

Determinants of Utilization of Malaria Preventive Interventions in Kenya: A Systematic Literature Review

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Abstract

Background: Despite continued efforts to implement malaria preventive interventions, the infection continues to be a major public health concern within the African region including in Kenya. Systematically identifying the determinants of utilization of malaria preventive interventions can help re-design implementation strategies and make the interventions more effective.

Methods: A systematic literature review was conducted to identify the determinants of utilization of insecticide-treated bed nets (ITNs) and intermittent preventive treatment (IPT) for malaria prevention in Kenya. Articles reporting on determinants of utilization of ITNs and IPT in Kenya, and published between 1998 and 2023 were searched from the following databases: PubMed, CINAHL, Medline, Cochrane library, and ProQuest. Narrative synthesis was used to synthesise data from the included articles and findings were presented using Andersen framework for health service utilization.

Results: The search identified 16 studies that met the inclusion criteria and had full text available. Most studies identified education level, knowledge on malaria risk and prevention, socioeconomic status, accessibility, cost of acquiring ITN, side effects of IPT, individual beliefs, and myths and misconceptions as major factors affecting utilization of ITNs and IPT. Whereas some studies identified age, marital status, sex, characteristics of ITNs such as shape and colour, gestational age at antenatal clinic (ANC) initiation, sociocultural beliefs, perceived risk of malaria infection and complications, lack of IPT practice by healthcare facilities, and perceived benefits as other factors determining utilization of ITNs and IPT for malaria prevention.

Conclusion: A number of predisposing, enabling and need factors determine uptake and utilization of ITNs and IPT for malaria prevention in Kenya. Community education to increase awareness on malaria infection, associated complications and prevention measures, and to demystify myths and incorrect beliefs is needed. Additionally, investing in programs to

increase availability of ITNs and IPT is needed in order to improve access to these malaria preventive interventions.

Index Terms- insecticide-treated bed nets, intermittent preventive treatment, malaria, preventive interventions

I. INTRODUCTION

Good health and well-being (Goal 3), is one of the seventeen sustainable development goals (SDGs) that were adopted by all United Nations (UN) member states in 2015 as part of the 2030 agenda for sustainable development [1]. One of the targets for SDG 3 (target 3.3) is to end the epidemics of malaria, tuberculosis, AIDS, and neglected tropical diseases, and to combat hepatitis, water-borne diseases and other communicable diseases [1]. Despite continued efforts by nations to fight malaria, the infection continues to be a major public health concern to many countries especially within the African region. According to the World Health Organization (WHO), there was an increase in the number of malaria cases worldwide in 2021 with a record 247 million cases compared to 245 million cases in 2020. Additionally, there were approximately 619,000 malaria deaths in 2021 [2]. The African region bears the highest share of global malaria burden. In 2021, the region accounted for 95% of global malaria cases and 96% of all malaria deaths [2]. There is therefore a need for African countries to evaluate their ongoing efforts for prevention and control of malaria and re-design interventions to be more effective.

In Kenya, the burden of malaria morbidity and mortality continues to be high. According to the Kenya malaria indicator survey conducted in 2020, malaria accounts for 13% to 15% of all outpatient consultations in Kenya and approximately 70% of the population remains at risk of infection [3]. Each year, approximately 6.7 million clinical cases of malaria are reported in Kenya with approximately 4000 deaths mostly among children [4]. In a review conducted in 2020 to assess the country's progress towards achievement of SDG 3, the ministry of health reported that Kenya was off-track in achieving the targets on malaria incidence [5]. In 2018, the Kenya National Malaria Control Program reported that the incidence of malaria in Kenya was 1.7 times more than the global incidence [6]. Understanding the gaps in measures put in place to prevent and

control malaria can help the country to design more effective public health interventions.

ITNs and IPT are key measures that were adopted for malaria prevention in Kenya. Use of IPT was first introduced in Kenya in 1998 as a malaria preventive intervention in pregnancy. In 2001, the Ministry of Health in Kenya developed a national strategy for malaria control which targeted to increase coverage of ITNs [7]. Although the government has made efforts to scale up these interventions over the years, uptake and coverage remain low [8] and this may account for the continued high incidence of malaria infections. Understanding factors that may influence utilization of these interventions can help to re-design public health programs to improve their uptake and utilization. There are limited systematic literature reviews focusing on the determinants of utilization of ITNs and IPT in Kenya and thus this systematic review sought to examine this topic in order to provide knowledge that can inform programs and policies to improve uptake and use of these interventions. The aim of this systematic review was to identify the determinants of utilization of ITNs and IPT among the Kenyan populations and make recommendations for improvement of their uptake and utilization.

