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What Factors Contribute to the Inconsistent Use of Insecticide Treated Bed Nets in Tropical Africa? A Review of the literature on Malaria Prevention

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Abstract: Objective: To review the evidence showing the factors associated with inconsistent use of insecticide-treated bed nets (ITN), primarily among pregnant women and households in tropical Africa. Methods: Literature from the last 11 years was reviewed to identify reasons for inconsistent insecticide-treated bed net use. The review primarily focused on empirical studies covering issues related to pregnant women and households in tropical Africa. The reasons for inconsistent use of ITN were broadly classified as personal and external factors as guided by the socio-ecological model. Results: Personal factors identified include psychosocial barriers, socio-economic barriers, and biological barriers. Within the psychosocial barriers, issues relating to outcome expectations, acceptance, risk perception, misconceptions about malaria etiology, local terminologies, and self-treatment were reported. Income status was the primary focus of the socio-economic barriers, while, breathing difficulty, unfriendly smells and discomforts from reactions to the ITN made up the biological factors. External factors were identified at the interpersonal, organizational, community, and environmental levels. Key themes identified under each level respectively include gender-based issues (Interpersonal), healthcare system (organizational), agency/community practices (community), and heat (environmental). Conclusion: The review revealed barriers to consistent ITN use among pregnant women and households in tropical Africa. Some key barriers to consistent ITN use, identified, include wrong beliefs, misconceptions about malaria etiology, risk perception, weak or no acceptance of the ITN and gender-based issues. To tackle this challenge, in-depth behavior research based on the appropriate use of behavior theories would be needed. This would help to unpack why and how these factors affect insecticide treated net use behavior. The findings from the behavior change research can then be used to design and implement an effective behavior change intervention that would reduce malaria related morbidity and mortality among the target population.

Keywords: Malaria Prevention, Insecticide-Treated Bed Nets, Inconsistent Use, Pregnant Women, Intervention.

INTRODUCTION

The World Health Organization (WHO) reported in 2015 that an estimated 3.2 billion people (about 40 percent of the world's population) are at risk of malaria. In the tropics and subtropics, malaria remains a leading health problem, affecting populations in Asia, Africa, South and Central America. Although malaria is in theory completely preventable and has been successfully eradicated from some parts of the world, morbidity and mortality from the disease is still huge. Out of 219 million clinical cases of malaria that occurred globally in 2014, WHO reported about 660,000 deaths (ibid). Seventy-five percent of the deaths from malaria and 90 percent of malaria cases in 2014 occurred in tropical Africa. To this end, malaria is considered endemic in tropical Africa with huge public health and economic impact (DFID 2010).

Malaria is a disease caused by protozoan Plasmodium and transmitted to humans through the bite of an infected female mosquito, genus Anopheles. The disease is characterized by bouts of fever, headache, nausea, and general malaise. Also, anaemia, seizures, kidney failure, coma, and death can occur if malaria is left untreated (Alaii et al. 2003). Presently, the most vulnerable population to malaria are pregnant women and children under age five (UNICEF 2015). Children below five years of age are especially vulnerable because they have not had the chance to develop the partial malaria immunity pertained to high transmission areas. On the other hand, hormonal changes, contraindication to some anti-malaria drugs and reduction of immunity have been implicated as contributors to the vulnerability of pregnant women (ibid). Malaria in pregnancy can result in low birth weight infants and neonatal and/or maternal mortality (Hill et al. 2013).

Most often, the poor bear the overwhelming burden of disease. This occurs because access to effective treatment and resources is limited. As a disease, malaria impoverishes societies, undermining development as it reduces the productivity of sick people and their caretakers (Sachs et al. 2002). Economically, it is claimed that malaria also accounts for at least 1.3 percent reduction in Africa's economic growth annually with approximately US$ 12 billion annual losses both as a direct and indirect cost of the disease (ibid). DFID (2010) noted that malaria is responsible for 5.2 percent loss in all disability adjusted life-years (DALYs) in Africa, leading to its rank as the fourth leading cause of the burden of disease in low-income countries.

