

# Attempting to Understand the Knowledge, Perspectives and Practices of People Living in Chilinza, Malawi on the Topic of Malaria

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## ABSTRACT

This study addresses the issue of malaria in the village of Chilinza in the country of Malawi. The goal of this study is to better understand the knowledge, practices, and perspectives of people living in Chilinza regarding malaria-specifically, using a community-centered approach, 1) learning to understand the problem through the eyes of the locals 2) identifying “positive deviance” or successful practices in use that could be replicated or amplified and 3) potential obstacles that the people of Chilinza have that prevent them from utilizing resources (cultural, practical, religious, etc.). This study utilizes quantitative preliminary surveys and qualitative in-depth interviews. The hypothesis is that there are households within the community that are already adopting “best practices,” and identifying and replicating these best practices can help reduce malaria cases. The findings of this study indicate that there are solutions from within the community for combating malaria transmission including using Insecticide Treated Bed Nets (ITBNs) regularly, typing up the ITBN during the daytime to preserve the net, and using *Mphungabwi* as a natural mosquito repellent. Although the findings of this study may be difficult to directly apply to other villages or countries, it can provide greater insight on how to effectively eradicate malaria from Chilinza and lessen malaria in other countries. This research project is generously funded by the center for African Studies at UC Berkeley. The Center for African Studies at UC Berkeley has no role in the design, the collection, analysis, and interpretation of data and in writing the manuscript.

**Keywords:** World Health Organization; Insecticide-treated bed nets; Malaria deaths; COVID-19

## INTRODUCTION

This research aims to identify solutions to malaria from within the community of Chilinza in Malawi. According to the World Health Organization (WHO), the African Region carries a disproportionately high share of global malaria cases. As of 2020, there were 241 million reported cases of malaria globally and 627,000 deaths due to malaria. The African region was home to 95% of global malaria cases and 96% of global malaria deaths. Children under 5 years of age accounted for approximately 80% of all malaria deaths in the African Region [1]. The COVID-19 pandemic has also disrupted attempts to deliver malaria services, contributing to the 14 million malaria cases and 69,000 deaths seen globally in 2020 [2]. From 2019 to 2020, there was an estimated 12 percent increase in malaria deaths in Sub-Saharan Africa. In light of COVID-19, there is an even greater urgency to develop methods to eradicate malaria from countries, especially in Sub-Saharan Africa.

One of the countries within Sub-Saharan Africa is Malawi, which

is a landlocked country in Sub-Saharan Africa. Malawi accounts for 2% of global malaria cases and deaths and is among the top 15 countries with a high malaria burden. As of 2019, 23% of all outpatient visits in Malawi stemmed from malaria, with 5.2 million confirmed cases. Malaria is most prevalent in rural villages outside of the cities in Malawi. There, the problems of poor nutrition, limited or no access to healthcare and reluctance to use Insecticide-Treated Bed Nets (ITBN) are most pronounced.

Although malaria is a deadly disease, it is preventable. Malaria prevention practices that are globally recognized and applied include using ITBNs at night when sleeping, using insecticide repellent, practicing vector control, ingesting antimalarial drugs, and, more recently and vaccinating children against malaria. There are challenges, however, to implementing these techniques, especially in more remote and rural areas and communities.

There have been numerous studies on the effectiveness of malaria prevention techniques in Malawi (ITBNs, mosquito larval vector control, and case management), as well as improvements in

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vaccine technology. But one aspect that has yet to be studied, from recent or past research, is 1) Identifying people who are already practicing effective malaria preventative techniques and 2) Understanding why those people choose to actively practice malaria prevention.

This strategy, called positive deviance, is drawn from Jerry Sternin who was a public health officer focused on malnutrition in children for Save the Children in Vietnam during the 1990s. Sternin decided to look for positive deviants-successful practices already in use that can be replicated or amplified in the communities [3]. This study seeks to take the principles from Sternin's experience in Vietnam and transfer them to the problem of malaria in a community of Malawi. No studies so far have attempted to look at malaria preventative practices already in place that have yet to be transferred to the entire community.

