

# Effectiveness of Health Education in Community-based Malaria Prevention and Control Interventions in sub-Saharan Africa: A Systematic Review

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## ABSTRACT

**Objective:** This review assessed the effectiveness of health education in community-based malaria prevention and control interventions in sub-Saharan Africa (SSA).

**Methods:** We systematically reviewed published and unpublished literature, searching 7 databases and 3 websites namely Malaria Journal, World Health Organization and Centre for Disease Control and Prevention to find relevant studies. Study designs included were randomized controlled trials, non-randomized trials, quasi experiments, before and after studies, and surveys. A narrative synthesis was performed on the extracted data.

**Results:** Seventeen studies were included in the review. Nine studies covered health education interventions on Insecticide Treated bed Nets (ITNs), three utilised health education to promote Intermittent Presumptive Treatment in pregnancy (IPTp), four reported on the effect of health education in home-based management of malaria whilst one study focused on environmental management in malaria control. Factors found to affect health education in malaria control and prevention interventions included educational level of participants, the nature of health messages and the level of community involvement.

**Conclusion:** The results of the review suggest that health education interventions are effective and remain a valuable tool in community-based malaria prevention and control interventions in SSA. This review found moderate evidence that health education interventions influence the uptake of community-based malaria prevention and control interventions, enhance knowledge about malaria and generally improve malaria prevalence and mortality in children under five and pregnant women.

**Key words** Malaria, systematic review, health education, sub-Saharan Africa

## INTRODUCTION

Health education has long been considered an important approach in the implementation of community-based malaria prevention and control interventions in sub-Saharan Africa (SSA).<sup>1</sup> Health education in malaria prevention and control interventions traditionally have been championed through radio education, TV and newspaper advertisements, talk shows and documentary series.<sup>2</sup> Live concerts and musical shows have been used in communities to educate people about malaria prevention and control.<sup>3</sup> More recently, a number of malaria interventions in SSA have utilised participatory techniques in educating communities in malaria interventions.<sup>4</sup> Community health workers (CHWs) have also served as health educators in the promotion and education of the appropriate use of Insecticide Treated Nets (ITNs), Intermittent Presumptive Treatment in pregnancy (IPTp) and home base management of malaria (HMM).<sup>5,6</sup> Other malaria interventions have utilised community volunteers to educate beneficiaries resulting in increased uptake of interventions.<sup>5</sup> As these interventions take up a greater portion of national governments' resources as well as budgetary allocations of international initiatives such as the RBM programme, their effectiveness is being questioned due to lack of strong evidence.

Available literature indicates that there exists a complex relationship between health education and uptake of malaria interventions.<sup>2</sup> Arogundade *et al.*,<sup>7</sup> report that the use of health education in promoting ITNs led to an increase in ITN usage among pregnant women in Nigeria. Research further shows that malaria interventions such as HMM, ITNs and IPTp which use health education often engage community members who later became innovators in diffusing information about the intervention in the community, thereby increasing uptake of interventions.<sup>8,9</sup> Nigatu *et al.*'s<sup>6</sup> study, however, observed that increasing knowledge does not necessarily lead to behavioural change nor does education necessarily results in empowerment without power being ceded to individuals and communities in malaria interventions.

Although there are a plethora of primary studies suggesting the contribution of health education in community-based malaria interventions in SSA, there has not been any attempt to systematically review studies on this subject matter. To fill this gap, this systematic review was conducted to assess the extent to which health education has been effective in community-based malaria prevention and control interventions in SSA. A secondary aim of the review was to identify the factors that affect the effectiveness of health education in community-based malaria interventions.

The initial search showed that there are systematic reviews on malaria prevention in migrant population and travelers,<sup>10</sup> barriers to treatment,<sup>11</sup> ITNs usage<sup>12</sup> and home-base management of malaria.<sup>13</sup> These may not be the limit of systematic reviews of malaria prevention and control studies but there seems to be a gap in synthesising the body of evidence on health education in community-based malaria prevention and control interventions in SSA. Community-based interventions in malaria prevention in sub-Saharan Africa have gained grounds especially where community volunteers mainly referred to as community health workers have served as catalyst for fostering health education in malaria prevention and control.<sup>14</sup>

## METHODS

### Review format

The review was guided by the Evidence for Policy and Practice Information and Co-ordinating Centre's (EPPI-Centre) Methods for Conducting a Systematic Review.<sup>15</sup> The EPPI approach to conducting a systematic review allows for a greater variety of study designs to be included, as well as a narrative synthesis when appropriate<sup>16</sup> rather than including only Randomised Controlled Trials (RCTs) as advocated by traditional systematic reviews (e.g. Cochrane method). Like other systematic review organisations, the EPPI-Centre focuses on social science and public policy reviews, and requires accountability, rigour and explicit methods in conducting a review.

