GENDER AND VECTOR-BORNE DISEASE CONTROL: THE TRANSFORMATIVE ROLE OF WOMEN IN COMBATTING MALARIA AND DENGUE

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Vector-borne diseases (VBDs) such as malaria and dengue continue to pose significant public health challenges globally, especially in low- and middle-income countries. Women, as primary caregivers and key members of communities, play an essential yet underrecognized role in preventing and controlling VBDs. Their involvement spans from household water management and sanitation to participation in national health programs and grassroots mobilization. However, their roles are often informal, constrained by gender norms, and inadequately supported by public health policy. This review analyses peer-reviewed studies, program evaluations, and data from WHO, Global Fund, and National Vector-Borne Disease Control Program sources to explore women's roles in malaria and dengue control. Empirical evidence from India and the Global South was synthesized to identify patterns

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of female participation, barriers, and enablers. Evidence suggests that women play a central role in controlling mosquito breeding through daily domestic activities, including covering water containers, waste disposal, and environmental sanitation. ASHAs (Accredited Social Health Activists), Self-Help Group (SHG) members, midwives, and brigadistas play active roles in community-based interventions. Yet, they face systemic challenges, including limited training, exclusion from decision-making processes, and a lack of formal recognition. Successful interventions—such as eco-health models in Tamil Nadu and female-led dengue control in Nicaragua—highlight the transformative impact of empowering women in VBD control. Studies also point to gender disparities in healthcare access, particularly in tribal and rural communities, affecting timely malaria diagnosis and treatment. Women are indispensable agents in the fight against malaria and dengue. Integrating gender-sensitive approaches into VBD control programs can enhance effectiveness, promote community ownership, and drive sustainable public health outcomes. Formal recognition of women's contributions, targeted training, and leadership opportunities are critical to strengthening national and global efforts toward VBD elimination. This review calls for transformative approaches that shift unhelpful gender norms and empower women as key agents of change in vector control strategies.

INTRODUCTION

Malaria and dengue are among the most prevalent vector-borne diseases (VBDs), contributing significantly to the global burden of infectious diseases. According to the World Health Organization (WHO), VBDs account for over 17% of all infectious diseases, resulting in more than 700,000 deaths annually (WHO, 2024A). Malaria is a parasitic infection transmitted by *Anopheline* mosquitoes. It causes an estimated 249 million cases globally and results in more than 608,000 deaths each year (WMR, 2024) (WHO, 2024B).

Dengue, the most widespread viral VBD, is transmitted by *Aedes* mosquitoes. According to the World Health Organisation (WHO), the global incidence of dengue has increased dramatically over recent decades (WHO, 2024B). As of April 30, 2024, the WHO reported over 7.6 million dengue cases globally, including more than 3,000 deaths. More than 3.9 billion people in over 132 countries are at risk of contracting dengue, with an estimated 96 million symptomatic cases and

approximately 40,000 deaths reported annually (WHO, 2024C). Other viral VBDs include chikungunya, Zika virus, yellow fever, West Nile fever, and Japanese encephalitis, all transmitted by mosquitoes, as well as tick-borne encephalitis, transmitted by ticks. Many vector-borne diseases are preventable through protective measures and effective community mobilisation.

The World Malaria Report 2024 (WHO, 2024A) indicates a concerning global resurgence in malaria cases, with an estimated 263 million cases and 597,000 deaths in 2023, marking a fifth consecutive year of rising incidence. In contrast, India has made significant strides in malaria control. Between 2017 and 2023, the estimated number of malaria cases in India decreased by 69%, from 6.4 million to 2 million, and deaths fell by 68%, from 11,100 to 3,500. Notably, India exited the WHO's High Burden to High Impact (HBHI) group in 2024, reflecting substantial progress in reducing malaria incidence and mortality.

India's commitment to achieving malaria elimination by 2030 is underpinned by comprehensive strategies outlined in the National Strategic Plan for Malaria Elimination (2023–2027) (NVBDCP, 2027). Thesestrategies include enhanced surveillance through the "test, treat, track" approac,d community-based interventions,ands strengthened quality diagnostics. District-specific strategies, particularly for high-burden, tribal, hard-to-reach, and forested areas, have been instrumental in addressing the unique challenges of these regions.

