

Impact of the Roll Back Malaria Programme on the Knowledge of Malaria among Pregnant Women in Kaduna State, Nigeria

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Abstract

Malaria remains a leading cause of maternal and neonatal morbidity and mortality in Nigeria, disproportionately affecting pregnant women. The Roll Back Malaria (RBM) programme, a global initiative to reduce malaria incidence, aims to improve malaria knowledge and preventive practices among high-risk groups, including pregnant women. This study investigates the impact of the RBM programme on malaria knowledge and prevention behaviours among pregnant women in Kaduna State, Nigeria. A cross-sectional survey was conducted with 300 pregnant women attending antenatal clinics across five public health facilities in the state. Participants' knowledge of malaria transmission, symptoms, and prevention practices was assessed and analysed based on their exposure to RBM educational interventions. Results indicate that RBM-exposed women demonstrated significantly higher knowledge of malaria transmission (87%) and symptoms (77%) compared to unexposed women (62% and 57%, respectively). Moreover, ITN usage was considerably higher among the RBM-exposed group (92%) versus the unexposed group (68%), underscoring the programme's effectiveness in promoting protective behaviours. Statistical analysis showed a significant association between RBM exposure and increased malaria knowledge ($\chi^2 = 14.56, p < 0.001$). These findings suggest that RBM programme exposure positively impacts malaria awareness and preventive practices among pregnant women, reducing their risk of malaria infection. To enhance malaria prevention, we recommend expanding RBM outreach, integrating malaria education into routine antenatal care, and implementing community-based education campaigns. These strategies could improve maternal health outcomes and further reduce malaria's burden on vulnerable populations in malaria-endemic regions.

Keywords: Kaduna State, Knowledge, Nigeria, Prevention, Pregnant Women, Roll Back Malaria

INTRODUCTION

Malaria remains a significant global health challenge, particularly in sub-Saharan Africa, where it contributes substantially to morbidity and mortality rates. As one of the highest-burden countries, Nigeria accounts for approximately 25% of global malaria cases and deaths, making malaria a pressing public health issue (World Health Organization [WHO], 2021) [1]. Among the population groups

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affected by malaria, pregnant women are especially vulnerable due to the immunological and physiological changes that occur during pregnancy, increasing their susceptibility to infection (Desai, Hill, & Kachur, 2020; Onoka, Hanson, & Mills, 2016) [2,3]. Malaria in pregnancy is associated with a range of adverse outcomes, such as severe anaemia, miscarriage, low birth weight, and neonatal death, thus posing a significant threat to maternal and child health (Van Eijk, Hill, & Alegana, 2019) [4].

Recognizing the urgency to address malaria's impact, the Roll Back Malaria (RBM) programme

was launched in 1998 as a global partnership aimed at reducing malaria incidence and mortality through coordinated action and advocacy. RBM's collaborative framework includes organizations like WHO, UNICEF, UNDP, and the World Bank, all working towards a shared goal of reducing malaria to manageable levels worldwide (RBM Partnership to End Malaria, 2020) [5]. The programme's main objectives focus on malaria prevention, effective diagnosis and treatment, distribution of Insecticide-Treated Nets (ITNs), and raising awareness about malaria transmission and prevention strategies (National Malaria Control Programme [NMCP], 2018) [6]. In Nigeria, RBM has implemented targeted interventions to increase malaria awareness, particularly among high-risk groups, including pregnant women.

In Kaduna State, where malaria transmission is endemic and year-round, the RBM programme has taken a prominent role in malaria prevention efforts, specifically through educational campaigns. Pregnant women, as a focus of these campaigns, are provided with information about malaria transmission, symptoms, and prevention strategies, including the use of ITNs, Intermittent Preventive Treatment Pregnancy (IPTp), and prompt treatment-seeking behaviours. By prioritizing education and outreach, RBM aims to empower pregnant women with the knowledge needed to protect themselves and their unborn children from malaria.

Despite extensive RBM efforts in Kaduna State, the effectiveness of these interventions in enhancing malaria knowledge among pregnant women has been under-examined. Knowledge is a critical determinant of health behaviours, and an informed population is more likely to adopt preventive practices, seek timely treatment, and participate in malaria control efforts (Aina, Adetayo, & Abiola, 2018) [7]. Evaluating the influence of the RBM programme on pregnant women's knowledge of malaria is essential to understanding the reach and impact of these interventions. Such an evaluation can also provide insights into areas where RBM initiatives could be strengthened or adjusted to achieve better health outcomes.