### Search Strategy

Seven electronic databases were searched for studies namely Academic Search Complete, MEDLINE, Global Health, EMBASE, CINAHL, PsychINFO and the Cochrane library. These databases are well renowned in extensive journals from health and allied health sciences including public health. Other websites such as World Health Organisation (WHO), Malaria Journal and Centre for Disease Control and Prevention were also searched. Experts in the field were also contacted to see if further studies could be added. This was done to capture relevant studies not published in databases to minimise selection bias.<sup>17</sup>

As recommended by the EPPI-Centre<sup>15</sup> the strategy balanced sensitivity with specificity in its results. Key words for searching were identified based on the focus of this review and included 'health education', 'malaria', 'prevention', 'sub-Saharan Africa', 'community-based', 'pregnant women', 'children under five'. Boolean operators such as 'OR / AND' were used to broaden or narrow the search. For instance, 'Malaria AND Community-based', 'Malaria AND children under five', Health education OR Health promotion. Word truncation was also employed. Thus, root words like 'malaria' and 'health education' were truncated as 'malaria\*', and 'health education\*'.

### Inclusion Criteria

#### *Types of Study Design*

Owing to the epistemological debates regarding the nature of evidence in Public Health, it was imperative to adopt a pluralistic approach for recruiting studies for this review. In view of this, no restrictions on study design was included. Due to the varying types of anticipated study designs, no restrictions were imposed on the control or comparison group. The time frame considered for the review was studies published in English from 1986 to 2010, where the base year depicts the milestone for health promotion and health education as a result of the Alma Ata Declaration of 'Health for All' and the onset of Ottawa Charter for health promotion which emphasised on community-based approaches and the end year (2010) marks assessment of progress towards the Roll Back Malaria Programme in SSA.

#### *Population*

The target group included pregnant women and children under five. Studies that targeted the entire community, mothers and caregivers of children under five were also included as they influence the adoption of interventions for children under five years.

#### *Intervention*

Studies reporting on the use of health education in combination with any of the following community-based

malaria prevention and control interventions (ITNs, IPTp, HMM and environmental management) were included. Community-based health education interventions that report on community involvement, empowerment and community health workers in malaria prevention and control were also included. All studies that reported on malaria control and prevention interventions without health education component were excluded. Studies that were not conducted in SSA were excluded to reduce the level of heterogeneity due to the scope of this review.

#### *Outcomes*

Studies reporting on any of the following outcomes were included:

- Effect of malaria intervention on prevalence, morbidity and mortality rates among pregnant women and children under five.
- Uptake of malaria interventions (ITNs, IPTp, HMM and environmental management).
- Knowledge and behavioural change resulting from the use of health education in malaria prevention and control interventions.

#### **Study quality assessment**

Central to judging the methodological quality of selected studies was the assessment of *internal validity* and *reliability* of the studies. The critical appraisal tool designed by Effective Public Health Practice Project (EPHPP)<sup>18</sup> was used for appraising the quality of the included studies. The assessment was based on the study design, sampling and selection, data collection methods, data analysis, validity and reliability of the study. Selected studies were analysed by the authors independently to assess the quality of the study and identify possible biases within the studies reviewed. Authors of selected studies were contacted via email where necessary to obtain missing data. After independent analysis of articles, authors ensured reliability through series of discussions for cross-checking extracted and analysed data until consensus was built.

#### **Data extraction and synthesis**

A decision on which data to extract from selected studies is crucial as it largely influences the findings of a review. A standardised data extraction form developed by the Centre for Reviews and Dissemination<sup>17</sup> was adapted for this study. The form consisted of these sections; details of publication, the aim of the study, study characteristics, study participants, nature of intervention, study findings, method of evaluation, outcome measures as well as reviewer's assessment of effectiveness of intervention based on extracted data and methodological quality of studies. The draft data extraction form developed at the protocol stage was piloted on a representative sample of the included studies and was refined to reduce bias and enhance its validity and reliability.<sup>19</sup>

Due to the considerable heterogeneity of the interventions, study designs and outcomes reported in the included studies, a meta-analysis was not practical.<sup>15</sup> Rather, a narrative synthesis (qualitative descriptive analysis of the differences and relationships of included studies) was conducted on extracted data to present the results of the review.<sup>17</sup> To avoid bias in the narrative synthesis, the results of each study were reported judiciously and efforts were made to avoid inappropriate emphasis on the findings of any one particular study.

## **RESULTS**

### **The intervention studies**

A systematic and thorough search yielded 857 references of which 793 were irrelevant to the review. Fig. 1 depicts the results of the literature search. Fifty-six (56) full texts were retrieved for inclusion. Forty-one (41) of the retrieved studies failed to meet the inclusion criteria and were further excluded (31 excluded on the basis of the intervention or outcome; 4 studies excluded by study design and 6 were commentaries). Three (3) additional studies were obtained via reference list of included studies and one (1) study was obtained from the authors which were eligible for inclusion. A total of nineteen (19) studies finally met the inclusion criteria and data were extracted for synthesis. Two studies were excluded after data extraction due to inadequate information for the review. Seventeen studies (17) were finally included in the review.