A key achievement in the search for prevention and control for malaria was the introduction of the Insecticide Treated Bed Nets (hereafter referred to as ITN). Swartz et al. (1992) defined ITN as bed nets that have undergone treatment with insecticides (permethrin, deltamethrin or lambda-cyhalothrin) which can repel mosquitos. Insecticide-treated bed nets serve as a physical barrier that can prevent the mosquito from accessing human beings. Additionally, the insecticide on the ITN can kill the mosquito vector when they come in contact with the ITN (Haggenougen et al. 2003). The ITN, therefore, breaks the chain of transmission between the mosquito vector and the human host (WHO 2009 and WHO 2011). ITN also reduces the mosquito population. Studies have shown ITN to be safe for human use (Zaim et al. 2000). Recent evidence by Belay et al. (2008) suggests ITN reduce malaria occurrence by 48 percent. Likewise, WHO (2015) showed ITN decrease the parasite prevalence by 20 percent. A review by Lengeler (2004) of over twenty randomized controlled trials of ITN showed that proper application of ITN could reduce child mortality from malaria by one fifth and malaria morbidity by half.

Although the UN, through the RBM program distributed billions of ITN to different countries, ownership of ITN in many cases has not translated into use (RBM 2014). WHO

(2016) revealed that access to ITN rose to about 75 percent of the population at risk in 2015. However, the same report indicated that only a little over half of that population (53 percent) actively utilize the ITN (Ibid). This constitutes a significant barrier to the set targets for malaria control. Failure of ITN based interventions to achieve specified targets, especially that of the MDGs which aimed at reducing global malaria deaths to near zero by 2015 has been linked to the lack of adequate consideration given to the social and behavioural factors related to ITN use (Haggenougen et al. 2003). Human behaviour tends to be influenced by social, economic, cultural, psychological and political factors. Since human behaviours can contribute to weakening (or strengthening) disease preventing and health promoting activities, the fact that behaviours are not easy to change becomes a challenge (Kok 2014).

Reviews of literature on malaria control and prevention have increasingly identified research gaps and the importance of a social science perspective to the challenge (Gikandi et al. 2008; Maslove et al. 2009 and Galvin et al. 2011). In addition, reviews in this light happen to be essentially different in focus as they do not utilize the socio-ecological approach used in this study. Given the persistent nature of the malaria challenge there remains a need for continuous updating of reviews focused on current research findings in previously identified gap areas. This review therefore bridges that gap and provides a much-needed update on the malaria challenge.

In this review, inconsistent use of ITN has been linked to underlying social, economic, cultural, and psychological factors since improving the use of ITN, requires an understanding of these factors before starting to think about malaria control intervention programs (Blas, 2013). To unpack these factors, the socio-ecological model which focuses on the interrelationships between individuals and their environments was used. Within the socio-ecological model, health is a function of individuals and the environments in which they live. Environment within this context refers to family, social networks, organizations, communities and societies (Bartholomew-Elderidge et al. 2016). Basically, an intervention at one environmental level can influence causal factors at multiple levels. Thus, a review of studies aimed at uncovering the underlying individual, environmental, social and behavioural factors contributing to the inconsistent use of ITN (at both the personal and environmental levels), is required and constitutes the focus of the literature review study.

METHOD

A literature search was done on published articles till the 25th of June 2018. Electronic databases and search engines for published literature like PubMed, Medline, Google Scholar, and BIDS were used. A test search was conducted to fine-tune the search terms. Search terms include; insecticide-treated bed nets, ITN, bed net, mosquito net combined with the Boolean operator ‘AND’ with other words including, barriers, use, inconsistent use, utilization, pregnant* and Africa. Grey literature was found by following up on references from published articles. Grey literature utilized included reports from the World Health Organization, UNICEF and Centre for Disease Control (CDC) among others.

Study inclusion criteria

Titles and abstracts were carefully reviewed to check for eligibility for inclusion or exclusion. Inclusion was based on the following criteria; (1) study participants could be identified as owning or having access to an ITN, (2) the study addressed obstacles to insecticide-treated bed net use generally or more specifically among pregnant women and mothers of children under age five, (3) the study was published in the last 10 years, (4) the study was conducted in populations in tropical Africa, and (5) were in the English language.