This study, therefore, aims to bridge the knowledge gap by investigating how exposure to the RBM programme influences the knowledge of malaria transmission, prevention, and treatment among pregnant women in Kaduna State, Nigeria. The findings could offer critical insights for policymakers, health practitioners, and stakeholders in designing more effective malaria education and prevention strategies, ultimately contributing to the broader goal of reducing malaria's impact on maternal and child health.

Literature Review

Impact of Malaria in Pregnancy

Malaria in pregnancy is a major cause of maternal and neonatal morbidity and mortality in malaria-endemic regions, with sub-Saharan Africa carrying a significant burden. Pregnant women experience a unique vulnerability to malaria due to immunological shifts and increased physiological demands during pregnancy, which can exacerbate the risks associated with malaria infection (Van Eijk et al., 2019) [4]. Studies indicate that malaria infection during pregnancy often leads to severe maternal anaemia, placental malaria, preterm birth, and intrauterine growth restriction, collectively increasing the risks of prenatal mortality and low birth weight (Desai et al., 2020) [2]. According to a 2021 WHO report, malaria-related complications during pregnancy account for up to 10,000 maternal deaths and 200,000 infant deaths globally each year, with Nigeria contributing a substantial proportion of these cases (WHO, 2021) [1]. These findings highlight the critical need for targeted malaria interventions to protect pregnant women and their newborns from these adverse health outcomes.

Roll Back Malaria Programme Objectives and Strategies

The Roll Back Malaria (RBM) programme, established in 1998, has sought to alleviate malaria's global burden through collaborative efforts that emphasize prevention, diagnosis, and treatment. The programme's primary goals include reducing malaria incidence and mortality by promoting community-based malaria interventions, such as insecticide-treated net (ITN) distribution, intermittent preventive treatment in pregnancy (IPTp), and early diagnostic and treatment services (RBM

Partnership to End Malaria, 2020) [5]. In Nigeria, the National Malaria Control Programme (NMCP) works in partnership with RBM to implement national malaria strategies, including extensive health education campaigns, the distribution of ITNs, and IPTp services through antenatal clinics. The NMCP specifically aims to educate high-risk populations, such as pregnant women, to foster greater malaria awareness and encourage preventive practices (NMCP, 2018)[6]. However, while these efforts are intended to reach all pregnant women, their effectiveness may vary based on regional factors such as healthcare access, socio-economic disparities, and cultural attitudes towards malaria prevention.

RBM Programme's Impact on Malaria Knowledge and Practices among Pregnant Women

The success of malaria prevention strategies largely hinges on knowledge dissemination and behavioral change, particularly in at-risk groups like pregnant women. Research on malaria interventions in sub-Saharan Africa indicates that malaria knowledge directly influences health behaviours, including the use of ITNs and early treatment-seeking (Aina et al., 2018) [7]. A systematic review by Hill, Hoyt, Van Eijk., D'Mello-Guruge, TerKuile., and Steketee, (2014) revealed that educational interventions aimed at increasing malaria awareness among pregnant women significantly improved ITN usage and IPTp adherence [56]. Furthermore, findings from several Nigerian studies suggest that when women receive targeted education about malaria transmission, symptoms, and prevention, they are more likely to adopt protective measures such as ITNs and IPTp (Akaba, Agida, Onafowokan, & Ogu, 2018; Okafor, & Amadi, 2018) [89]. This is particularly relevant in Kaduna State, where malaria remains endemic, and where knowledge gaps regarding malaria prevention have historically contributed to underutilization of preventive measures.

Nevertheless, while the RBM programme has made significant strides in promoting malaria education, challenges remain. A study by Oladimeji, Tsoka-Gwegweni, and Adebisi, (2019) [10] in Southwest Nigeria found that although ITN ownership rates were high, consistent usage was lower, suggesting that awareness does not always translate to practice. Similarly, factors such as socio-economic barriers, cultural beliefs, and accessibility of healthcare services can influence the extent to which knowledge translates into action. This underscores the importance of assessing not only the knowledge gained through RBM initiatives but also the behavioural and contextual factors that affect the adoption of preventive practices.