II. METHODOLOGY

The Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline was followed in screening and selection of the studies [9]. Figure 1 shows the process of articles screening and selection of studies to be included in data synthesis.

Search Strategy

A systematic review of studies done in Kenya focusing on determinants of utilization of ITNs and IPT for malaria prevention and published between 1998 and 2023 was conducted. The databases searched include: PubMed, CINAHL, Medline, Cochrane library, and ProQuest. The search terms used include: intermittent preventive therapy, intermittent prevention therapy, intermittent preventive treatment, intermittent prevention treatment, intermittent prophylactic treatment, intermittent presumptive treatment, insecticide treated nets, insecticide treated bed-nets, malaria, utilization, uptake, use, and Kenya. Boolean commands "OR" and "AND" were used to combine the search terms as needed.

Inclusion Criteria

To be included in the systematic literature review, studies had to be quantitative or qualitative and reporting on determinants of utilization of ITNs or IPT. Additionally, they had to be conducted in Kenya and published between 1998 and 2023. Only studies published in English were included in this systematic review.

Exclusion Criteria

Studies were excluded from the review if they did not report on determinants of ITN or IPT utilization, were not conducted in Kenya or were not published in English. Additionally, case reports, review articles and case studies were also excluded from the review. Articles published before 1998 were also excluded because that is the year the Ministry of Health first introduced the use of IPT for malaria prevention in Kenya.

Data Extraction

A data extraction table was developed in Microsoft word and used to record key information from the included articles. Key information recorded include; title of the study, author, publication year, study design, main findings, and quality score. EndNote program was used for reference management, screening and keeping track of identified articles. Supplementary table 1 summarizes key information for the 16 included studies.