THE ROLE OF WOMEN IN VECTOR CONTROL IS VITAL TO THE PREVENTION AND MANAGEMENT OF VECTOR-BORNE DISEASES (VBDs) SUCH AS MALARIA AND DENGUE

As primary caregivers within households, women are often at the forefront of managing family health and maintaining environmental hygiene—both of which are critical for reducing mosquito breeding and disease transmission. Their roles as caregivers, community health workers, educators, and mobilizers make them key agents in VBD control strategies. Empowering women with knowledge, skills, and resources not only strengthens household and community resilience but also enhances the overall effectiveness of prevention, diagnosis, and treatment initiatives. This paper reviews the involvement of women in the control of malaria, dengue, and other vector-borne diseases, highlighting their roles and the impact of their participation in global and national efforts to combat these diseases.

METHODS

This review synthesises empirical studies and programmatic reports from India and other regions of the Global South, with a focus on women's roles in malaria and dengue prevention and control. Peer-reviewed literature, program evaluations, and websites from the WHO and NVBDCP were reviewed and analysed to identify patterns in female participation, key barriers, and enabling factors. This review examines the multifaceted contributions of women in VBD control, with a focus on dengue and malaria, drawing on empirical evidence from India and other parts of the Global South.

RESULTS AND DISCUSSION

1. The Role of Women in Malaria Control.

(i) ***Women as Primary Caregivers and Health Advocates:*** Women are often caring for family health, ensuring that children and all members receive good health. They can play a crucial role in keeping their surroundings clean and free from mosquito breeding sites. They may take key decisions regarding healthcare-seeking behaviour, influencing the timely and proper use of long-lasting insecticidal nets (LLINs) and good coverage of indoor residual spraying (IRS). Women can manage the cleanliness of their homes to prevent mosquito breeding and resting, as well as protect their family members from mosquito bites, if they are provided with the appropriate knowledge. If women are empowered, they can also contribute to prevention, early diagnosis and ensuring treatment adherence as advised by health workers.

Targeted health communication with women in households has also proven helpful in improving treatment adherence for malaria, particularly for *Plasmodium vivax* cases. During the 2024 field engagement in Mumbai, surveillance officers, in collaboration with the National Professional Officer (NPO) for Malaria and WHO Country Office (WCO) India, interacted directly with patients diagnosed with *P. vivax*. These interactions aimed to create awareness about the importance of completing the 14-day radical treatment regimen using Primaquine to prevent relapse (Fig. 1). The sessions were particularly focused on reaching female caregivers, who often influence health-related decisions in families. This patient-focused

communication model helps ensure treatment compliance and builds trust within communities, especially when messages are tailored for and delivered to women who manage household health.

Fig. 1. Field interaction with a *P. vivax* patient by Surveillance Officer, BMC and NPO (Malaria), WCO India, to create awareness about the importance of completing radical treatment in Mumbai in May 2024.

(ii) ***Women as Community Health Workers (CHWs), Accredited Social Health Activists (ASHAs), and Midwives:*** Several countries, including Ethiopia, Kenya, and India, have trained women as CHWs to diagnose and treat malaria in rural areas. In India, the National Health Mission (NHM) has mobilized over one million Accredited Social Health Activists (ASHAs) to bridge the gap between communities and public health services.

Fig. 2. ASHAs in Assam learning for the preparation of blood slides for diagnosis of malaria

The word" *ASHA"* means "hope" in Hindi, reflecting its vital role in healthcare delivery. ASHAs were recognized with the WHO Director-General's Global Health Leaders Award at the 75th World Health Assembly in 2022 for their outstanding contributions to public health (WHO, 2022). ASHAs are trained to diagnose malaria using rapid diagnostic tests (RDTs), prepare blood slides (Fig. 2,) and administer antimalarial drugs at the community /village level. They receive incentives for detecting cases and ensuring completion of malaria treatments. In recent years, diagnosis and treatment have improved in India.