Gaps in Literature on RBM Impact in Kaduna State

While the RBM programme has been widely implemented across Nigeria, research specifically evaluating its impact on malaria knowledge among pregnant women in Kaduna State is limited. Most studies on malaria knowledge and prevention focus on Nigeria's South-western regions, creating a knowledge gap regarding the effectiveness of RBM interventions in northern states like Kaduna. Additionally, existing research tends to focus on general awareness, with few studies examining the depth of knowledge about malaria transmission, symptoms, and specific preventive practices (Oladimeji et al., 2019; Yaya, Uthman, Kunnuji, & Bishwajit, 2018) [1011]. Understanding these knowledge nuances is essential, as knowledge gaps may directly impact adherence to malaria preventive measures.

This study thus seeks to address this gap by examining how the RBM programme has influenced malaria knowledge among pregnant women in Kaduna State. By focusing on transmission knowledge, symptom recognition, and preventive practices, this research will provide insights into the RBM programme's effectiveness in one of Nigeria's high-burden states. Such findings could inform policymakers, healthcare providers, and the NMCP in refining malaria prevention and education strategies for better health outcomes among pregnant women.

Methodology

This study employs a cross-sectional survey design to assess the influence of the Roll Back Malaria (RBM) programme on malaria knowledge among pregnant women in Kaduna State, Nigeria. The cross-

sectional design allows for capturing a snapshot of the knowledge, attitudes, and behaviours of pregnant women at a single point in time, providing valuable insights into the impact of RBM education and interventions.

Study Area and Population

The study was conducted in Kaduna State, a region in northern Nigeria with a high incidence of malaria. Kaduna's population is predominantly rural, with limited access to healthcare services, which underscores the importance of community-level health education and intervention programs like RBM. The study population consisted of pregnant women aged 18 and above attending antenatal care (ANC) services in five selected public health facilities across Kaduna State. The inclusion criteria required participants to be in their first, second, or third trimester of pregnancy, currently attending ANC services, and to have had some level of exposure to RBM initiatives, either through formal health education sessions or community outreach programs.

Sampling Method

To ensure a representative sample, the study used multistage sampling. The sampling procedure involved two main stages

Stage 1: Selection of Health Facilities

Kaduna State is divided into multiple administrative zones. Five public health facilities were purposively selected across different zones within Kaduna State to capture a diverse range of socio-demographic characteristics and exposure levels to the RBM programme. The selection of these health facilities was based on factors such as malaria prevalence rates, population density, and the presence of RBM-supported programs.

Stage 2: Selection of Participants

Within each health facility, systematic random sampling was used to select pregnant women attending ANC services. A sampling interval was determined by dividing the total number of women attending ANC on a typical day by the target sample size for each facility. The first participant was chosen randomly, and subsequent participants were selected at regular intervals (e.g., every third person) until the desired sample size was reached.

The final sample size was calculated using Cochran's formula for sample size estimation for population proportions, yielding a target of 300 participants. This sample size ensures adequate statistical power to detect significant associations between RBM exposure and malaria knowledge.

Data Collection

Data were collected through structured questionnaires administered by trained research assistants. The questionnaire was developed based on existing malaria knowledge assessments and RBM programme materials, ensuring it covered all key areas of malaria knowledge and preventive practices. The questionnaire was divided into four sections

Section A: Socio-Demographic Information

This section collected data on participants' age, educational level, marital status, occupation, parity (number of children), and trimester. This socio-demographic information was essential for understanding the background of the participants and identifying any socio-demographic factors that might influence malaria knowledge and practices.

Section B: Knowledge of Malaria Transmission

This section assessed participants' understanding of malaria transmission, including questions on the causes of malaria (e.g., mosquito bites), common misconceptions (e.g., malaria caused by bad air), and the importance of preventing mosquito bites.

Section C: Knowledge of Malaria Symptoms and Treatment

Participants were asked to identify symptoms of malaria, such as fever, chills, and body aches, and to indicate their knowledge of treatment-seeking behaviours. This section also included questions on the importance of early treatment and awareness of available malaria treatment services.

Section D: Malaria Prevention Practices

This section evaluated participants' knowledge and use of preventive measures, including the use of insecticide-treated nets (ITNs), intermittent preventive treatment in pregnancy (IPTp), and environmental control measures (e.g., clearing stagnant water and maintaining clean surroundings).