#### *Study setting and design*

Table 1 presents the characteristics of the studies and the interventions. As shown in Table 1, three each of the studies were conducted in Kenya<sup>20-22</sup> and Burkina Faso,<sup>23-25</sup> two each were conducted in Ghana,<sup>26,27</sup> Nigeria<sup>28,29</sup> and Uganda<sup>30,31</sup> and a study each from Benin,<sup>32</sup> Mali,<sup>33</sup> Tanzania,<sup>34</sup> Sudan,<sup>35</sup> and Eritrea<sup>36</sup>. Five each of the seventeen studies for the review were cluster-randomised controlled trials (c-RCT) and before-and-after studies. Four studies were survey with quantitative outcomes, two non-randomised trials and a quasi-experimental study.

### Characteristics of the interventions

As indicated in Table 1, some of the interventions targeted specific population groups such as mothers and caregivers of children under five,<sup>23,29</sup> pregnant women<sup>21,22,25,30</sup> and school children<sup>27</sup> whilst nine interventions targeted the entire community.<sup>24,26,28,30-32,34-36</sup> The health education interventions focused on ITNs,<sup>20,21,24,27,28,31,33,35,36</sup> IPTp,<sup>22,25,30</sup> HMM,<sup>23,26,29,32</sup> and environmental management.<sup>34</sup> All interventions that targeted pregnant women focused on enhancing knowledge and appropriate use of IPTp for controlling malaria in pregnancy. All the interventions had a training component. Although the basic methods used in the interventions were similar (discussion, drama, skills training, IEC.), they had variable structures, intensities of input and durations. Most studies used a combination of methods to deliver the interventions.

