural and social factors, and resource limitations. Solutions include continuous education, feedback, and recognition of community efforts. Overall, implementing environmental and vector control measures is vital for reducing malaria transmission and protecting vulnerable populations, such as pregnant women.

Nutritional Interventions and Support

Nutrition plays a crucial role in enhancing the immune response to malaria, reducing susceptibility to infections, supporting recovery, and combating anemia [12]. Pregnant women in malaria-endemic areas have increased nutritional needs, including protein, iron, calcium, folic acid, iodine, and essential vitamins and minerals. Iron and folic acid are essential for preventing anemia, while protein is necessary for fetal growth, maternal tissue development, and immune cell production. Vitamins and minerals, such as vitamin A, zinc, and vitamin C, support immune function and wound healing. Pregnant women need increased caloric intake to meet the energy demands of pregnancy and fetal development. Nutritional interventions can include antenatal nutrition counseling, community nutrition programs, food assistance programs, and biofortification [18-19]. These programs aim to improve the nutritional status and overall well-being of pregnant women. Integrating nutrition interventions with malaria prevention and treatment programs ensures a holistic approach to maternal and child health. Regular monitoring of nutritional status helps identify those in need of additional support. Program impact evaluation helps refine and improve interventions, ensuring they effectively meet the needs of pregnant women in malaria-endemic areas. Overall, comprehensive programs that provide supplementation, food fortification, education, food assistance, and agricultural support, integrated with malaria prevention and treatment efforts, can significantly improve the nutritional status and overall well-being of pregnant women [13].

Access to Healthcare Services

The importance of antenatal care (ANC) in ensuring the health of both the mother and the developing fetus is undeniable. Strategies to improve access include community outreach programs, incentive schemes, telemedicine, and digital health, and improving healthcare infrastructure. Malaria prevention is integrated into routine ANC, with rapid diagnostic tests and microscopy used for screening. Treatment protocols follow national and international guidelines, and safe and effective antimalarial drugs are available. Preventive measures include intermittent preventive treatment in pregnancy (IPTp), distribution of insecticide-treated nets (ITNs), and nutritional support through iron and folic acid supplements [14]. Overcoming barriers to accessing healthcare

services includes reducing or eliminating user fees, implementing health insurance schemes, providing transportation vouchers, establishing more healthcare facilities in remote and rural areas, addressing sociocultural barriers, increasing awareness about ANC, strengthening the healthcare workforce, and implementing national policies that prioritize maternal health and malaria prevention.

Role of Policy and Government Initiatives

Malaria prevention in pregnancy is a complex issue that requires a coordinated approach involving national policies, government-funded programs, and international collaborations. National policies outline strategies and guidelines for malaria prevention, emphasizing the importance of Intermittent Preventive Treatment in Pregnancy (IPTp), the use of Insecticide-Treated Nets (ITNs), and access to prompt diagnosis and treatment. Regional policies, developed by organizations like the World Health Organization (WHO), focus on specific endemic areas and emphasize cross-border cooperation. Governments fund malaria prevention programs, targeting high-risk populations like pregnant women and young children [15]. These programs aim to improve antenatal care services, provide essential supplies and medications, and provide nutritional support. Financing mechanisms include health budget allocation, public-private partnerships, and monitoring and evaluation. International collaborations and support include the World Health Organization (WHO), the Global Fund to Fight AIDS, Tuberculosis, and Malaria, regional and bilateral partnerships, and NGOs and international foundations. These organizations provide funding, research, and field programs, raise awareness, and support research and development of new malaria tools. Technical assistance and capacity building are also provided by international partners to strengthen local health systems and improve healthcare delivery. By aligning policies with global recommendations, investing in targeted programs, and leveraging international support, countries can enhance their malaria control efforts and improve health outcomes for pregnant women and their infants.