The questionnaire was pilot-tested with a sample of 20 pregnant women at a non-participating health facility to identify any ambiguities or issues in comprehension. Feedback from the pilot test was used to refine and adjust the questionnaire. The revised questionnaire showed a reliability coefficient (Cronbach's alpha) of 0.95, indicating acceptable internal consistency.

Data Collection Procedure

Data collection was conducted over a four-week period, with research assistants visiting each health facility on scheduled ANC days to administer the questionnaire. Before participation, all women received a verbal explanation of the study's purpose, procedures, and confidentiality assurances. Written informed consent was obtained from each participant prior to data collection. For participants with limited literacy, research assistants read the questions aloud and recorded the responses.

Data Analysis

The collected data were entered into SPSS (Statistical Package for the Social Sciences), version 25.0, for analysis. Data cleaning was conducted to address any missing values or inconsistencies. The analysis proceeded in the following stages

Descriptive Statistics

Descriptive statistics, including frequencies, percentages, means, and standard deviations, were used to summarize the socio-demographic characteristics of the sample, as well as participants' knowledge levels in each section (transmission, symptoms, prevention).

Inferential Statistics

Chi-square tests were applied to examine associations between socio-demographic variables (e.g., educational level) and malaria knowledge outcomes. Additionally, logistic regression analysis was conducted to assess the influence of RBM programme exposure on malaria knowledge while controlling for potential confounders, such as age, education, and parity.

Knowledge Scoring

To quantify malaria knowledge, a scoring system was developed. Correct responses were assigned one point, while incorrect or "don't know" responses received zero points. Scores were summed to create an overall knowledge score for each participant. Based on these scores, participants were categorized into three knowledge levels: low (0–5 points), moderate (6–10 points), and high (11–15 points). This scoring enabled a quantitative assessment of the extent to which RBM exposure influenced malaria knowledge among the participants.

Ethical Considerations

Ethical approval for the study was obtained from the Kaduna State Ministry of Health. All procedures complied with ethical standards, ensuring that participants' confidentiality, privacy, and autonomy were maintained. Participation was voluntary, and participants could withdraw from the study at any time without consequences. Data were anonymized to protect participants' identities, and all collected data were securely stored.

Limitations of the Study

This study has several limitations. Firstly, as a cross-sectional design, it captures a single point in time and thus cannot establish causality between RBM exposure and malaria knowledge. Additionally, self-reported data on malaria knowledge and preventive practices may be subject to recall bias or social desirability bias, as participants may provide responses they believe are socially acceptable. Finally, the study is limited to pregnant women attending ANC services, potentially excluding pregnant women in the community who do not have access to ANC care.

Results

The results are presented in three main sections: demographic characteristics of the participants, levels of malaria knowledge (transmission, symptoms, and prevention practices), and inferential analysis examining the association between RBM programme exposure and malaria knowledge.

Demographic Characteristics of Participants

Table 1 summarizes the socio-demographic characteristics of the 300 pregnant women who participated in the study. The mean age of participants was 28.5 years (SD = 5.3), with ages ranging from 18 to 42 years. The majority of participants were in their second or third trimester (70%) and had at least primary school education (80%).

Demographic Variable	Frequency (n = 300)	Percentage (%)
Age Group (years)		
18–24	82	27.3
25–34	150	50.0
35 and above	68	22.7
Trimester		
First	60	20.0
Second	110	36.7
Third	130	43.3
Educational Level		
No formal education	30	10.0
Primary	90	30.0
Secondary	120	40.0
Higher	60	20.0
Marital Status		
Married	270	90.0
Single/Other	30	10.0

Table 1. Demographic Characteristics of Participants

Source: Field Survey (2024)

Malaria Knowledge Levels

Participants' knowledge of malaria transmission, symptoms, and prevention practices was assessed and categorized into low, moderate, and high knowledge levels.

Knowledge of Malaria Transmission

Table 2 presents the distribution of participants' knowledge regarding malaria transmission. A large proportion of women (87%) exposed to the RBM programme correctly identified mosquito bites as the primary transmission mode, while only 62% of those unexposed were able to do so.

Knowledge of Transmission	RBM Exposed (n = 180)	RBM Unexposed (n = 120)	Total (n = 300)
Correct (mosquito bites)	156 (87%)	74 (62%)	230 (76.7%)
Incorrect	24 (13%)	46 (38%)	70 (23.3%)

Table 2. Knowledge of Malaria Transmission among Participants.