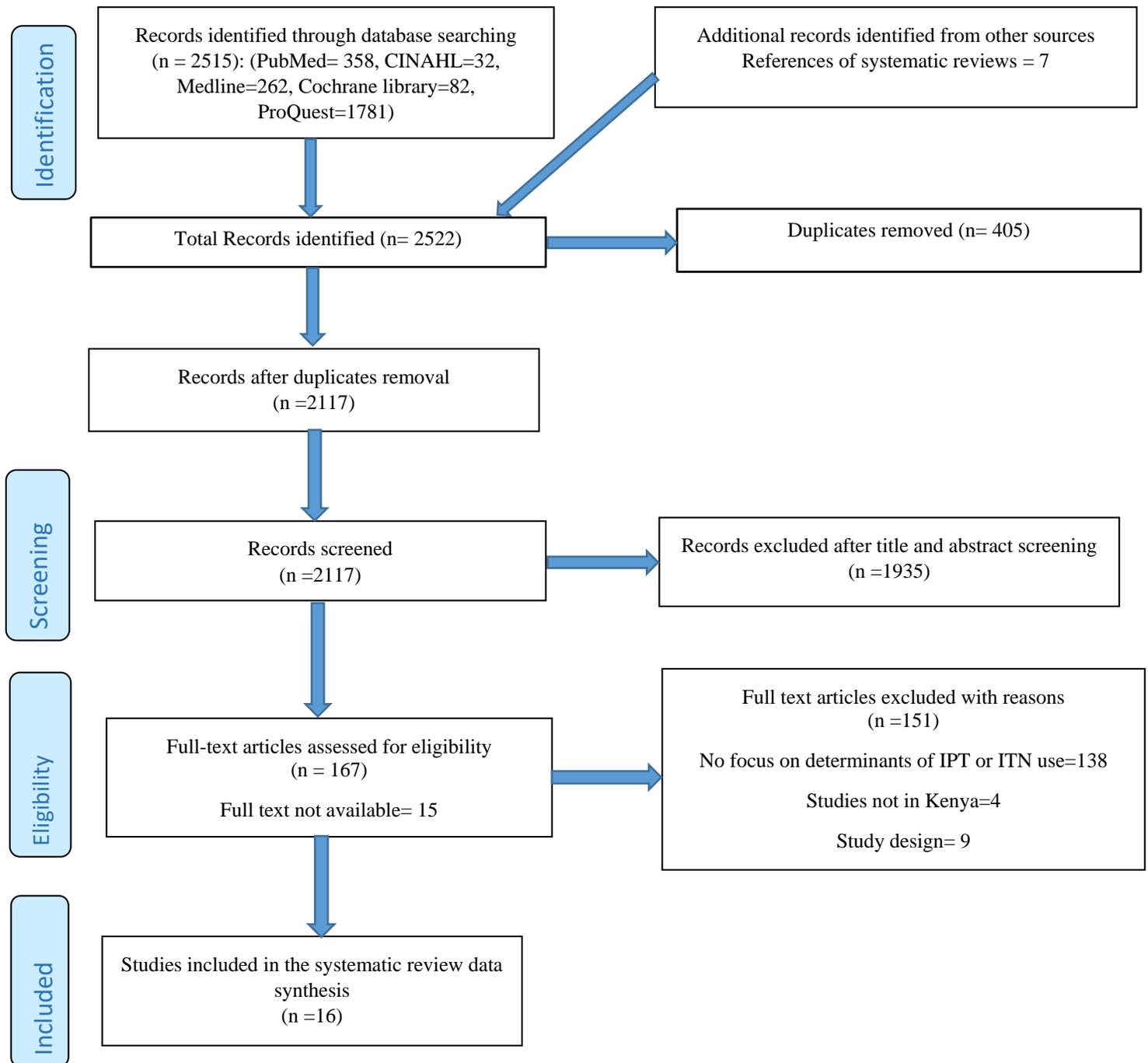
Critical Appraisal

Quality assessment for the included studies was carried out using the Joanna Briggs Institute (JBI) critical appraisal tools for cross-sectional studies and qualitative studies [10]. The Mixed Methods Appraisal Tool (MMAT) was used to assess quality of studies conducted using a mixed-methods approach [11]. The tools consist of questionnaires that evaluate different aspects of a study which among others include; whether there is a clear research question and objectives and whether appropriate methods were used for data collection, analysis and presentation. Classification of scores was based on a previous systematic review and meta-analysis where a score of 70% and above was regarded as high quality, 50%-69% as moderate quality and 49% and below as low quality [12]. Studies included in this systematic review were all high quality studies.

Data Synthesis

Narrative synthesis approach was used to synthesis findings from the included articles and identify the determinants of utilization of ITNs and IPT for malaria prevention in Kenya as reported by the studies. In order to have a clear presentation that is easy to understand, determinants of ITNs and IPT utilization identified in this systematic review were grouped and presented using Andersen framework for health service utilization. The model classifies determinants of health service utilization into three main domains. According to the latest version of the model, determinants of health service utilization can fall in either of the three domains which are predisposing factors, enabling factors and need factors [13]. The three domains represent individual and contextual factors that may influence utilization of health services.

Figure 1: Flowchart of articles screening and selection



III. RESULTS

The initial search identified a total of 2515 studies from the main databases and an additional 7 records from references of systematic reviews. After removal of duplicates, 2117 articles remained for inclusion in the systematic review. Following title and abstract screening, 1935 articles were excluded as they did not meet the inclusion criteria. Full texts could not be found for 15 articles and thus full review was conducted for 167 articles. Following full text review, 151 articles were further excluded. Of the 151, 138 had no focus on ITN or IPT utilization, 4 were not conducted in Kenya and 9 were excluded based on study design. A total of 16 articles were included for final data synthesis. Supplementary table 1 summarizes key information for the 16 included studies.

Determinants of Utilization of Insecticide-treated Bed Nets

Predisposing factors

Predisposing factors associated with utilization of ITNs included; education level, individual beliefs, knowledge on malaria transmission and prevention methods, age, marital status, myths and misconceptions, knowledge on benefits of ITN use, sleeping arrangement, socio-cultural beliefs, sex, gravidity, shape and color of the net. Seven studies reported that children of parents or guardians with secondary level of education or higher were likely to sleep under a mosquito net compared to those with less than secondary level of education. Belief that ITNs brought heat was reported by six studies with participants indicating excessive heat as the reason they only used ITNs during rainy seasons and not in dry seasons. Four studies reported that knowledge on malaria transmission and prevention methods led to a higher likelihood of ITN utilization among the participants.