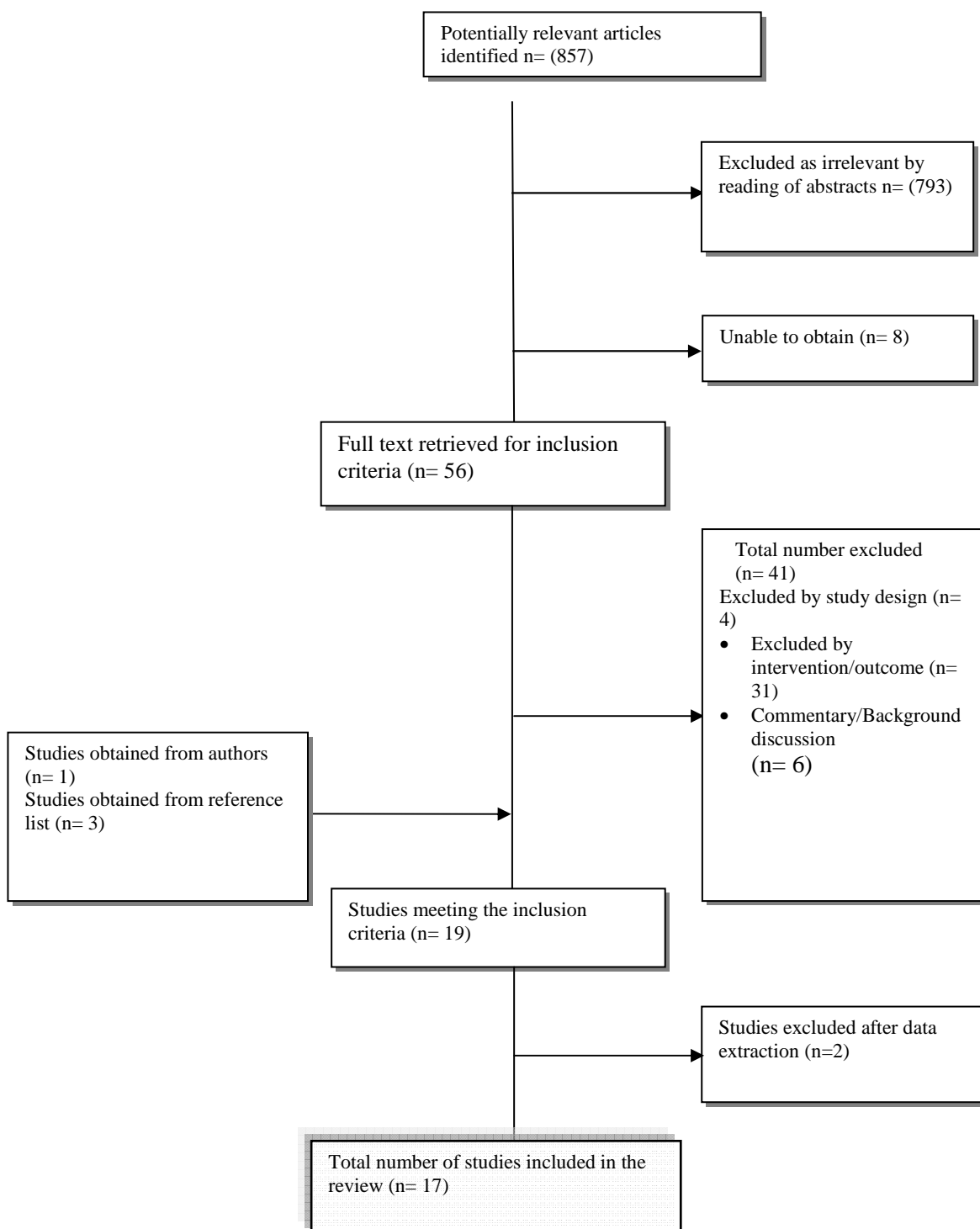


Fig. 1: Study Selection Process

The specific methods used included information communication methods (posters, brochures, television, radio, bill boards, flip charts, videos), interpersonal communication,<sup>20,22,24,27-30,33,35</sup> popular media (role-play, music and dance, drama and games)<sup>20,25,27,33</sup> and interactive learning methods (group discussions and workshops).<sup>20,21,23,25,29,32,33,36</sup> Majority of the studies engaged professional staff to carry out the intervention, but two studies considered the effectiveness of peer-educators.<sup>23,30</sup> One key characteristic across the studies was the involvement of community members in the intervention. Seven interventions enabled some form of participant control.<sup>28,120,25,30,32,33</sup> Trained volunteers generally known as community health workers mainly facilitated the delivery of activities of the interventions. Ayi *et al.*,<sup>27</sup> used school children as players in delivering the intervention to their respective communities.

### Study participants

Five studies had sample size above 1000 with the largest being 2240.<sup>25</sup> The smallest sample size was 133 (70 for intervention group and 63 for control group).<sup>33</sup> Studies which used cluster sampling were delineated by administrative boundaries, catchment zone of health facility or malaria endemic zones. Participants of most studies were randomly recruited with households being the unit of sampling. Majority of the studies included mothers, caregivers and pregnant women,<sup>24,26,28,29,31,32,35,36</sup> but four studies were for pregnant women only,<sup>21,22,25,30</sup> and two targeted the general population.<sup>33,34</sup> Ayi *et al.*,<sup>27</sup> included school children. All studies were community-based and majority of them were conducted in a rural setting (12/17). Two studies were conducted in an urban setting<sup>29,34</sup> and three studies were conducted in both urban and rural settings.<sup>24,27,36</sup>

### Theoretical basis of interventions

Two studies<sup>27,34</sup> stated clearly that community participation underpinned the intervention. Although not stated by most of the studies, the concept of community involvement was used in all interventions. Houeto and Deccache<sup>32</sup> stated the intervention was based on health promotion concepts (empowerment, participation, equity, collaboration and sustainability) whilst study March *et al.*,<sup>24</sup> reported that the intervention was based on social marketing principles.

Table 1: Characteristics of studies and interventions

Study	Study Design	Nature of intervention	Target group	Implementation methods	Activities	Time-frame of intervention exposure	Setting	Study Quality
Elsheikh <sup>35</sup>	Quasi-experiment	Educational programme of ITNs distribution and treatment	Children under five and pregnant women	Advocacy, community mobilisation, information and communication strategy, interpersonal communication	Community volunteers mobilise community members and embarked on interpersonal selling of malaria, posters were distributed and billboards raised	Not stated	Sudan, Rural	High
Houeto and Deccache <sup>32</sup>	Before and after study	Community-based health promotion programme to control malaria in children under five	Children under five, mothers and caregivers of children under five	Community mobilisation, advocacy and training	Group discussions and general assembly of community members were held to get the community involved in identifying causes, control and prevention of malaria and resources for success, community healthworkers helped in mobilising community members in group meetings, training and environmental management activities	27 months	Benin, Rural	Moderate
Marsh <i>et al.</i> , <sup>20</sup>	c-RCT	Community ITNs usage educational programme	Mothers and caregivers of children	Training, communication and information strategies	School teachers in the community were trained as	1 year	Kenya, Rural	Low