National Vector Borne Disease Control Programme, incentives for ASHA (April 2024) for preparing blood slides or testing through RDT are Rs. 15/slide or test, and Rs. 200 per confirmed case for ensuring complete treatment as per the drug regimen. For referring a case and ensuring complete treatment is Rs. 300 (ASHA, 2024). Midwives and Auxiliary Nurse Midwives (ANMs) also play a

crucial role in ensuring that pregnant women receive comprehensive malaria treatment, thereby reducing maternal and neonatal complications. Research supported by the Bill & Melinda *Gates Foundation* has emphasized the importance of community-driven health innovations in malaria control (GATES FOUNDATION, 2025). The foundation has invested in developing new vector control tools, including improved insecticides and insecticide-treated nets (ITNs).

Additionally, the foundation has highlighted the role of women in healthcare, supporting initiatives that train female health workers to enhance access to malaria prevention and treatment. According to ther World Malaria Report 2024, to advance health outcomes for women and society, it is crucial to ensure that health innovations are designed to meet women's specific needs and that they benefit women equitably from these advancements (GATES FOUNDATION, 2025). The Global Fund's initiatives in Africa and Asia demonstrate that training women as community health workers improves access to malaria prevention and treatment, significantly reducing morbidity (GLOBAL FUND, 2024).

2. Women's Role in Dengue Prevention: Opportunities and Barriers.

(i) Global Perspectives: Women's involvement is central to dengue prevention, particularly in low- and middle-income countries where community-based strategies are essential. They are often at the forefront of household-level vector control through tasks such as managing water storage, disposing of waste, cleaning surroundings, and eliminating mosquito breeding sites. However, despite their active participation, structural barriers limit their recognition and leadership in formal dengue control programs.

A qualitative meta-synthesis by Mungall-Baldwin (MUNGALL-BALDWIN, 2022) in 2022 analyzed 18 studies across Latin America, the Caribbean, and Southeast Asia, revealing that women's participation, while widespread, remains neither gender-equitable nor transformative. Although women engage in informal environmental management, they face seven key barriers—including entrenched gender norms, limited decision-making power, and inadequate access to resources—and benefit from six enablers such as local knowledge and strong communication skills. The study underscores the urgent need to address gender biases and institutional gaps to enhance both the effectiveness and inclusivenessinclusive of dengue control efforts.

Similarly, GÓMEZ AND CASTRO (2022) further documented women's contributions to dengue control in Brazil, Nicaragua, and Sri Lanka, highlighting how domestic responsibilities are often extended into public health roles. Their findings show that women leverage their domestic duties for public health benefits, with notable participation in street cleaning, household maintenance, and community mobilization, particularly in urban areas like Fortaleza, Brazil. This active engagement reflects gendered divisions of labour, where women assume responsibility for environmental sanitation and health. The study recommends gender-sensitive public health interventions that formalise and support women's roles in vector control. Their leadership in these initiatives has been instrumental in reducing dengue transmission and improving public health outcomes (GÓMEZ AND CASTRO, 2022).

In Ciudad Sandino from Nicaragua, NADING G (2013) reported that the role of women in dengue prevention is significant. The city's low-paid health workers, known as brigadistas (female health volunteers), are predominantly female, with many being single mothers or heads of households. These women conduct house-to-house visits to raise awareness about dengue prevention and eliminate mosquito breeding sites. Women, often single mothers, were key to maintaining neighbourhood hygiene and ensuring community participation. Their deep understanding of household dynamics and adaptability make them effective in these roles.

These global examples underscore the dual potential of women's participation in dengue control: reducing disease burden and advancing gender equity. To enhance the sustainability and impact of dengue prevention efforts, public health interventions must institutionalize and support women's roles through gender-sensitive strategies and inclusive leadership opportunities.

(ii) Indian Perspective: In India, the involvement of women in dengue prevention and control has been both strategic and impactful. Accredited Social Health Activists (ASHAs) and women's Self-Help Groups (SHGs) have played a central role in mobilizing communities and implementing preventive measures at the grassroots level. ASHAs are trained female community health workers responsible for educating households on vector control practices, distributing Information, Education, and Communication (IEC) materials, and assisting in the identification and elimination of mosquito breeding sites. Their proximity

to the community allows for the effective dissemination of health messages and fosters active participation in dengue prevention efforts.