Source: Field Survey (2024)

Knowledge of Malaria Symptoms

Table 3 shows participants' knowledge of malaria symptoms. The RBM-exposed group had higher recognition of fever, chills, and body aches as symptoms of malaria compared to the unexposed group.

Knowledge of Symptoms	RBM Exposed (n = 180)	RBM Unexposed (n = 120)	Total (n = 300)
High	138 (77%)	68 (57%)	206 (68.7%)
Moderate	32 (18%)	36 (30%)	68 (22.7%)
Low	10 (5%)	16 (13%)	26 (8.7%)

Table 3. Knowledge of Malaria Symptoms among Participants

Source: Field Survey (2024)

Knowledge of Malaria Prevention Practices

Participants' knowledge and reported use of malaria preventive practices, such as ITN use and environmental control measures, are presented in Table 4. Among RBM-exposed women, 92% reported using ITNs compared to 68% of unexposed women.

Prevention Practices	RBM Exposed (n = 180)	RBM Unexposed (n = 120)	Total (n = 300)
ITN use	166 (92%)	82 (68%)	248 (82.7%)
IPTp knowledge	150 (83%)	72 (60%)	222 (74.0%)
Environmental control	140 (78%)	66 (55%)	206 (68.7%)

Table 4. Knowledge and Use of Malaria Prevention Practices among Participants

Source: Field Survey (2024)

Inferential Analysis of RBM Exposure and Malaria Knowledge

Chi-square tests were conducted to examine associations between RBM programme exposure and malaria knowledge levels. Results indicate a statistically significant association between RBM exposure and high levels of knowledge about malaria transmission, symptoms, and prevention practices ($p < 0.05$).

Association between RBM Exposure and Overall Malaria Knowledge Level

Table 5 shows the association between RBM exposure and overall malaria knowledge level. Participants exposed to RBM programmes were more likely to have high malaria knowledge compared to those who were not exposed.

Knowledge Level	RBM Exposed (n = 180)	RBM Unexposed (n = 120)	Chi-square (χ^2)	p-value
High Knowledge	142 (79%)	58 (48%)	14.56	0.001
Moderate	30 (17%)	42 (35%)		
Low	8 (4%)	20 (17%)		

Table 5. Association between RBM Exposure and Overall Malaria Knowledge Level.

Source: Field Survey (2024)

These findings indicate that RBM programme exposure significantly influences malaria knowledge among pregnant women in Kaduna State. Women exposed to RBM educational interventions showed higher levels of knowledge regarding malaria transmission, symptoms, and prevention practices, supporting the hypothesis that RBM exposure enhances malaria-related knowledge.

Discussion

The findings of this study demonstrate a significant positive association between the Roll Back Malaria (RBM) programme and enhanced malaria knowledge among pregnant women in Kaduna State, Nigeria. The results suggest that pregnant women exposed to the RBM programme exhibited higher

levels of knowledge about malaria transmission, symptoms, and prevention practices compared to their unexposed counterparts. These findings align with existing literature that emphasizes the importance of health education programs, particularly for high-risk groups like pregnant women, in malaria-endemic regions (Aina et al., 2018; van Eijk et al., 2019) [7, 4].

Malaria Transmission Knowledge

The study found that 87% of RBM-exposed women correctly identified mosquito bites as the primary mode of malaria transmission, compared to 62% among unexposed participants (Table 2). This difference suggests that RBM education initiatives play a critical role in dispelling common misconceptions about malaria transmission. Prior studies have reported similar results; for example, Akaba et al. (2018) [8] found that targeted malaria education increased accurate knowledge of malaria transmission among pregnant women in similar settings. This improvement in knowledge is particularly important, as awareness of the correct transmission mode influences preventive behavior, such as ITN use, which is essential in reducing malaria incidence (Hill et al., 2014) [12].

Knowledge of Malaria Symptoms

Knowledge of malaria symptoms was significantly higher among RBM-exposed participants, with 77% exhibiting a high level of symptom awareness, compared to 57% in the unexposed group (Table 3). Symptom recognition is crucial, as it facilitates prompt treatment-seeking behaviour, which reduces malaria-related complications for both mother and child (Desai et al., 2020) [2]. The RBM programme appears effective in raising awareness of symptoms such as fever, chills, and body aches, which may encourage early healthcare visits and help reduce severe malaria cases among pregnant women in Kaduna State. These findings are consistent with other studies suggesting that symptom awareness is a direct benefit of targeted health education (Oladimeji et al., 2019) [10].