The importance of this study is that the findings can be used to find more effective ways of addressing malaria in the village of Chilinza. The study itself will most likely not be able to be applied globally or even nationally. But there may be certain practices and approaches that could potentially be applied to other villages or other countries. If this is the case, and the strategies and approaches used in this study are applied successfully in other villages and countries, then there could be large implications in the eventual eradication of malaria in Chilinza, Malawi, and globally.

## MATERIALS AND METHODS

### Study design and setting

This is a cross-sectional study using quantitative method surveys and qualitative method interviews. The research was conducted solely in Chilinza, TA Malili, Malawi. Chilinza is home to 207 households (as of July 2022). The study population included families with children between the ages of 0-17 years and the recruitment and subject permission took place via public announcement and word of mouth from the acting chief of Chilinza. Participation in the study was completely voluntary, and any household in Chilinza with children was eligible for participation in this study. The study took place over the course of 6 weeks between June 11<sup>th</sup>, 2022-July 20<sup>th</sup>, 2022 and consisted of a preliminary survey followed by interviews that were asked by a team fluent in English and Chichewa (the national language of Malawi). The study was separated into three phases-1) learning to understand the problem through the eyes of the locals 2) identify "positive deviants" or successful practices in use that could be replicated or amplified and 3) potential obstacles that the people of Chilinza have that prevent them from utilizing resources (cultural, practical, religious, etc.).

### Data collection

**Surveys:** The first and second phase of this study was conducted in the form of surveys. Since the surveys were conducted during the daytime when the male guardians were out working, those surveyed were almost all women. The children in the households also had their height and weight measured in order to calculate BMI (Body Mass Index) which can be used as a reflection of better nutrition. With the information from this survey we hoped to identify positive deviants-households that have children with BMI higher than the average as well as those who are less frequently sick. Once these households were identified, in-depth interviews took place in these

households. Families that had children whose BMI fell within the 5<sup>th</sup> and 85<sup>th</sup> percentile for their age as well as low prevalence of illness were deemed "healthy." However, most children measured were within the healthy BMI range based on their age and sex. Instead, there were differences in the frequency and consistency of people's ITBN usage. As a result, differences in ITBN usage were used to determine positive deviants.

**Interviews:** Phase three of this study was conducted through in-depth interviews. The interviewees were divided into five sections-households where everyone uses a mosquito net every day, households where only the parents use their net every day, households where only children use their net every day, households who do not have any mosquito net and households who sometimes use their mosquito nets. The goal of the interviews would allow us to gain a better understanding if there were certain practices and perspectives regarding ITBN usage and malaria prevention practices. Questions regarding malaria, mosquito breeding patterns, ITBNs, and other malaria preventive practices were asked.

## RESULTS AND DISCUSSION

Through the surveys and interviews, we were able to 1) Identify people who are positive deviants or those who are practicing malaria preventative techniques and 2) Understand why those people choose to actively practice malaria prevention. The findings are split into four Sections-strengths, Weakness, Opportunities, and Threats identified (SWOT) [4].

For this study, 160 households were enrolled in this study, each family had anywhere between 1-6 children. All 372 children (under the age of 18 years) in Chilinza were measured and weighed.

### Strengths

Through surveys and interviews, we were able to gain a better understanding of people's knowledge, perspective, and understanding of malaria, mosquitoes and ITBNs. Originally, we had hypothesized that there would be greater variations in nutritional habits and knowledge on mosquito breeding patterns. However, excluding 49 of the 372 children measured and weighed, all the other children in Chilinza were within the 5<sup>th</sup>-85<sup>th</sup> percentile Body Mass Index (BMI) for their age and sex, which is a healthy BMI according to the Center For Disease And Control (CDC, 2022) and within the 3<sup>rd</sup>-97<sup>th</sup> percentile z-score which is healthy for children under the age of 2 (NIHR, 2022). In addition, there was very little variation in nutritional habits and the number of meals being consumed. The average number of meals that children were eating on average was 2.46 meals a day. 337 out of 372 children were eating 2-3 meals a day (Figure 1).