RESULTS AND DISCUSSION

The primary search identified 1504 citations, from which 184 articles were excluded after removal of duplicates. Of the 1320 articles left, 1244 were excluded with the application of the inclusion criteria leaving 78 articles. Of these 78 articles reviewed, most had direct links to pregnant women (N = 64), while the others had household data that covered questions relating to pregnant women (N = 14). The findings made were broadly classified into two key categories, namely personal and external factors as guided by the socio-ecological model (Solar et al. 2010).

Reasons for inconsistent use of ITN

Personal Factors

Personal factors refer to individual level circumstances that increase the likelihood of inconsistent ITN use. The findings made under this category were divided into three broad groups; psychosocial barriers, socioeconomic barriers, and biological barriers. Barriers that can be influenced by behavior change communication such as psychosocial factors have been given more emphasis than barriers that difficult or impossible to address such as socio-economic factors and biological factors as we might be able to influence these with interventions.

Psychosocial factors

Psychosocial factors in this study refer to individual level outcomes produced as a result of psychological and social influences which affect an individuals physical and mental functioning (Ambrose et al. 2011; Ankomah et al. 2012; Ramanantsoa et al. 2017). Within this framework, factors such as outcome expectations, acceptance, and risk perception would be considered. People from different social backgrounds are likely to have different beliefs (Haggenougen et al. 2003; Deressa et al. 2008). These beliefs may vary based on diverse factors such as cultural, educational, and economic factors (Pell et al. 2011). More importantly, these beliefs may influence health promoting behavior. For example, in Ethiopia, a survey by Birhanu et al. (2015) reported that respondents did not use ITN because they had little belief in the efficacy of the ITN. In addition, three different quantitative studies done in three different parts of Nigeria (Abuja, Ibadan and Edo) by Wagbasoma et al. (2010), Tongo et al. (2011), and Akaba et al. (2013) among pregnant women showed that 6.0, 2.0 and 1.0 percent of the respondents did not believe in the efficacy of the ITN and therefore did not use the ITN.

Underpinning these wrong beliefs may also be a fundamental misconception about the etiology of malaria (Manderson et al. 1998; Boene et al. 2014). Indeed, Esse et al. (2008) in a cross-sectional mixed method study reported that 74 percent of the respondents from two villages in Cote d' Ivoire identified the sun as the main cause of malaria, while 6 percent attributed the disease to the activities of sorcerers. This non-mosquito etiology of malaria was also found in a qualitative study in Kenya by Omwono et al. (2018). The authors noted that 12, 8 and 13 percent of respondents indicated that malaria was caused by rain, eating sugarcane and dirty environments respectively. On the other hand, Birhanu et al. (2017) reported that caretakers of children in Ethiopia indicated that malaria was caused by cold (6.3 percent), dirt (6.1 percent) and hunger (2.7 percent). If the at-risk population does not have a clear understanding of the etiology of malaria, they are not likely to see the need to use the ITN.

Although ITN have been proven to be safe for use globally (Haggenougen et al. 2003), selected population groups still express a perception of risk to using ITN (Ovadje et al. 2016 and Birhanu et al. 2015). Quantitative studies among pregnant women in Nigeria and Ethiopia by Olajide et al. (2011) and Berkessa et al. (2015) revealed that 23 and 10 percent of respondents respectively, believed that the ITN was toxic. In some cases, this perception of risk is centred on the insecticide applied to the ITN, as users are afraid of possible harmful side-effects that are assumed to arise as a result of the alleged toxicity of the chemicals used

(Kilian et al. 2015). For example, Taremwa et al. (2017) reported that 1.5 percent of respondents (pregnant women) in a study done in Uganda, believed that the chemicals in the ITN causes cancer. This perception of risk has also resulted in a situation where the benefits of the ITN is known, however, use of the ITN remained low because of the deeper underlying risk perception. A qualitative study by Mbonye et al. (2006) reported that although most pregnant women in Mukono district, Uganda, generally knew the benefits of ITN, very few of them used it. The low levels of use of the ITN reported by over half of the respondents, was linked to the view that ITN are very harmful to adults, children, and pregnant women (Ibid). Additionally, in a mixed method study by Chuma et al. (2010) participants expressed concerns about the focus of ITN interventions on children and pregnant women in Kenya. Their anxieties were hinged on the misconception that the intervention may be a means of harming Kenyan women's fertility and the unborn babies.