			under five		health workers. The project staff and health workers engaged community members in small group discussions, role-play and the use of video, pictures, flip charts and posters to educate community members on ITNs				
Mbonye, Eygberg and Magnussen <sup>20</sup>	Non-RCT	An intervention to assess delivering of IPT at the community level compared with health facilities	Pregnant women	Community mobilisation, training	Community representatives were trained as health workers to promote safe motherhood and correct use of IPT in pregnancy.	Not stated	Uganda, Rural	Moderate	
Kouyaté <i>et al.</i> , <sup>23</sup>	c-RCT	An intervention to improve home-based management of childhood malaria and bridging the gap between health care providers and mothers in the management of childhood malaria	Caregivers of pre-school children, women groups	Training of women as peer educators, community mobilisation	Training course on malaria management and control was done for health workers who also undertook further training for women group leaders. The women group leaders became peer educators in community sensitisation campaigns. Pictorial charts, posters and role-play were used.	1 year 3 and months	Burkina Faso Rural	Moderate	
Ouma <i>et al.</i> , <sup>22</sup>	Cross-sectional survey	An intervention to enhance appropriate IPT usage and control malaria in pregnancy	Pregnant women	Training	Health care workers were trained on the appropriate use of IPT. Community brochures were used to deliver IPT information to communities.	2 years	Kenya, Rural	Moderate	
Williams <i>et al.</i> , <sup>21</sup>	Before and after study	Community-based education on malaria prevention, malaria and ITNs use	Pregnant women, children under five and community members.	Training and community education, community mobilisation and participation	Not stated	1 year	Uganda, Rural	Low	
Gies <i>et al.</i> , <sup>25</sup>	c-RCT	A promotional intervention to evaluate antenatal care use and improve IPT uptake for malaria control in pregnancy.	pregnant women	Training, community mobilisation and involvement	Training workshop for health care providers on the delivery of IPT, local knowledge, beliefs and traditions relate to malaria were identified using interviews and group discussions. Health messages were developed based on community's the findings of the interviews and group discussions. Posters and pictorial materials as well as games, music and dance were used	4 years	Burkina Faso, Rural	High	

Rhee <i>et al.</i> , <sup>33</sup>	Before and after study	Educational programme to promote ITNs usage for malaria prevention	community members	Skill training and education about signs, symptoms, transmission and prevention of malaria	in the malaria program at the community level Group discussions and malaria sensitization through public speaking and meetings	Not stated	Mali, Rural	Low
Chirdan, Zoakah and Ejembi <sup>19</sup>	Before and after study	An intervention to strengthen malaria knowledge, practice of prevention and treatment among care givers of children under five.	caregivers of children under five	Training	Group discussions, posters and charts were used as teaching aids for the training on malaria causes, control and prevention	Not stated	Nigeria, Urban	High
Castro <i>et al.</i> , <sup>34</sup>	Cross-sectional survey	An evaluation of a community-based environmental management intervention to prevent malaria.	community members	Community sensitisation and involvement	Community sensitisation and environmental management activities	1 year and 7 months	Tanzania Urban	Moderate
Owusu Agyei <i>et al.</i> , <sup>24</sup>	Longitudinal survey	An intervention to evaluate progress of FEM in reducing malaria morbidity and mortality.	Mothers and caregivers of children under five, community members	Community healthwork (Training)	Training of caregivers in home management of malaria	4 years	Ghana, Rural	Moderate
Shulman <i>et al.</i> , <sup>21</sup>	c-RCT	An intervention to reduce parasite exposure upon the adverse consequences of malaria in pregnancy.	Pregnant women	Education	House-to-house education, group discussions, posters, plays and interactive learning sessions were held on ITNs handling and usage	14 months	Kenya, Rural	Moderate
Brieger <i>et al.</i> , <sup>28</sup>	c-RCT	An intervention to study community members reactions to ITNs provision alternative to IRS and insecticides treated curtains	Community members and Children under five.	Persuasive communication, Community healthwork (Skills development)	Field workers mobilised community members, Community training sessions were held on the importance and use of ITNs followed by house-to-house education and support	11 months	Nigeria, Rural	Moderate
Nyarango <i>et al.</i> , <sup>36</sup>	Cross-sectional survey	An intervention of assessing Eritrea's malaria control programme.	Children and pregnant women and community members	A holistic national programme with health systems strengthening and information and communication strategy inclusive	Training, workshops, practices in the prevention and protection against malaria, community mobilisation and involvement and governmental policy	5 years	Eritrea, Rural and urban	High
Muller <i>et al.</i> , <sup>24</sup>	c-RCT	ITNs distribution through a social marketing system	children under five and community members	Education and communication	Promoting ITN usage through radio and television messages, and posters	12 months	Burkina Faso, Rural and urban	Low
Ayi <i>et al.</i> , <sup>27</sup>	Before and after study	School-based malaria education intervention on children and community members.	community members and school children	Training, visual materials and role-play	Community campaign by school children through the use of picture charts, posters, songs, drama, poetry and <i>durbar</i>	8 months	Ghana, Partially urban and rural	Low

### Narrative synthesis of findings

Heterogeneity in intervention designs and outcomes made meta-analysis and effect size for synthesis impracticable and inappropriate. Studies were therefore categorised and described as reported in the following narrative synthesis.