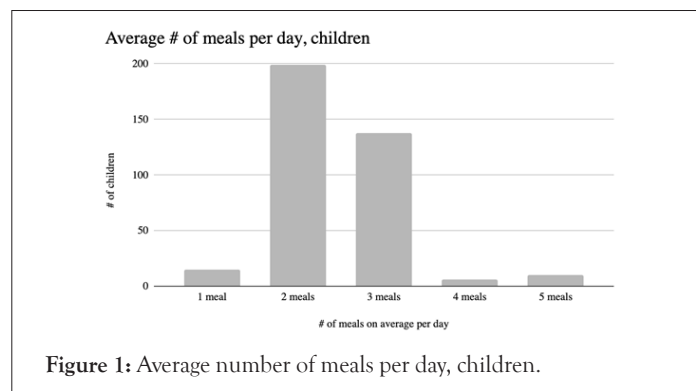


Figure 1: Average number of meals per day, children.

These food included, nsima, nkhwani (pumpkin leaves), nyemba (beans), rape (rapeseed), soya (soy beans), and mpilu (mustard leaves) to name a few. Some families included chicken, fish, and eggs, but these families were exceptions. These households had family members that worked at the school for construction and or cleaning. For this reason, those families were not considered as positive deviances. In addition, there were families that were eating 1 meal a day without much variation in nutrients. However, because these were not habits with positive effects, these cases were categorized as outliers but not positive deviants. While wealth can dictate access to better health outcomes, wealth level as a preventative measure was not included. Instead, the level of knowledge and understanding was focused on.

In addition, all of the 20 households interviewed, regardless of whether or not they owned or used an ITBN, knew that mosquitoes breed in stagnant water. All 20 households shared similar techniques for removing stagnant water-either they built drainage systems, or they did their laundry on a slope so that water drained better.

### Weaknesses

Weaknesses were also identified; it became clear that knowledge was dictating actions. More specifically a lack of knowledge was impacting decisions that negatively affected families. Households that did not have a clear understanding of how malaria was transmitted were often the families that were not using their ITBNs regularly. Some beliefs that reduced the usage of ITBNs included that malaria was spread when warm clothes were not worn or that malaria was spread when someone coughed on another person. One distinction that is important to make is that many colds and flus are often assumed to be malaria. Unless families get tested at the hospitals or clinics, many families assume that symptoms of colds and flus are malaria. This was identified in a previous survey done in 2017 when respondents from Chilinza claimed suffering from malaria monthly [5]. Because it is difficult for the people in Chilinza to get tested at the medical clinic every time they feel ill, it is not plausible to know the actual number of cases of malaria that occur. In addition, because cold-like symptoms are often perceived to be malaria, some households in Chilinza do not perceive malaria as a huge threat, nor a preventable threat. The fear and threat of malaria is not as present or imminent.

From interviews, it was clear that misconceptions of how malaria is transmitted translated into misuse of ITBNs. Some households that did not have a clear understanding of malaria transmission reported using their nets for other circumstances. One family of 5 that was interviewed has one usable net because the other net was used for fishing. It is relatively common for people to use ITBNs as fishing nets not just in Chilinza but also in Malawi which is an issue that stems from food insecurity [6]. When asked how malaria was transmitted, both the mother and father answered not eating good food and sleeping in a “cold place.” When asked where all the information was heard from, the parents said that they learned malaria related facts from school. Another family shared that they had used their nets to store and collect maize. Usually maize is stored in a cylindrical thatched granary called a nkhwake, but in this case the family had extra and needed a place to store their maize that would be protected from pests and animals. The ITBN then was used to cover and contain the extra maize. This family demonstrates another dilemma the perceived threat is ultimately food insecurity or a lack of food and as a result, malaria is not

considered as a high priority. Because the Malawian agriculture system is so dependent on rainfall (maize requires large amounts of water), seasons of prolonged droughts or flooding greatly impact food production and security. As a result, the people of Chilinza's focus are more on having enough food rather than malaria, which seems like a more removed issue. Food is an immediate and visible threat, whereas malaria is not (Figure 2).