Two studies reported that people aged between 20 to 40 years had higher utilization of ITNs compared to those below 20 and above 40 years. Two studies reported that married women were more likely to use ITN compared to unmarried ones while two studies reported that men were less likely to use an ITN compared to women. Four studies reported myths and misconceptions as barriers to ITN use. The most common myths were that it was a secret family planning method used by the government, it caused bad dreams and sleep disturbance. Three studies associated sleeping arrangements with ITN usage where those sleeping on the floor or in open places believed that ITNs should only be used by people sleeping on a bed. Two studies reported that rectangular nets were more preferred than conical ones while green and navy blue nets were more preferred than white and light blue ones. Being multigravida was associated with higher ITN use compared to primigravida in one study. One study associated socio-cultural practices with ITN use where participants said they refused to use white rectangular shaped nets because they resembled a casket rapped in a white cloth as the one used to bury dead people according to their culture.

Enabling factors

Enabling factors associated with utilization of ITNs included socio-economic status, cost of buying an ITN, accessibility, ITN stock outs, side effects, logistics of using an ITN, and setting. Four studies indicated that participants reported cost of buying an ITN as a major barrier for using it with many reporting that they could not afford to buy one. Six studies reported that participants who had a higher socio-economic status were more likely to use an ITN compared to those of lower socio-economic status. Nine studies reported lack of access to ITNs as a reason given by participants for not using it. Barriers to access included long distance and more travel time to the healthcare facility and prioritization of pregnant women and children below five years when ITNs were being distributed or issued by health facilities. Six studies reported that unintended side effects led to low usage of ITN. Most commonly mentioned side effects included rash, flu, unpleasant smell, dizziness and suffocation especially for young children. Four studies associated logistics of using a net with its use. The studies indicated that having to hang the net every day and cleaning it were reported by many participants as reasons for not using it. One study reported stock outs of ITNs at the facility where they are issued as a barrier to utilization while one study indicated that women from urban areas were more likely to be using an ITN compared to those from rural areas.

Need factors

Need factors associated with utilization of ITNs included perceived risk of malaria infection and associated complications, and perceived benefits of using an ITN. Two studies reported that individuals who perceived themselves to be at risk of malaria infection were more likely to sleep under an ITN compared to those who perceived themselves not to be at risk. One study reported that participants from malaria endemic areas used ITNs more compared to those from non-endemic areas because they perceived themselves to be at risk of acquiring the infection. One study reported that mothers who felt that their unborn babies were at risk of developing complications in case they get infected with malaria were more likely to sleep under an ITN compared to those who did not have such perceptions. One study reported that perceived benefits of ITN use led to a higher likelihood of use. Most commonly cited benefits included protection from malaria, protection from nuisance insects, and provided warmth at night.

Determinants of Utilization of Intermittent Preventive Treatment

Predisposing factors

Predisposing factors associated with utilization of IPT included education level of the parent or guardian, knowledge on malaria transmission and prevention methods, knowledge on benefits of IPT, age, and marital status. Two studies reported that women who had secondary education level and above were more likely to take up IPT compared to those with less than secondary education or no education at all. One study reported that women aged between 20 to 40 years had a higher uptake of IPT

compared to those below 20 or above 40 years of age. Two studies reported that married women had a higher uptake of IPT compared to unmarried women. Also, two studies reported that knowledge on benefits of IPT led to a higher uptake and optimal utilization of the intervention compared to women who had no knowledge about it.

Enabling factors

Enabling factors associated with utilization of IPT for malaria prevention included IPT practice by facility, gestational age at initiation of antenatal clinic, and accessibility. Three studies reported that lack of IPT practice by facilities as indicated by failure to issue IPT to pregnant women during ANC clinics was a barrier to uptake and utilization of this intervention. Two studies reported that late initiation of ANC visits was associated with sub-optimal uptake of IPT compared to early initiators and those who completed more than four ANC visits during

pregnancy. One study reported that long distance and more travel time to the healthcare facility was a barrier to optimal IPT uptake and utilization because it made access difficult.

Need factors

Need factors associated with utilization of IPT included perceived risk of malaria infection and associated complications and perceived benefits of IPT use. One study reported that mothers from malaria endemic areas were more likely to have optimal uptake of IPT compared to those from non-endemic areas since they felt at risk of infection. Additionally, one study reported that mothers who felt that their unborn babies were at risk of developing complications in case they get infected with malaria were more likely to have optimal uptake of IPT compared to those who did not have such perceptions.