#### ITNs

Nine studies<sup>20,21,27,28,31,33,35,36</sup> covering interventions on ITNs use were found. Elsheikh<sup>35</sup> used a quasi-experimental design, consisting of two groups experimental and control to examine the effect of health education on ITNs utilisation in Sudan. The intervention resulted in increased acceptance and utilisation of ITN all year round from 2.7% at baseline to 41.3% in the intervention group (OR=12.9,  $p=0.000$ ) but there was no significant difference in the control group. The percentage of children under 5 years who used ITNs was increased from 64% at baseline to 85.3% in the post survey, in the experimental group. The prevalence of malaria decreased by 5% in the experimental community from 29.3% at baseline to 24.3% at the post-intervention survey. Marsh *et al.*,<sup>25</sup> found that community education on ITNs use increased awareness usage of ITNs from 59% to 92% ( $p<0.001$ ). Rhee *et al.*, (2005) (9) found that there was a significant change in knowledge in the post educational intervention to ITNs usage ( $t=17.78$ ,  $p<0.001$ ) but no significant difference between the groups ( $p=0.96$ ). Individuals in the intervention group were significantly more likely to impregnate their nets than individuals in the control group (AOR= 0.52,  $p=0.001$ ). Shulman *et al.*,<sup>21</sup> assessed the effectiveness of ITNs in preventing malaria and anaemia among pregnant women in rural Kenya by conducting home-based education on correct hanging and handling of nets. There was lower level of severe anaemia in the intervention group (15.1%) than in the control group (20.1%) although the difference was not statistically significant. Nyarango *et al.*,<sup>36</sup> examined the effect of educating communities and training community health workers on malaria control. A time series analysis showed a strong negative relationship between the number of distributed ITNs and malaria morbidity ( $\beta = -0.125$ ,  $p<0.05$ ). Malaria morbidity was strongly correlated with the numbers of ITNs distributed ( $\beta = -0.125$ ,  $p < 0.005$ ). Ayi *et al.*,<sup>27</sup> reported that treatment of ITNs significantly increased from 21.5% to 50% in the intervention group ( $p<0.001$ ) although it was almost the same in the control group (25.3% to 30.5%).

#### IPTp

Three studies<sup>22,25,30</sup> were identified that utilised health education to promote IPTp. Mbonye, Bygbjerg and Magnussen<sup>30</sup> conducted a non-randomised community trial to assess a new delivery system of IPTp through traditional birth attendants, drug shop vendors, community reproductive health workers and adolescent peer mobilisers (the intervention) compared with IPTp at health units (control). After the intervention, there was an increased uptake of IPTp at the community level (92.4%) compared with health facility (76.1%). In a rural neighbourhood in Kenya, Omua *et al.*,<sup>22</sup> found that training of Health Care Workers and use of simplified IPTp messages increased IPTp coverage by 41% for at least one dose, and 21% for at least two doses of SP. Gies *et al.*,<sup>25</sup> conducted a cluster-randomized trial comparing intermittent preventive treatment with sulfadoxine-pyrimethamine (IPTp-SP) with and without community based educational activities in rural Burkina Faso. Complete uptake of IPTp-SP was 71.8% with and 49.1% without education ( $P = 0.008$ ). The IPTp-SP uptake was lowest in adolescents delivering during high malaria transmission with (29%) or without education (30%). Uptake of SP was higher during the low transmission season than in the high transmission season (adjusted odds ratio = 2.17, 95% confidence interval = 1.59-3.03).

#### HMM

Four studies<sup>23,26,29,32</sup> reported on the effect of health education in home-based management of malaria. Houeto and Deccache<sup>32</sup> used a quasi-experimental pre-post study conducted over a period of 27 months to assess the effect of health education in controlling child malaria in a rural community in Benin. The prevalence of malaria was significantly reduced from 34% to 20% after the intervention ( $p = 0.008$ ). The uptake of health care significantly increased after the intervention ( $\chi^2 = 48.07$ ,  $p = 0.000000$ ). Kouyaté *et al.*,<sup>23</sup> implemented a cluster-randomised controlled trial in rural Burkina Faso. Six and seven villages were randomly assigned to the intervention and control arms respectively. Febrile children from intervention villages were treated with chloroquine (CQ) by their mothers. Compared to baseline findings, the prevalence of anaemia (29% vs 16%,  $p < 0.0001$ ) and malaria parameters such as prevalence of *P. falciparum* parasitaemia, fever and palpable spleens was lower at follow-up but there were no differences between the intervention and control group. Chirdan *et al.*,<sup>29</sup> assessed the impact on health education on knowledge of malaria: its recognition, treatment and prevention among caregivers of children under five and found that the intervention significantly impacted on perception ( $P<.001$ ), knowledge ( $P<.001$ ), malaria prevention practice ( $P=.001$ ), first line treatment option ( $P=.031$ ) and the type of treatment given to the children with fever ( $P=.048$ ). Owusu-Agyei *et al.*,<sup>26</sup> found that educating



mothers/caregivers of children under five significantly improved the management in terms of the type and dosage of drugs ( $p < 0.0001$ ).