The National Vector Borne Disease Control Programme (NVBDCP), a flagship initiative of the Government of India, aims to control vector-borne diseases including dengue through integrated vector management, surveillance, early diagnosis, prompt treatment, and community engagement. ASHAs and SHGs play a crucial role in implementing NVBDCP strategies, particularly in underserved and high-risk areas. In several Indian states, ASHAs have conducted house-to-house visits to educate residents about proper water storage practices, encourage the regular cleaning of containers, and eliminate potential breeding sites for mosquitoes. Their contribution not only strengthens program delivery but also enhances community compliance and long-term behavioural change.

ASHAs are also receiving incentives for their dengue work. As mentioned in the document (ASHA, 2024), incentive for ASHA for source reduction & IEC activities for prevention and control of Dengue and Chikungunya,incentive @ Rs. 200/- (1 Rupee per house for maximum 200 houses per month). The time period for involvement of ASHAs may be throughout the year. However, the total amount should not be exceeding Rs. 2400/- per ASHA/year.

Dengue fever remains a significant public health concern in India, particularly in densely populated urban and peri-urban areas where vector breeding is exacerbated by irregular water supply and inadequate sanitation infrastructure. While national, state, and municipal health programs have made commendable strides in vector control, the sustained success of these efforts increasingly depends on the active participation of women, especially at the household level. Women play a pivotal role in managing domestic water storage and maintaining sanitation, both of which are closely linked to preventing mosquito breeding. Although women are well-represented in leadership roles,roles but the engagement of household women remains underutilized. Strengthening their involvement is essential for translating policy into effective grassroots action.

Evidence from India supports this approach. KUMARI ET AL. (2016) reported that the highest densities of *Aedes aegypti* larvae in Delhi were found in plastic drums and cemented tanks used for water storage, again linked to irregular supply. Their findings emphasized the importance of educating women about proper

container management and preventive actions like covering containers with mesh or cloth to stop mosquito breeding (KUMARI ET AL., 2016). In an earlier study, KUMARI AND COWORKERS (2011) found that *Aedes albopictus*, a secondary dengue vector, had also adapted to breed in man-made containers in urban areas, reinforcing the need for sustained household-level water management strategies (KUMARI ET AL., 2011).

During a 2024 field visit to the Greater Mumbai Municipal Corporation, it was also observed that *Aedes aegypti,* the primary vector for dengue, commonly breeds in household water storage containers such as plastic drums, buckets, and cans. This issue is particularly pronounced in informal settlements where the piped water supply is irregular, compelling families to store water for daily use. In these settings, household containers are often left uncovered, creating ideal habitats for mosquito breeding. Public health teams demonstrated simple interventions, such as covering water containers with cloth (Fig. 3), as an effective method to prevent mosquito access and reduce larval habitats. Such interventions are efficient for women to implement, given their central role in managing household water.

Community-based approaches involving women have proven to be highly effective in dengue control. In Tamil Nadu, women's Self-Help Groups (SHGs) were mobilized to implement eco-health practices for dengue prevention (ARUNACHALAM ET AL., 2012). Members of these groups were trained to distribute water container covers, organize community clean-up drives, and disseminate health education materials within their neighbourhood. The intervention, led by Arunachalam and colleagues (ARUNACHALAM ET AL., 2012), demonstrated a significant reduction in dengue vector indices and highlighted how empowering women can lead to sustained behaviour change at the community level. These findings highlight the potential for community-led vector control, particularly when interventions are grounded in local knowledge and led by female community members.

Fig. 3. Demonstrated to cover the plastic drums with clothes for the prevention of *Aedes* breeding in Mumbai slum area.

Despite the growing leadership of women in health governance, a gap remains in targeted health communication focused on household women, particularly homemakers, who are the primary custodians of domestic hygiene and water use. Strategic, culturally sensitive communication campaigns can play a vital role in reinforcing positive behaviours, such as the routine inspection and cleaning of water containers, the correct disposal of unused vessels, and participation in community clean-up events. Additionally, involving women in neighbourhood surveillance activities can further strengthen early detection and timely response to potential outbreaks.