Table 1: Determinants of ITNs utilization by number of identified studies reporting each determinant

Classification	Determinants	No. of studies
Predisposing factors		
	Education level	7 (43.75%)
	Individual beliefs	6 (37.50%)
	Myths and misconceptions	4 (25%)
	Knowledge on benefits of use	4 (25%)
	Knowledge on malaria transmission and prevention methods	4 (25%)
	Sleeping arrangements	3 (18.75%)
	Marital status	2 (12.50%)
	Age	2 (12.50%)
	Sex	2 (12.50%)
	Shape and color of the net	2 (12.50%)
	Socio-cultural beliefs	1 (6.25%)
	Gravidity	1 (6.25%)
Enabling factors		
	Accessibility	9 (56.25%)
	Socio-economic status	6 (56.25%)
	Side effects	6 (56.25%)
	Cost of buying an ITN	4 (25%)
	Logistics of using an ITN	4 (25%)
	Setting (Rural/Urban)	1 (6.25%)
	Stock outs	1 (6.25%)
Need Factors		
	Perceived risk of malaria infection and associated complications	4 (25%)
	Perceived benefits of ITN use	1 (6.25%)

Table 2: Determinants of IPT utilization by number of identified studies reporting each determinant

Classification	Determinants	No. of studies
Predisposing factors		
	Education level	2 (12.5%)
	Knowledge on malaria transmission and prevention methods	2 (12.5%)
	Knowledge on benefits of use	2 (12.5%)
	Marital status	2 (12.5%)
	Age	1 (6.25%)
Enabling factors		
	IPT practice by health facility	3 (18.75%)
	Gestational age at ANC initiation	2 (12.5%)
	Accessibility of IPT	1 (6.25%)
Need Factors		
	Perceived risk of malaria infection and possible complication	2 (12.5%)
	Perceived benefits of IPT use	2 (12.5%)

IV. DISCUSSION

The determinants of utilization of ITNs and IPT for malaria prevention in Kenya identified in this systematic literature review include; predisposing factors (education level, individual beliefs regarding ITNs or IPT, knowledge on malaria transmission and prevention methods, age, marital status, sex, myths and misconceptions, sociocultural beliefs, shape and color of ITNs, sleeping arrangement, knowledge on benefits of ITN or IPT use, and gravidity), enabling factors (socio-economic status, cost of buying an ITN, accessibility, ITN stock outs, side effects, logistics of using an ITN, setting, IPT practice by facility, and gestational age at initiation of antenatal clinic) and need factors (perceived risk of malaria infection and associated complications, and perceived benefits of using an ITN or IPT).

Education level was identified as a key factor affecting utilization of both ITN and IPT use across all populations. This is in line with other research studies that have associated a higher education level with better uptake and utilization of these malaria preventive interventions. A systematic literature review conducted to determine factors affecting delivery and use of malaria preventive interventions in sub-Saharan Africa reported that there was low coverage of IPT and ITNs among women without education compared to educated women [14]. Being educated is associated with higher socioeconomic status and higher knowledge on malaria transmission and prevention thus better decisions on taking up malaria prevention interventions [15]. Designing health education programs to educate community members on malaria prevention may help to overcome this challenge.

Access to ITNs and IPT was reported by many studies in this review as a determinant of uptake and utilization of these interventions. Factors such as cost, availability, distance to health facilities, stock outs, IPT practice by healthcare facilities, and prioritization of pregnant women and children below five years when ITNs are being issued by facilities can all impact on

the people's ability to access these interventions. The findings are in line with a study conducted in Uganda which indicated that access related issues such as stock outs and cost were a major barrier to utilization of malaria preventive interventions. The study recommended mass distribution of free ITNs as a strategy that can be used to improve access to these interventions [16]. Programs such as mass distribution of free ITNs and delivery of IPT at the community level may help to improve access to these interventions for the Kenyan populations.

Knowledge on malaria transmission and prevention measures and benefits of ITN or IPT use were also identified in this review as major determinants of utilization of these interventions in Kenya. Similarly, a study conducted in South Sudan reported lack of knowledge on malaria transmission, prevention measures and how to use them as a major barrier to compliance with utilization of preventive measures [17]. Incorrect beliefs and myths regarding ITNs were also identified as key barriers to utilization with up to four studies reporting this association. A study conducted in rural Uganda reported similar results indicating that misperceptions were a major barrier to use of ITNs [18]. Myths and misconceptions can be a great barrier to implementation of any health intervention and timely correction is always needed in order to have successful programs.