Knowledge and Use of Malaria Prevention Practices

The findings showed that 92% of RBM-exposed women reported using insecticide-treated nets (ITNs), compared to only 68% of unexposed women (Table 4). This high level of ITN usage among RBM-exposed women underscores the effectiveness of RBM's emphasis on preventive practices, especially in high-risk groups. The observed usage rates among RBM-exposed women are consistent with findings by Hill et al. (2014) [12], which highlight the success of ITN promotion as a malaria prevention strategy. Additionally, the higher knowledge of intermittent preventive treatment in pregnancy (IPTp) and environmental control practices among the exposed group aligns with the RBM programme's goal of integrating multiple preventive strategies for malaria control.

The increased usage of ITNs and awareness of IPTp among RBM-exposed women suggest that the programme effectively encourages the adoption of protective behaviours. However, the gap in ITN usage between exposed and unexposed women highlights a need for expanded RBM outreach to increase preventive practices among all pregnant women, particularly those with limited programme exposure.

Overall Malaria Knowledge and RBM Discussion

The findings of this study demonstrate a significant positive association between the Roll Back Malaria (RBM) programme and enhanced malaria knowledge among pregnant women in Kaduna State, Nigeria. The results suggest that pregnant women exposed to the RBM programme exhibited higher levels of knowledge about malaria transmission, symptoms, and prevention practices compared to their unexposed counterparts. These findings align with existing literature that emphasizes the importance of health education programs, particularly for high-risk groups like pregnant women, in malaria-endemic regions (Aina et al., 2018; van Eijk et al., 2019) [7,4].

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Programme Exposure

The overall malaria knowledge scores indicated that 79% of RBM-exposed participants had high knowledge levels, while only 48% of unexposed participants reached this level (Table 5). This significant difference suggests that RBM exposure substantially contributes to higher malaria knowledge, aligning with research that links targeted health interventions to improved disease knowledge and health-seeking behaviours (Aina et al., 2018) [7]. These findings are particularly relevant in the context of Kaduna State, where high malaria transmission rates necessitate extensive awareness and prevention efforts.

The significant chi-square value ($\chi^2 = 14.56$, $p < 0.001$) confirms the positive impact of RBM exposure on malaria knowledge. This is consistent with other research findings in sub-Saharan Africa, which indicate that health education programs are crucial in promoting knowledge and behavioural change among high-risk populations (Oladimeji et al., 2019) [10]. The RBM programme's apparent effectiveness in Kaduna State implies that similar community-based interventions could benefit other malaria-endemic regions within Nigeria.

Implications for Policy and Practice

These findings have several practical implications for policymakers, healthcare providers, and public health practitioners. First, they underscore the need for sustained malaria education efforts targeting

pregnant women. Knowledge alone does not always translate to behavior change, yet this study shows that RBM exposure significantly increased both knowledge and the adoptions of preventive practices, particularly ITN use and symptom recognition. Consequently, there is a need to expand RBM education programs across Kaduna State and beyond to reach more pregnant women, including those in rural and underserved areas. Such expansion could include community-based education campaigns, increased ITN distribution, and better access to IPTp in antenatal care services [10].

Furthermore, the study's findings support integrating malaria education into routine antenatal care services. Since healthcare facilities serve as primary points of contact for pregnant women, integrating malaria education into these services could ensure broader and more consistent coverage of malaria prevention information. Additionally, since knowledge gaps and cultural beliefs sometimes affect malaria prevention behaviors, local healthcare providers should consider culturally tailored education strategies that address common misconceptions and promote community involvement [11].

Limitations and Future Research

While this study provides valuable insights, several limitations should be noted. First, as a cross-sectional study, it captures data at one point in time, making it difficult to infer causality between RBM exposure and malaria knowledge. Longitudinal studies would be beneficial in establishing a causal link and assessing the long-term effects of RBM exposure on knowledge retention and health outcomes among pregnant women.

Secondly, the reliance on self-reported data for knowledge and ITN usage may introduce social desirability or recall bias, as participants may over report desirable behaviours. Future studies could benefit from including objective measures, such as physical verification of ITN usage, to validate self-reported data. Additionally, this study was limited to pregnant women attending ANC services, potentially excluding women who do not have access to ANC care. Expanding future research to include community-based surveys may provide a more comprehensive understanding of malaria knowledge among all pregnant women in Kaduna State [1].