The risk perceived with ITN use may also be escalated by local terminologies used to identify malaria, the ITN, and the insecticide (Mattern et al. 2016). Different words are used to identify the ITN and the disease malaria. These may vary according to language or the symptoms experienced. However, a disease like malaria which has a wide variety of symptoms may not be appropriately named in local dialects, thereby giving room for misconceptions. In a study by Esse et al. (2008), the author noted that malaria which was referred to as "djèkouadjo" was considered to be different from "anumą" which is used to describe convulsions. While the respondents believed that djèkouadjo was treatable with modern medicine, they believed that "anumą" (a symptom of cerebral malaria) was only treatable by traditional healers. This shows that within the same population using the same language, the same disease can be viewed differently (Mattern et al. 2016). These varying perspectives may also affect an individual's preventive behaviours.

On a broader scale, inconsistent use of ITN has been traced to cultural beliefs. A recent qualitative study by Quist et al. (2017) checked how cultural beliefs influence pregnant womens attitude to ITN use in Ghana. The study revealed that respondents did not use the ITN consistently, because, they believed that ITN were only useful as a preventive measure from mosquito bites in the absence of their husbands. As explained by Quist et al. (2017), the perspective of the respondent was born out of the communities' belief that the man is the spiritual protector of the family and confers the necessary protection against everything, including mosquitos. In light of these findings, it is important to give attention to these beliefs, as failure to do so may result in inaction on the part of at-risk individuals in a population (Pinchoff et al. 2016).

In line with the concept of misperception are questions surrounding acceptance of new innovations versus a preference for older culturally driven malaria prevention methods. Although the ITN is not entirely new globally, to many users in certain parts of tropical Africa ITN are still viewed with scepticism; hence acceptance remains a challenge (Idowu et al. 2008; Singh et al 2013; Berkessa et al. 2015). Kilian et al. (2015) in a household survey done in Nigeria revealed that 5.8 percent of the respondents were not yet ready/willing to use the ITN, while 4.1 percent did not use the ITN because they disliked the ITN. Another survey by Hetzel et al. (2014) in Papua New Guinea revealed that 13.1 percent of respondents showed indifference or a clear opposition to the use of the ITN. Meanwhile in a cross-sectional study by Adenye et al. (2014), 4 percent of the respondents (pregnant women and mothers of children under age five) indicated a lack of interest in the ITN.

Perhaps the climate of weak or non-acceptance of the ITN may be the result of a preference for older, culturally available malaria prevention methods (Azabre et al. 2013; Diema et al. 2017). Prior to the arrival of the ITN, local and traditionally accepted methods of mosquito prevention were in use (Idowu et al. 2008). Such methods include burning of cow dung, mechanical killing of the mosquito, the use (spreading/burning) of herbs like:

Murumanyama (Cassia abbreviate oliv), Ngaka (Mormordica balsamina), Muone (Adenia cissampelodes) and Gnade (Pennisetum glaucum) among others (Bonkian et al. 2017). Despite the effectiveness of the ITN, some individuals still prefer to remain with the old methods of prevention rather than migrate to the new. This is illustrated in the findings made in a quantitative study among pregnant women in Nigeria by Tongo et al. (2011). The study showed that 10.8 percent of the respondents preferred to use local methods (such as the use of traditional herbs) to prevent malaria. In addition, a household survey done in Ghana by Diema et al. (2017) revealed that 75 percent of respondents preferred to use other methods of malaria prevention such as burning of herbs and physically killing of mosquitoes. Just as preference for older culturally motivated malaria prevention methods may be a key driver of the weak or lack of acceptance of the ITN, it may also be a contributor the misuse of the ITN (Admasie et al. 2018). Since the nets are given out free of charge and the at-risk population have other means of malaria prevention, recipients have opted in some settings to use the ITN for unintended purposes such as nursing of seedlings, fishing and fencing of animal pens (ibid). On the other hand, the study by Diema et al. (2017) noted that the ITN is sometimes appropriately used, not to prevent malaria but to avoid the nuisance of mosquito noises.