Adverse effects associated with frequent exposure to ITNs were reported by several studies as reasons given by participants for not using this intervention with headache and dizziness being mostly reported. Although not many studies have specifically investigated the potential effects of continuous exposure to synthetic pyrethroids used in ITNs, those conducted suggest that it is safe even to newborn babies. A randomized controlled trial conducted among mothers with newborn babies in Burkina Faso to investigate safety of ITNs reported that they were generally safe to use with only few cases of headache reported by the mothers [19]. There is a need to conduct more studies on potential side effects of ITNs use in order to determine whether reported side effects are real or just perceived.

The determinants of ITNs and IPT utilization identified in this systematic review are not unique to Kenya and have been reported globally, and especially within the African region. With many countries still performing below expectations in the fight against malaria, achievement of SDG 3 by 2030 remains uncertain. World Health Organization reported an increase in the global incidence of malaria infections in 2021 compared to 2020, with the highest burden being in Africa [2]. Low uptake and utilization of existing malaria preventive measures has been associated with the high burden of the disease in African countries. Factors similar to the ones identified in this systematic review have been reported to hinder progress in the fight against malaria infection in many African countries [20]. Since malaria is a global public health concern, global efforts are needed to support countries struggling to end malaria pandemic if SDG 3 is to be achieved by 2030. Programs should be designed to make ITNs and IPT available for example mass distribution and provision of free nets to all populations at risk. Also, community health programs should be started to educate populations on malaria transmission and prevention methods. Such programs will require efforts from global communities to avail funding and technical support for them to be successful.

The strength of this systematic review is that it included studies that focused on different population groups including those from endemic and seasonal transmission areas thus giving a wider picture of ITNs and IPT use behavior and associated factors. Inclusion of qualitative and mixed method studies also brought a deeper understanding of ITNs and IPT utilization behavior. The use of Andersen's framework to report findings provided a clear picture of the identified determinants. The limitations of this systematic review include heterogeneity in characteristics of included studies such as variability in study participants, setting, and methodology which may affect interpretation of findings. The number of identified studies reporting on determinants of IPT utilization in Kenya was very small pointing to the few number of studies conducted in the country focusing specifically on IPT utilization. More studies need to be conducted focusing on IPT utilization in Kenya and its associated factors.

V. CONCLUSION

A number of determinants of ITNs and IPT utilization in Kenya were identified in this systematic review and this could be classified as predisposing, enabling and need factors based on Andersen's model of health service utilization. The determinants are not unique to Kenya but impact on malaria prevention behaviors in many countries especially within the African region where the burden of malaria infections is highest. In order to accelerate progress towards achievement of SDG 3 by 2030, collaborative efforts are needed from governments and the international community to design and implement programs to improve uptake of malaria preventive interventions in Kenya and other countries.

APPENDIX 1: SUPPLEMENTARY TABLE

The online supplementary table is provided as a separate document

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REFERENCES

1. United Nations, 2022. *Goal 3: Ensure healthy lives and promote well-being for all at all ages*. [online] United Nations. Available at: <https://sdgs.un.org/goals/goal3>.
2. World Health Organization, 2023. *Malaria*. [online] Who.int. Available at: <https://www.who.int/news-room/fact-sheets/detail/malaria>.
3. Ministry of Health, 2021. *Kenya Malaria Indicator Survey 2020 Final Report*. Ministry of Health, Kenya.
4. Sultana M, Sheikh N, Mahumud RA, Jahir T, Islam Z, Sarker AR. Prevalence and associated determinants of malaria parasites among Kenyan children. *Trop Med Health*. 2017; 45:25.
5. Ministry of Health, 2020. *Kenya Progress Report on Health and Health-related SDGs*. Ministry of Health, Kenya.
6. Kenya National Malaria Control Program, 2018. *Atlas of Africa Statistics Report 2018*
7. Ministry of Health, 2001. *Kenya National Malaria Strategy 2001-2010*. Ministry of Health, Kenya.
8. Udu, R., Ochieng, D. and Apat, D., 2017. The level of adoption of malaria prevention strategies on pregnant women in Sauri, Siaya sub county, Kenya. *Int J Adv Sci Res Manag*, 2, pp.47-51.
9. Moher, D., Liberati, A., Tetzlaff, J., Altman, D.G. and PRISMA Group*, T., 2009. Preferred reporting items for systematic reviews and meta-analyses: the PRISMA statement. *Annals of internal medicine*, 151(4), pp.264-269.
10. Moola, S., Munn, Z., Tufanaru, C., Aromataris, E., Sears, K., Sfetcu, R., Currie, M., Qureshi, R., Mattis, P., Lisy, K. and Mu, P.F., 2017. Chapter 7: Systematic reviews of etiology and risk. *Joanna Briggs institute reviewer's manual*. The Joanna Briggs Institute, 5.
11. Hong, Q.N., Pluye, P., Fàbregues, S., Bartlett, G., Boardman, F., Cargo, M., Dagenais, P., Gagnon, M.P., Griffiths, F., Nicolau, B. and O'Cathain, A., 2018. Mixed methods appraisal tool (MMAT), version 2018. *Registration of copyright*, 1148552(10).