CONCLUSION

The Roll Back Malaria programme has had a substantial positive impact on malaria knowledge and preventive behaviors among pregnant women in Kaduna State, Nigeria. RBM-exposed women demonstrated higher levels of knowledge regarding malaria transmission, symptoms, and prevention practices, suggesting that RBM's educational efforts effectively promote malaria awareness and protective behaviour adoption. These findings reinforce the importance of malaria education programs, particularly for vulnerable populations, as a means of reducing malaria incidence and mortality. Expanding RBM programme efforts to reach more pregnant women could further improve malaria prevention and contribute to better maternal and child health outcomes in malaria-endemic regions.

Recommendations

The findings from this study provide several actionable recommendations for policymakers, healthcare providers, and public health organizations working to reduce malaria prevalence and improve maternal health in Kaduna State, Nigeria.

Expand Roll Back Malaria Programme Outreach to Underserved Areas

The study revealed a significant difference in malaria knowledge between pregnant women who were exposed to the Roll Back Malaria (RBM) programme and those who were not. Expanding RBM outreach to underserved rural and peri-urban areas could bridge this gap and increase access to malaria education for women who may not regularly attend antenatal care (ANC) services. Mobile health units, community health workers, and local partnerships could be leveraged to reach these populations.

Integrate Malaria Education into Routine Antenatal Care Services

Given that antenatal care is a primary point of contact for pregnant women, integrating malaria education more thoroughly into routine ANC services could ensure consistent messaging and reach a

larger proportion of pregnant women. This integration should emphasize malaria transmission, symptom recognition, and the use of insecticide-treated nets (ITNs) and intermittent preventive treatment in pregnancy (IPTp). ANC providers should be trained to deliver malaria education in a culturally sensitive manner, using local languages and addressing common misconceptions.

Enhance ITN Distribution and Follow-Up Initiatives

Although ITN usage was higher among RBM-exposed women, the overall usage could be improved. The RBM programme should enhance ITN distribution efforts and conduct follow-ups to ensure that ITNs are being used consistently and correctly. Community health workers and peer educators could play a role in demonstrating the correct use and maintenance of ITNs to reduce non-compliance and encourage ongoing usage.

Promote Community-Based Malaria Education Campaigns

Community-based education campaigns could complement the RBM programme's efforts and help to foster a supportive environment for malaria prevention. These campaigns can include information sessions, group discussions, and visual aids that educate pregnant women and their families about malaria prevention. Involving community leaders and influencers can also enhance the credibility and reach of these campaigns, helping to address cultural beliefs or misconceptions that may hinder the adoption of preventive behaviours.

Encourage Early Symptom Recognition and Prompt Treatment-Seeking

The study found that RBM-exposed women had a higher awareness of malaria symptoms, which is essential for prompt treatment-seeking behavior. Educational campaigns should emphasize the importance of recognizing early malaria symptoms and seeking treatment immediately. ANC clinics should provide pregnant women with resources, such as symptom checklists or informational brochures, and clearly communicate where to seek treatment if symptoms arise.

Strengthen Monitoring and Evaluation of the RBM Programme

To ensure the continued effectiveness of the RBM programme, a robust monitoring and evaluation framework should be implemented. Regular assessments of malaria knowledge and preventive behaviors among pregnant women can help identify gaps in the programme's outreach and effectiveness. Additionally, data collected from these evaluations can be used to refine RBM strategies, tailor interventions to specific community needs, and scale successful initiatives to other high-burden regions.

Encourage Cross-Sector Collaboration for Sustainable Malaria Prevention

Sustainable malaria prevention requires coordinated efforts from multiple sectors, including healthcare, education, and local government. Collaboration between these sectors could strengthen malaria prevention efforts, facilitate resource sharing, and improve access to malaria education and prevention tools for pregnant women. For instance, partnerships with local schools, community centers, and non-governmental organizations could increase malaria awareness in the broader community, further supporting maternal health initiatives.

Implement Culturally Tailored Educational Materials

Cultural beliefs and misconceptions about malaria can affect preventive behaviours. Educational materials should be tailored to local languages, cultural contexts, and literacy levels to ensure that messages resonate with the target audience. Visual aids, stories, and analogies familiar to the local population can make malaria information more relatable and understandable, potentially increasing the likelihood of behavior change.

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