Innovative Technologies and Approaches

Mobile Health (mHealth) applications are being used to provide pregnant women with information on malaria prevention, antenatal care, and health tips. These apps offer personalized guidance on malaria prevention strategies, such as the use of insecticide-treated nets (ITNs) and the importance of intermittent preventive treatment (IPTp). Telemedicine and remote consultations are also available, allowing pregnant women to receive medical advice, diagnosis, and treatment recommendations from a distance [16]. mHealth technologies can collect and track health data, improving healthcare delivery. Community engagement and support are also being supported through health campaigns and social media. New preventive and therapeutic tools are being developed, including novel antimalarial drugs, combination therapies, enhanced diagnostic tools, and innovative preventive tools like long-lasting insecticidal nets (LLINs) and indoor residual spray (IRS) innovations. Research on malaria vaccines is ongoing, with the RTS,S/AS01 vaccine receiving WHO recommendation for use in children in malaria-endemic areas [20-22]. Vaccine delivery systems are being explored, and new methods for vaccine delivery are being explored. Emerging preventive measures include genetic and biological approaches, environmental management, behavior change interventions, and community health worker programs. These innovations contribute to more effective and accessible malaria control strategies, ultimately improving health outcomes and reducing the burden of malaria [17].

Cultural and Socioeconomic Factors

Cultural and socioeconomic factors significantly influence malaria prevention practices and health outcomes for pregnant women. Traditional medicine and herbal remedies, perceptions of malaria, gender norms, and health behaviors can influence these practices. Economic status, nutritional status, education, awareness, and living conditions also contribute to the risk of malaria. Poor living conditions, such as inadequate housing and sanitation, can increase exposure to mosquitoes and exacerbate malaria transmission. Socioeconomic factors also affect the availability and affordability of preventive measures, such as ITNs and medications. Inadequate waste management and standing water can create breeding sites for mosquitoes, exacerbating malaria transmission. Limited resources can hinder access to these essential tools [4]. To address these barriers, strategies include cultural sensitivity and engagement, targeted awareness campaigns, training community health workers, economic support and accessibility, improving living conditions, and policy and advocacy. Community involvement, culturally appropriate education, targeted awareness campaigns, economic support, and environmental management can help bridge gaps in knowledge and promote effective malaria prevention practices. Inclusive policies and health equity advocacy can also help reduce socioeconomic disparities in malaria prevention and treatment.

Monitoring and Evaluation

Monitoring and evaluation are crucial for assessing the effectiveness of malaria prevention programs, such as insecticide-treated nets (ITNs), intermittent preventive treatment (IPTp), and other interventions. These processes ensure accountability and transparency in resource allocation, fostering trust among stakeholders and donors [2]. Regular monitoring helps identify challenges and gaps in program implementation, allowing for timely adjustments and improvements. Evidence-based decisions are made by generating data on program

performance and outcomes, which can guide future interventions, resource allocation, and strategic planning. Key indicators for assessing program effectiveness include coverage, health outcomes, implementation, service delivery, behavioral and knowledge indicators, and community involvement. Successful programs often involve local stakeholders in the design and implementation of interventions, ensuring cultural appropriateness and addressing local needs. Integrating malaria prevention measures with existing maternal and child health services enhances program effectiveness [12-16]. Data-driven decision-making is used to refine interventions, allocate resources effectively, and measure impact. Addressing barriers to access and utilization is critical for program success, such as subsidizing ITN costs, improving healthcare infrastructure, and providing transportation support. Tailored interventions to address specific barriers faced by pregnant women improve program effectiveness. Sustainability and scalability are also essential components of effective malaria prevention programs. By assessing program effectiveness through key indicators, learning from successful initiatives, and addressing challenges, stakeholders can improve malaria prevention efforts, enhance health outcomes, and ultimately reduce the burden of malaria [7].

CONCLUSION

Malaria during pregnancy poses a significant threat to maternal and fetal health, especially in sub-Saharan Africa. Despite advancements in interventions like insecticide-treated nets (ITNs), intermittent preventive treatment (IPTp), preventive chemotherapy, and health education, several barriers persist. The integration of ITNs and IPTp into routine antenatal care has proven effective in reducing malaria incidence and associated complications. However, addressing barriers to their use, such as cultural beliefs, accessibility issues, and economic constraints, remains crucial. Preventive chemotherapy faces challenges related to adherence and drug resistance, necessitating ongoing efforts in education and healthcare access. Health education and awareness programs empower pregnant women to engage in preventive practices and seek timely medical care. Early diagnosis and prompt treatment are critical for preventing severe outcomes and improving health outcomes for both mothers and infants. Environmental and vector control measures, including indoor residual spraying and larval source management, are essential for reducing mosquito populations and malaria transmission. Nutritional support enhances the immune response and overall health of pregnant women, complementing malaria prevention efforts. Access to healthcare services, supported by effective policies and government initiatives, is vital for ensuring preventive measures and treatments reach those in need. Continuous monitoring and evaluation are key to refining interventions and overcoming challenges.

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