Acceptance of the ITN may also be hampered by the concept of self-treatment which is widespread across tropical Africa. As noted by Heggenhougen et al. (2003), self-treatment in Africa remains the first line of treatment, with drugs easily procured from roadside pharmacies without a prescription. This is still true today as revealed by a qualitative study by Attu et al. (2018) in Ghana. The study noted that only 3 percent of 337 respondents indicated that they visit a health facility for treatment whenever they suspect malaria. Another study by Kojom et al. (2018) that sought to identify the reason for malaria self-treatment among Cameroonian mothers revealed that the behavior (self-treatment) had become a habit and the ease of obtaining the drugs, contributed to this habit. Ernst et al. (2016) reemphasized this finding in the results of a Kenyan household survey that linked non-use of available ITN to attitudes that taking malaria drugs is easier.

Socio-economic factors

Inequality in material possession is a stable characteristic of every society. This inequality can be portrayed as a system of social stratification (Deallegri et al. 2013; Tusting et al. 2013). People attain different positions in the social hierarchy according, mainly, to their social class, occupational status, educational achievement, and income level (Shayo et al. 2015). This section focuses on the role of the socio-economic influencer, income on consistent ITN use.

One of the commonly reported barriers to ITN use among pregnant women and households in tropical Africa is income (Musa et al. 2009). Income is one of the yardsticks used to measure socio-economic status (SES). Most households with insufficient incomes are forced to make health-related choices based on financial considerations (Njau et al. 2013). In many cases, ITN related issues are not considered a top priority (ibid). Studies from Nigeria, Kenya, Uganda, Tanzania, Democratic Republic of Congo and Rwanda also reported cost to be a significant barrier to ITN ownership and use among pregnant women (Worrall et al. 2005). If the people cannot afford to buy the ITN, how would they use it? The geographically widespread nature of the findings on the influence of income on ITN and ownership and use to a degree indicates that these variables remain a major barrier to ITN use. Also, studies reviewed showed that higher levels of ITN use could be found among those with higher incomes. For example, a study in Kenya by Choonara et al. (2015) revealed that women from wealthier households were considerably more likely to use ITN than women from poorer households. Likewise, another study by Moon et al. (2016), in Mozambique, observed that a larger

household monthly income contributed to ITN utilization. Generally, these findings tend to indicate that the poor, including pregnant women, are less likely to own and use the ITN.

Biological factors

Biological factors at the Individual level were also reported as barriers to the consistent use of the ITN. Specifically, barriers related to human biological reactions such as discomforts from the use of the ITN were reported. In a study by Manu et al. (2017), the authors indicated that pregnant women interviewed reported experiencing some sort of difficulty with breathing, while other participants indicated that the ITN had an unfriendly smell. Furthermore, other studies reported that participants (pregnant women) felt itchy, experienced sleeplessness, and some others had a suffocating feeling when sleeping under the ITN (Wiseman et al. 2007; Pinchoff et al. 2015; Mondal et al. 2016; Berkessa et al. 2015 and Msellemu et al. 2017).

External Factors

External factors in this paper try to answer the question what interpersonal, organizational, community and environmental factors serve as behavioural drivers of inconsistent ITN use among the at-risk population group? Within this framework, the following will be considered; gender-based relations linked to Interpersonal factors, organizational factors linked to the health care system, community practices, and environmental factors.