#### *Environmental management*

Castro *et al.*,<sup>34</sup> assessed the effect sensitising communities on environmental management has on malaria control. After community sensitization, two drains were cleaned followed by maintenance. There was a reduction in the odds of malaria infection during the post-cleaning period in intervention neighbourhoods when compared to the pre-cleaning period (OR = 0.12, 95% CI 0.05–0.3,  $p < 0.001$ ). During the post-cleaning period, a higher risk of infection (OR = 1.7, 95% CI 1.1–2.4,  $p = 0.0069$ ) was observed in neighbourhoods under no intervention compared to intervention ones.

#### *Factors affecting health education in community-based malaria interventions*

A few of the studies (6/17) highlighted the factors that influenced health education in the intervention. Elsheikh<sup>35</sup> stated that massive, persistent and repetitive health education messages positively influenced uptake of intervention. Marsh *et al.*,<sup>20</sup> indicated that identifying the right messages for education and perceptions of people about the severity of malaria affected the level of community involvement in the intervention. Williams *et al.*,<sup>31</sup> stated that failure to emphasise important messages affected the intervention's effectiveness. Castro *et al.*,<sup>34</sup> observed that health education in environmental management to prevent malaria was influenced by consistent educational programmes coupled with commitment of community members and financial resources for environmental management activities. Nyarango *et al.*,<sup>36</sup> found that high community involvement (80%) in educational components of malaria interventions influenced the uptake of such programmes. Ouma *et al.*,<sup>22</sup> found that the educational level of pregnant women was associated with uptake of IPT (OR 0.63,  $p=0.01$ ).

#### **Study quality assessment**

The quality of studies was assessed using the quality assessment tool developed by the Effective Public Health Practice Project<sup>18</sup>. Studies were assessed across eight categories (study design, selection bias, confounders, blinding, data collection methods, attrition, intervention integrity, and analyses) and rated on a scale of 1 to 3 accordingly. Averaging the category rankings assigned an overall rating of low, moderate and high for 1, 2 or 3 respectively. Four studies<sup>25,29,35,36</sup> were deemed to be of high quality. Eight studies<sup>21-23,26,28,30,32,34</sup> were deemed to have moderate quality. Five studies<sup>20,24,27,31,33</sup> were of low quality. Articles were not excluded due to a low quality rating but this was considered with analysing effectiveness.

#### **DISCUSSION**

This review aimed at assessing the effectiveness of health education in community-based malaria prevention and control interventions in SSA. Of the 17 studies included in the review, 13 focused on a single malaria intervention where health education was utilised with ITNs being the highest (7), followed by IPTp (3), HMM (2) and environmental management of malaria (1).

The findings provide clear evidence that health education is effective in increasing uptake of malaria prevention and control interventions in SSA. The review encountered a number of methodological problems, the first being the inability to include studies published in other language aside English. The lack of inclusion of literature in non-English languages is an important limitation on internationally comparative research. Another critical issue is that almost half of the studies had small sample size and this might have resulted in the lack of statistically insignificant differences in their findings as well as being prone to type II error.<sup>37</sup> Most of the cluster-RCT studies did not account for blinding and attrition which may have potential effect on the assessment of effectiveness.<sup>17</sup> Also, it was deemed crucial from the onset of this systematic review to include qualitative studies due to their ability to provide a multifaceted approach in exploring complex interventions in the field of public health and health promotion interventions.<sup>38</sup> Unfortunately, the search results yielded a few qualitative studies with some providing inadequate information and others totally ineligible to be included in the review. Not including qualitative studies in the review might result in losing valuable qualitative evidence on *why* health education is effective in increasing the adoption of malaria interventions.<sup>17</sup>

With the exception of one intervention<sup>34</sup> which focused on educating communities on environmental management practices, all other interventions focused on vector control (ITNs usage) and malaria treatment (IPT and HMM). This supports the fact that malaria interventions focus on reductionist biomedical approach of malaria control to the neglect of the socio-economic conditions that affect people's lives.<sup>39,40</sup>

Overall, moderate quality evidence showed the effectiveness of health education in uptake of community-based malaria interventions. All the included studies were consistent in their conclusions that health education

interventions were effective in malaria prevention and control by increasing the uptake of ITNs, IPTp, HMM and environmental management. They further reported that health education interventions resulted in reduced malaria prevalence and mortality in pregnant women and children under five. The health education interventions evaluated by these studies also led to enhanced knowledge in malaria prevention and control. These findings are consistent with other studies that when properly planned, health education can play a significant role in malaria prevention interventions.<sup>41-43</sup>