12. George PP, Molina JA, Heng BH. The methodological quality of systematic reviews comparing intravitreal bevacizumab and alternates for neovascular age related macular degeneration: A systematic review of reviews. *Indian journal of ophthalmology*. 2014 Jul; 62(7):761.
13. Travers, J.L., Hirschman, K.B. and Naylor, M.D., 2020. Adapting Andersen's expanded behavioral model of health services use to include older adults receiving long-term services and supports. *BMC geriatrics*, 20(1), pp.1-16.
14. Hill, J., Hoyt, J., van Eijk, A.M., D'Mello-Guyett, L., Ter Kuile, F.O., Steketee, R., Smith, H. and Webster, J., 2013. Factors affecting the delivery, access, and use of interventions to prevent malaria in pregnancy in sub-Saharan Africa: a systematic review and meta-analysis. *PLoS medicine*, 10(7), p.e1001488.
15. Balami, A.D., Said, S.M., Zulkefli, N.A.M., Bachok, N.A. and Audu, B., 2019. Effects of a health educational intervention on malaria knowledge, motivation, and behavioural skills: a randomized controlled trial. *Malaria journal*, 18, pp.1-14.
16. Wafula, S.T., Mendoza, H., Nalugya, A., Musoke, D. and Waiswa, P., 2021. Determinants of uptake of malaria preventive interventions among pregnant women in eastern Uganda. *Malaria Journal*, 20(1), pp.1-8.
17. Ayeni, G.O., Olagbegi, O.M., Nadasan, T., Abanobi, O.C. and Daniel, E.O., 2020. Factors Influencing Compliance with The Utilization of Effective Malaria Treatment and Preventive Measures in Wulu, South Sudan. *Ethiopian Journal of Health Sciences*, 30(4).
18. Perkins, J.M., Krezanoski, P., Takada, S., Kakuhikire, B., Batwala, V., Tsai, A.C., Christakis, N.A. and Bangsberg, D.R., 2019. Social norms, misperceptions, and mosquito net use: a population-based, cross-sectional study in rural Uganda. *Malaria journal*, 18, pp.1-13.
19. Lu, G., Traoré, C., Meissner, P., Kouyaté, B., Kynast-Wolf, G., Beiersmann, C., Coulibaly, B., Becher, H. and Müller, O., 2015. Safety of insecticide-treated mosquito nets for infants and their mothers: randomized controlled community trial in Burkina Faso. *Malaria Journal*, 14, pp.1-7.
20. Pell, C., Straus, L., Andrew, E.V., Menaca, A. and Pool, R., 2011. Social and cultural factors affecting uptake of interventions for malaria in pregnancy in Africa: a systematic review of the qualitative research. *PloS one*, 6(7), p.e224

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Supplementary table 1: Key information for studies included in the systematic review