Interpersonal Factors: Gender relations

Gender-based relations tends to play a role in the ownership and utilization of ITN. “Gender” refers to socially constructed roles, culture-bound conventions and behaviours that influence interpersonal relations among, and between women and men; boys and girls (Haggenougen et al. 2003). Until now weak levels of ITN use by pregnant women has remained despite the fact that they are a vulnerable population to malaria (Graves et al. 2011). Indeed, a survey in Nigeria by Garley et al. (2012) revealed that there is still a higher willingness to use the ITN among women than men. This finding coupled with quantitative studies in Uganda and Rwanda by Wanzira et al. (2016) and Kateera et al. (2015), which revealed that women were more likely to use ITN when compared to men, emphasize the fact that willingness to use the ITN on the part of the female may not be the challenge.

The socio-culturally ascribed leadership role given to the male partner in the home, however, can result in an imbalanced power relation that exposes the female partner to health risks because of the decision-making role of the male head of the home (Sangare et al. 2012). Pettifor et al. (2009) and Obala et al. (2015) reported that some pregnant women did not receive the support of their husbands in relation to the use of ITN. Among the 30 participants in the study, 23 percent reported that their husband or partner (who is considered the head of the home) decided they should not use the ITN (Pettifor et al. 2009). From the economic perspective, Chuma et al. (2010) noted that female participants were unable to purchase the ITN for themselves and their children because they were financially dependent on their husbands. Also, their husbands did not prioritize the use of ITN. The study further revealed that when women did earn an income and had control over their income, they were much more likely than men to purchase an ITN for their household. These findings show that even though women are more willing to use the ITN, the uneven gender-based power relations built on socio-cultural norms may expose women to poor preventive health behavior.

Organizational factors: Healthcare system

Organizational factors also contribute to the inconsistent use of ITN. Organizational factors here refers to the functioning and outcomes of established institutions that are set up to tackle specific challenges (Feachem et al. 2002). An example of these institutions is the

healthcare system. In relation to the use of ITN, the healthcare system plays an important role in ensuring access via distribution and awareness about ITN (Kweku et al. 2007; Skarbinski et al. 2011; Adebayo et al. 2014). However, access and awareness to ITN still remains a huge problem among the at-risk population. In a study by Fuge et al. (2015), among pregnant women in Ethiopia, 70 percent of the respondents did not have access to the ITN, while 26 percent of those who did not have access were not aware of the ITN. Another quantitative study among pregnant women in Nigeria by Aluko et al. (2012) indicated that 32 percent of respondents had never seen an ITN, while 55 percent of those without an ITN did not have access to the free distribution program carried out by the healthcare system. This lack of access to the healthcare facilities and invariably the ITN was also reported in a survey done in Ghana by Diema et al. (2017).

Conversely, when access to the healthcare facility is available, the ITN may not be equitably distributed across households (Animut et al. 2008). In a household survey in Kenya, Ernst et al. (2016), reported that only one ITN was distributed to each household. Similarly, a survey by Birhanu et al. (2015) in Ethiopia, reported an 11.1 percent intra-household ITN ownership gap. In most cases when these ITN are distributed only pregnant women get one, invariably, leaving households without pregnant women without an ITN (Ernst et al. 2016). On the part of the healthcare system, studies have reported insufficient stock and supply as a key barrier to distribution of ITN (Beiersmann et al. 2010 and Mubyazi et al. 2010). These weakness in the healthcare system affects distribution, which in-turn affects access, which cumulatively affects the use of the ITN.

Community Level Factors

Communities, as described by Agueldo (1983), refers to a group of people living in a defined area that have shared cultural patterns, social values and challenges. Barriers to ITN ownership and invariably ITN use at the community level include issues such as corruption and community practices. Corruption refers to conflict of interest where a party, that is expected to act in another's best interests, is rather motivated by self-interest (TI 2018). For example, a respondent in a study among pregnant women in Ethiopia by Belay et al. (2008) noted that community leaders in charge of ITN distribution gave more attention to their family members and relatives rather than fair distribution of nets to the households who deserve the nets. Also, community practices can contribute to inconsistent use of the ITN. In a cross-sectional study among pregnant women in Kenya, Ngoroge et al. (2009) noted that freely received ITN were returned by pregnant women in Mijikenda community because their cultural practices for burials entailed wrapping caskets with white sheets. Consequently, sleeping under the white colored rectangular ITN made the women uncomfortable, as it resembled a dead person in a coffin. The study further noted that those who slept under the ITN reported having experienced bad dreams and ITN talking to them.