All the interventions had training components. Mothers/caregivers received training in HMM whilst community health workers and some community leaders mostly received training in appropriate use of ITNs. The methods used for the training included group discussions and interactive learning through art and play which were found useful in enhancing understanding of the health messages. The use of these methods is in line with the 'Freirean concept of critical consciousness where the learners are active and are able to reflect and participate in the learning process.'<sup>44</sup> Ledwith and Springett<sup>45</sup> note that interactive learning also promotes dialogue that could affect uptake of interventions. All the training programmes formed part of the health education which had positive impact on the uptake of malaria interventions. Alcock *et al.*,<sup>46</sup> note that the use of training in health education components of community-based interventions increases participants' knowledge and gives them the confidence to serve as trainers at community levels for ripple effect on uptake of malaria prevention and control interventions. On the contrary, Cho and White<sup>47</sup> argue that although most health education interventions influence knowledge, little has been done in translating the knowledge into attitudes which adds to the knowledge-attitude gap. For instance, Williams *et al.*,<sup>31</sup> and Castro *et al.*,<sup>34</sup> reported that uptake of ITNs by households did not translate into optimum utilisation in children under five after the intervention.

With the exception of Elsheikh<sup>35</sup> which used mixed communication methods (interpersonal communication and mass media), all other interventions adopted either mass media (posters, billboards, pictorial charts, television and radio broadcasting) or popular media (role-play, drama, music and dance) or both. Elsheikh<sup>35</sup> combined interpersonal communication with mass media and achieved more significant outcomes than the other studies that utilised only mass media. This is in line with Hubley and Copeman's<sup>48</sup> observation that although health messages disseminated through mass media may reach the target audience, the audience may not necessarily act on the message. Following the Elaboration Likelihood Model (ELM), the use of mixed methods in communicating health messages could possibly help the audience to assimilate messages which might result in high cognitive development leading to increased behaviour change.<sup>49</sup> Morton and Duck<sup>50</sup> further note that when persuasive interpersonal communication is combined with mass media, it can influence self-efficacy which leads to people's ability to act on the message received.

A few studies included a process evaluation, which provided additional information on activities and 'hidden' changes that occurred during the intervention which may have had impact on the outcomes of the study. Rychetnik *et al.*,<sup>51</sup> has recommended that public health and health promotion evaluation, to gain a better understanding of *why* outcomes are or are not achieved, should include process evaluation and report any unintended effects. Factors that affected health education in malaria prevention and control interventions included community mobilisation and involvement, educational level of the target audience and nature of health messages delivered. Community mobilisation and involvement in health education campaigns were major factors that influenced the effectiveness of the interventions. Community involvement in this review, however, only led to knowledge enhancement without empowering community members. For instance, Ayi *et al.*,<sup>27</sup> study which made use of school children in malaria prevention and control only led to information-giving without impacting significantly on the communities. It has been realised from Arnstein's ladder of participation that community involvement does not necessarily lead to optimum participation of community members.<sup>52</sup> Mobilising community members and using local people as health workers through top-down training by professionals is deemed as a 'face value' which is mere 'tokenism'.<sup>52</sup> It has been suggested that people ought to be active participants in health interventions by integrating their perceptions, skills and know-how into health programme planning and implementation.<sup>53</sup> That is, participation in health education interventions focusing on malaria prevention and control at community levels must go beyond information giving to consider consultation and partnership and empowering the community to enable them make informed choices about the adoption of malaria interventions.<sup>54</sup>

Identifying and emphasising the right health messages in a persistent and repetitive manner was found to increase the audience's knowledge which further positively influenced the uptake of malaria interventions.<sup>20,31,33-35</sup> Systematic planning of health messages provides an opportunity for meeting the real health information needs of people as well as developing relevant communication strategies.<sup>55</sup>

## Conclusion

The results of the review suggest that health education interventions are effective and remain a valuable tool in community-based malaria prevention and control interventions in SSA. This review found moderate evidence that health education interventions influence the uptake of community-based malaria prevention and control interventions, enhance knowledge about malaria and generally improve malaria prevalence and mortality in children under five and pregnant women. Evidence from the review points to several factors that affect the effectiveness of health education in malaria prevention and control interventions including combining training and interpersonal communication coupled with popular media (role play, drama and art), effective community mobilisation and involvement in interventions, and the use of simple, consistent and repeated health educational messages. It is recommended that health education in community-based malaria prevention and control interventions move beyond knowledge enhancement to influence behavioural change. This could be achieved when interventions are underpinned by health education and behavioural change models such as health belief model, health action model, theory of planned behaviour and stages of change theory.

## Competing interests

The authors declared that they have no competing interests. There were no sources of funding for this review.

## Authors' contributions

EOA and SBOA performed the literature search and screened articles for inclusion. EOA analysed and interpreted the data, with SBOA consulting and reviewing EOA's work. EOA and SBOA reviewed all full text, screened articles and together selected the included studies. EOA drafted the manuscript. SBOA reviewed and edited the manuscript. Both authors conceived and designed the study and approved the final version.

## Acknowledgement

The authors are grateful to Professor Chris Spoor of the Institute of Health and Wellbeing, Leeds Metropolitan University, UK for his helpful comments on the writing of this manuscript.

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