Title of study	Author	Publication Year	Study design	Sample size	Main Findings	Quality Score
Insecticide-treated net (ITN) ownership, usage, and malaria transmission in the highlands of western Kenya	Atieli et al.	2011	Cross-sectional study	2425 (Male=1042 Female= 1383)	Determinants of ITN utilization included; season, education level of parent/guardian and knowledge on malaria transmission and prevention	80%
Factors influencing the usage of different types of malaria prevention methods during pregnancy in Kenya	Choonara et al.	2015	Cross-sectional study	622*	Factors influencing ITN and IPT utilization included; age, whether an area was malaria endemic or not, marital status, education level and socioeconomic status	70%
Comparing ownership and use of bed nets at two sites with differential malaria transmission in western Kenya	Ernst et al.	2016	Mixed-method (qualitative and cross-sectional)	105 (Male=53, Female=52)	Factors influencing utilization of ITNs included; access, cost, distance to health facility, stock outs, unintended side effects, beliefs, knowledge on malaria transmission and prevention, logistics of using a net, education level, wealth index and season	80%
Community reactions to the introduction of permethrin-treated bed nets for malaria control during a randomized controlled trial in western Kenya	Alaii et al.	2003	Qualitative study	137 (Male=33, Female=104)	Factors influencing utilization of ITNs included; concerns about the chemical used in ITNs, logistics of using the net, and season	90%
Insufficient Ratio of Long-Lasting Insecticidal Nets to Household Members Limited Universal Usage in Western Kenya: A 2015 Cross-Sectional Study	Coalson et al.	2020	Cross-sectional study	3834 (Male=27.5% Female=72.5%)	Determinants of ITN use included; perceived high risk of malaria infection, sex, and access	90%
Access and barriers to measures targeted to prevent malaria in pregnancy in rural Kenya	Gikandi et al.	2008	Cross-sectional study	4549*	Factors influencing ITN and IPT use included; whether someone was multigravida or primigravid, distance to ANC clinic, socioeconomic status, and education level	70%
Use of intermittent presumptive treatment and insecticide treated bed nets by pregnant women in four Kenyan districts	Guyatt et al.	2004	Cross-sectional study	1814*	Factors influencing use of ITNs and IPT included; setting and IPT practice by health facility	70%
Insecticide-treated net use before and after mass distribution in a fishing community along Lake Victoria, Kenya: successes and unavoidable pitfalls	Larson et al.	2014	Cross-sectional study	12404 (Male=49%, Female=51%)	Determinants of ITN use included; sex, education level, sleeping arrangements, age and access	80%

Use of insecticide treated nets among caregivers of children under five years in Makueni District, Kenya	Malusha et al.	2009	Cross-sectional study	400 (Male=45, Females=355)	Determinants of ITN use included; availability, cost, concerns about the chemical used in ITNs, side effects, marital status, education level, socioeconomic status, and knowledge on malaria prevention	80%
Determinants of the uptake of intermittent preventive treatment of malaria in pregnancy with sulphadoxine pyrimethamine in Sabatia Sub County, Western Kenya	Mutanyi et al.	2021	Cross-sectional study	372*	Determinants of IPT uptake included; marital status, gestational age at ANC initiation, knowledge on benefits of IPT and optimal doses, and IPT practice by health facilities	90%
Bed net use and associated factors in a rice farming community in Central Kenya	Ng`ang`a et al.	2009	Mixed-method (Cross-sectional study and qualitative)	368 (Male=127, Females=241)	Determinants of ITN use included; perceived benefits of bed nets, logistics of using a net, beliefs, cost, shape, and color of the net	80%
Use of insecticide treated bed nets among pregnant women in Kilifi District, Kenya	Njoroge et al.	2009	Mixed method (Cross-sectional and qualitative)	220*	Determinants of ITN use included; cost, perception of low risk of malaria, shape and color of the net, social cultural believes, individual beliefs, sleeping arrangements, and religion	70%
Prevalence and correlates of insecticide-treated bed net use among HIV-1-infected adults in Kenya	Nnedu et al.	2012	Cross-sectional survey	388 (Males=24.7%, Females=75.3%)	Determinants of ITN use included; education level and socioeconomic status	80%
Wealth, mother's education and physical access as determinants of retail sector net use in rural Kenya	Noor et al.	2006	Cross-sectional study	2695**	Determinants of ITN use included; education level, access, and wealth index	70%
Implementation of intermittent preventive treatment with sulphadoxine-pyrimethamine for control of malaria in pregnancy in Kisumu, western Kenya	Van Eijk et al.	2004	Cross-sectional study	1498*	Determinants of IPT use included; gestational age at ANC initiation, knowledge on optimal IPT doses, and IPT practice by health facility,	90%
Use of intermittent preventive treatment for malaria in pregnancy in a rural area of western Kenya with high coverage of insecticide-treated bed nets	Van Eijk et al.	2005	Cross-sectional study	635*	Determinants of IPT use included; availability, logistics of using a net, perceived inconvenience, perceptions on malaria complications, and being primigravida or multigravida	80%

*Study included only females

**Breakdown of males and females not provided