Environmental Factors

Within the tropical African climatic context, heat, has been linked to the non-use of ITN. (Onyeneho 2013; Augustincic et al. 2015). From the articles reviewed, a frequently mentioned reason for the inconsistent use of ITN was heat based discomfort (Eisele et al. 2009; Pulford et al. 2011; Zuradam 2012 and Russell et al. 2015). In studies by Pettifor et al. (2009); Auta (2012) and Akaba et al. (2013), pregnant women expressed discomfort as a result of the heat produced by the reduction in the free flow of air, while sleeping under the ITN. Specifically, in the study by Pettifor et al. (2009), 20 percent of the women reported being too hot under the net, while 72 percent reported other reasons such as discomfort from sweating.

Discussion

A cardinal part of the Millennium Development Goals (MDGs) and the present Sustainable Development Goals (SDGs), is the distribution of ITN to pregnant women (Sachs et al. 2017). The aim is to reduce and invariably end malaria morbidity and mortality among the vulnerable populations from malaria by increasing ownership of ITN and consistently preventing infection through the use of the ITN. Still, there remains an undesirable gap between ownership and use of ITN (UNICEF 2015). This review, therefore, identified from literature, key barriers and determinants of ITN use in tropical Africa, mainly among pregnant women and households. The findings were classified into personal and external factors (see appendix 1). Personal factors identified include psychosocial (beliefs, acceptance, risk perception, misconceptions, local terminologies, self-treatment), socio-economic (income) and biological factors. While external factors identified include; Interpersonal (gender issues), organizational (healthcare system), community (agency and practices) and environmental factors.

The results of this review revealed low levels of belief in the effectiveness of the ITN. The study also revealed that culture factors influence beliefs, which in turn affects ITN use (Eisele et al. 2011; Akaba et al. 2013). This finding emphasizes the need for culturally sensitive strategies that consider local understandings and beliefs. Furthermore, misconceptions about the etiology of malaria was identified as a barrier to consistent use of ITN (Toe et al. 2007; Omwono et al. 2018). Within this challenge lies the identification of incorrect alternative causal mechanisms of malaria. If the at-risk population does not believe the scientifically proven mosquito-based etiology of malaria, they are not likely to use the ITN, this gap in knowledge creates a severe information asymmetry that is often used in economy, it is defined as a situation where one party holds superior information compared to another (Yacoubian et al. 2025). At a deeper level the studies reviewed revealed a widespread perception of risk among the at-risk population and households. This resulted in low levels of use despite a clear knowledge of the benefits from use of the ITN in some cases (Mbonye et al. 2006). If the use of the ITN is perceived as risky, consistent use would be highly unlikely. Furthermore, the identified perception of risk may also be a contributor to weak or no acceptance of the ITN and a consequent preference of alternative preventive techniques which supplant the more effective ITN use.

Additionally, ITN use was also shown to be affected by widely practiced self-treatment. Since a cure for malaria is available and these drugs can be obtained easily without a prescription; self-treatment may be inevitable (Kojom et al. 2018). Consequently, preventing the disease using an ITN may not be seen as a priority. Indeed, the motivation to prevent the disease would be low given the circumstances. This, however, begs the question, do tropical Africans view treatment as a better option to prevention? Although prevention of the disease malaria should be the preferred option, easy accessibility of the treatment using drugs may also be a contributory factor to the inconsistent use of ITN. This issue though pertinent is not well studied.

Within the scope of external factors, income remains a major consideration. In this review, income was shown to play a role in determining ITN use (Ernst et al. 2016). Studies reviewed also revealed a strong association between being less well-off and being less likely to use ITN (Diema et al. 2017). This may be because of higher financial demands built on lower incomes and thereby hampering accessibility. However, while not using the ITN could result in morbidity, increased expenditure on treatment, and the risk of death, the challenges with low income are apparent and affordability should be weighted in ITN implementation programs. Moreover, the people's willingness to pay for preventive health (ITN) within this setting may need to be studied further.