In conclusion, women in India, whether as public health leaders or household managers, play a crucial role in the fight against malaria and dengue. While institutional leadership by women continues to grow, greater emphasis must be

placed on empowering women through targeted awareness campaigns, practical training, and community mobilization strategies. Such efforts can significantly enhance the effectiveness of vector control programs, leading to improved disease prevention at the grassroots level. Involving women meaningfully at every stage—from surveillance and prevention to treatment and community education—offers a sustainable path toward reducing the burden of vector-borne diseases in India

3. Women in Malaria Research and Policy-Making.

Increasing female leadership in malaria programs and research leads to more gender-responsive solutions, ultimately promoting gender-inclusive policies and action plans that empower women to contribute to and improve malaria control strategies.

4. The Global Fund.

The global fund to Fight AIDS, Tuberculosis, and Malaria has been actively assessing how gender equality is integrated into malaria programs. Their evaluations highlight that when women participate in decision-making, policies become more inclusive, addressing the specific vulnerabilities of women and children, who are disproportionately affected by malaria due to biological and socio-economic factors (ARUNACHALAM ET AL., 2012).

A WHO report 2024 and 2025 (WHO, 2024A; GLOBAL FUND, 2024) underscores that women, who make up a significant portion of the global healthcare workforce, are often underrepresented in leadership roles. Their increased participation in decision-making could lead to more equitable health policies, thereby addressing gender disparities in disease prevention and access to treatment. The study emphasizes that gender-responsive approaches can help bridge gaps in healthcare access, particularly in regions where cultural and societal norms hinder women's ability to seek timely malaria treatment. Thus, there is a critical role for female health policymakers in improving malaria interventions, particularly in addressing gender-related barriers to prevention and treatment access.

5. Challenges Faced by Women in Malaria and Dengue Control.

(i) Challenges in Malaria Control: Mostly, women in rural, tribal, and hard-to-reach areas face significant barriers in accessing malaria treatment due

to gender disparities, socio-economic constraints, and healthcare inaccessibility. In many malaria-endemic countries, married women and adolescent girls require permission from male family members to access health services due to harmful social and patriarchal norms, leading to delays and severe malaria complications (WHO, 2024B; SABIN ET AL., 2010).

Economic dependence on male family members makes treatment unaffordable, while household responsibilities often cause women to neglect their symptoms, leading to delayed diagnosis and poor adherence to treatment. Addressing these challenges requires gender-sensitive policies and improved access to healthcare. Women, especially in some rural, tribal-dominated and hard-to-reach areas, often lack access to healthcare due to financial constraints, mobility restrictions, and societal biases that prioritise men's healthcare needs over women's.

The World Malaria Report 2024 highlights how gender inequality affects malaria elimination efforts. It reveals that malaria disproportionately impacts vulnerable populations, particularly those in poverty, and that gender norms significantly influence access to healthcare and prevention measures. Studies show that children of less-educated mothers have higher malaria prevalence, emphasizing the need for inclusive policies and equitable healthcare access (WHO, 2024B).

Gender discrimination also leads to barriers such as low levels of education, restricted financial resources and a lack of influence in household decision-making among women, further impeding their ability to access malaria prevention and treatment (TEREFE ET AL., 2023; AMOAH AND ASAMOAH, 2022; DAS ET AL., 2011). In WMR 2024, an analysis of Malaria Indicator Survey (MIS) data from 19 sub-Saharan African countries shows that children under five whose mothers have no education or only primary education face a significantly higher malaria prevalence compared to those whose mothers have secondary or higher education (WHO, 2024C). Pregnant women are more susceptible to severe malaria, which can lead to maternal and neonatal mortality. Despite preventive programs, awareness and implementation gaps persist.