On the other hand, the review also showed a trend of increasing willingness to use the ITN by women, yet very few actually use the ITN (Garley et al. 2012). This rise in willingness

to use the ITN among women is reportedly due to the fact that most media campaign adverts tend to focus on encouraging women and children to use the ITN. Despite these, gender-based power relations rooted in the socio-cultural norms conferring household headship to the men still weakens ITN use among women. This uneven power relation was linked to societal norms and roles. More importantly, studies reviewed showed that this uneven power relation exposes women to ill health via pathways linked to decision making, belief and economic power. This reiterates the need for ITN use education and behaviour change programs not just for pregnant women but also for their male spouses/partners.

Another important external factor is the distally located challenge in the healthcare system. Although most of the ITN are provided at subsidized rates or at no cost to the recipient, distribution, which is coordinated by the healthcare system remains poor. Also, selective ITN distribution driven by agency (distribution to family and friends first) and community practices remains a barrier. On the other hand, the healthcare system reports stock-outs and inconsistent supply as barriers on their own end (Willey et al. 2012). This poor-quality service, in turn, gives rise to long waiting times for recipients, lack of access to the ITN, discouragement, lack or inequitable access and non-use of the ITN (Hill et al. 2013).

To truly address the barriers to consistent use of ITN at the personal and external levels, malaria as a disease must be viewed within the context of the local understandings of the Illness and ITN use (Nnko et al. 2012; Janßen et al. 2012). Also, a location specific understanding of structural factors such as distribution of the ITN would be needed. Although quite a number of articles addressed issues related to levels of ITN use, and perception of ITN use, attempts to unpack the deeper underlying determinants driving these issues were limited. There is therefore a need to further study the themes identified in this study from a deeper socio-cultural context. To do this, an in-depth research approach such as by applying the Intervention Mapping protocol to develop theory- and evidence-based behavior change programs may be helpful. The behavior change theories in the IM protocol are not new. They have been used in the past to explain behavioral challenges linked to physical exercise, condom use and smoking (Bartholomew Eldredge et al. 2016). However, the level of application of this theory-based intervention mapping protocol in malaria and ITN use research seems to be limited. The Intervention Mapping protocol goes beyond just identifying the levels and perceptions of ITN use to investigating the current attitudinal and normative beliefs underlying these perceptions while unpacking the mechanisms driving the inconsistent ITN use behavior (Kok et al. 2014).

Specifically, theories within the social cognitive model may prove helpful. The social cognition model is concerned with how individuals make sense of social situations (Kok et al. 2017). The approach focuses on individual cognitions or thoughts as processes that intervene between observable stimuli and responses in specific real-world situations (Fiske and Taylor, 1991). Amongst the theories that make up the social cognition model are the theory of planned behaviour, health belief model, and the social cognition theory (Kok et al. 2014). A common assumption underlying these theories is the importance of motivation to undertake a specific behaviour (ibid). These theories would implicitly contribute to understanding the underlying attitudinal and normative beliefs driving inconsistent use of ITN. The findings made would help in identifying target for future behaviour change interventions to improve consistent ITN use and as a result decrease the global malaria burden.

CONCLUSION

In conclusion, this review details barriers to consistent ITN use among pregnant women and households in tropical Africa. Some key factors that drive inconsistent use of ITN identified in this review were wrong beliefs, misconceptions about malaria aetiology, risk perception, weak or no acceptance of the ITN and gender-based issues. To tackle this challenge, there is need to go beyond description of the barriers as seen in most articles. This can be done

using a systematic approach for the design of theory and evidence-based interventions where they start with a detailed analysis of the local context by assessing the (relative) importance of factors driving the non-use and making an assessment of the community strength to tackle the problem. With this program development can be done by identifying objectives at the behavioral and determinant levels, selecting appropriate behavior change methods and applying these in line with theory, and anticipate program implementation.

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