(ii) Challenges in Dengue Control: Similarly, in dengue control, women's active community participation is often limited by traditional gender roles that restrict decision-making and mobility. They face resource constraints and inadequate recognition, despite managing key household-level prevention practices such

as water and waste management. Their roles in vector control, although critical, are often undervalued and unsupported within formal structures. Women's contributions are usually undervalued, and they may not receive adequate support or recognition for their efforts in dengue control. Community health initiatives, such as those involving ASHAs and women's Self-Help Groups in India, have demonstrated success; however, more gender-sensitive approaches are essential to overcome these barriers. Empowering women through inclusive policies, training, and leadership opportunities is crucial for enhancing the effectiveness of malaria and dengue control programs alike (SABIN ET AL., 2010; TEREFE ET AL., 2023; AMOAH AND ASAMOAH, 2022)**.** These challenges underscore the need for gender-sensitive policies and inclusive public health programs that empower women, enhance their access to resources, and formally acknowledge their critical role in combating dengue at the community level.

6. Strengthening their Role in Malaria and Dengue Control.

(i) Engaging Female-Headed Households in Malaria Prevention: Women-led households, especially in rural and low-income areas, play a crucial role in

Fig. 4. Safeguarding her Family: A Woman in Assam, India Ensures Proper LLIN Tuck-In for Malaria.

malaria prevention. Increasing their awareness of malaria prevention tools, such as ITNs, and ensuring timely access to healthcare and its proper use can significantly reduce malaria cases and deaths (Fig. 4). In some regions, LLINs distributed for malaria prevention are misused for purposes such as covering crop seedlings, fishing, or being kept as a gift. Observations in Chhattisgarh tribal areas and Assam indicate that involving women in awareness campaigns can help address these issues and ensure the proper use of LLINs.

(ii) *Women's Groups in Malaria Prevention:* The active participation of women in vector control, education, and treatment adherence can significantly accelerate malaria elimination efforts.

(iii) *Improving Compliance with Plasmodium vivax Treatment:* The 14-day radical cure with Primaquine for *P. vivax* malaria remains a challenge due to adherence issues. Training community health workers to follow up on patient compliance, along with engaging female-headed households, can enhance treatment completion rates.

(iv) *Addressing Gender Barriers in Healthcare Access*: The World Malaria Report 2024 highlights that children of less-educated mothers have a higher malaria prevalence. Promoting inclusive policies, equitable access to healthcare, and female education can help break this cycle and accelerate malaria elimination.

(v) *Training Female Teachers and Schoolgirls as Malaria Advocates:* Educating schoolgirls and female teachers on malaria prevention can create a ripple effect, as they pass on critical knowledge to their families and communities, encouraging wider adoption of protective measures.

(vi) *Enhancing Antenatal Care (ANC) for Malaria Prevention:* Integrating malaria testing and treatment into antenatal care services can help prevent maternal and neonatal malaria deaths.. Ensuring pregnant women receive complete treatment significantly reduces the complications in this vulnerable group.

(vii) *Auxiliary Nurse Midwives (ANMs): They* can also incorporate malaria education into their outreach programs, particularly in high-burden states.

(viii) *Empowering Women through Education and Economic Incentives:* Strengthening malaria awareness programs and providing financial incentives

for women participating in malaria vector control activities can enhance community engagement and improve prevention efforts.

(ix) *Household-Level Prevention Practices:* Women can play a key role in dengue prevention through their daily responsibilities in managing household sanitation and water storage. By ensuring clean, covered water containers, proper waste disposal, and maintaining a hygienic environment in and around their homes, they help reduce mosquito habitats and breeding sites, supporting effective vector control at the community level.

CONCLUSION

Women play a crucial role in controlling vector-borne diseases, such as malaria and dengue, serving not only as caregivers but also as frontline health workers, educators, and community mobilizers. Empowering women through education, skill-building, and leadership opportunities enhances the effectiveness of prevention, early diagnosis, and treatment adherence efforts. Gender-inclusive and community-based strategies can significantly accelerate progress toward malaria elimination and strengthen dengue control. Integrating women meaningfully into decision-making processes and health initiatives ensures more resilient and sustainable public health outcomes, particularly in vulnerable and underserved populations. India's ongoing commitment to eliminating malaria and reducing dengue burden can be greatly reinforced by recognizing and supporting women's pivotal contributions.

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