**Figure 2:** Malawian agriculture system and storage technology for Nkhokwe.

Another weakness that was identified was access to ITBNs. One household that was interviewed was in another village visiting family when the government handed out ITBNs in Chilinza. The mother explained that there is no place to buy ITBNs close by. This household was a family of 5, with 3 children all under the age of 10. The mother identified that mosquitoes and also “eating bad food” can cause malaria. To prevent malaria, she made sure that the utensils were clean and that the food that they ate was clean. The combination of lack of access to ITBNs as well as the misconception of how malaria is transmitted contributes to the prevalence of malaria in Chilinza.

All the households that were interviewed shared that they learned how malaria was transmitted through school. This stressed the importance of what information was being spread as well as how well the information was presented in a way that stuck with the community. 13 out of the 20 households did not have a clear understanding of how malaria is transmitted, which emphasizes the importance of the accuracy of information being spread as well as the engagement level.

### Opportunities identified-positive deviants

**ITBN:** One household, in particular, stuck out as positive deviants through careful observation and trial and error, they came to the conclusion that using ITBNs was a vital part of preventing malaria. This household has a firm understanding of what malaria is and how it is transmitted. When asked what malaria was and how it was spread, the mother answered “Malaria is a parasite that comes with mosquitoes. Malaria is spread by mosquitoes especially during rainy seasons.” The mother said that she learned this information from school but also from observations over the years she noticed that during the rainy season, members of her family were more likely to be bitten by mosquitoes and end up sick with malaria. Studies have

found malaria patterns associated with the rainy season in Malawi and other African countries [7-9].

What was most interesting about this household was that in the previous year, 2021 they did not have nor use ITBNs and during the rainy seasons the four children frequented the medical clinic to be tested and to receive medication for malaria. The mother and father decided that investing in an ITBN was worth the money if it meant that the children wouldn't have to travel around 2 kilometers to go to the nearest clinic and 5 kilometers to the nearest hospital. They purchased 2 ITBNs for the children (1 per two children) which cost around 2,500-4,000 Malawian Kwacha or 3-4 USD per net. With the new ITBN, during this past rainy season, the children were not sick as often and did not frequent the hospital as often. The mother said that this little "study" that her family did was a clear indicator that the use of ITBNs resulted in less sick days and less malaria related hospital visits. She also identified that children are more impacted by malaria than adults because during the rainy seasons, the children were ill more frequently than she and her husband. She said that she is an advocate of ITBNs for her neighbors and tells them that the ITBNs can prevent malaria infection.

This household in particular was essential in understanding the aspects that are necessary for positive changes in behavior. The combination of accurate information about the spread of malaria as well as an urgency to protect themselves from mosquitoes helped convince this family that ITBNs were necessary to prevent malaria despite the monetary investment and the hassle of sleeping in a net. These two aspects are echoed in a research study done during the COVID-19 pandemic. A study in Italy found that perceived likelihood of contracting the virus as well as knowledge of the spread of the virus influenced people's decisions to social distance [10]. Essentially understanding the imminent risk and having a firm understanding are vital to see positive changes in behavior [11]. This household was vital in understanding that in order to see positive change in behaviors with ITBN usage, highlighting the risks and accurate information is one potential key to improve upon.

This household was 1 of 3 households that had a very clear understanding of what malaria was and how it was transmitted and dedicated and consistent use of ITBNs, especially during the rainy season in Malawi. The two other households, similar to this household, are not by any means wealthier than other families in Chilinda. Their choice to use ITBNs consistently, especially for their children stems from an understanding that mosquitoes are the transmitters of malaria. These households demonstrate that an understanding of transmission of malaria is vital in order to see positive changes in behavior.

**ITBN day time practices:** One issue that prevents people from using ITBNs is bed bugs. One of the interview questions was "Why do you think people aren't using their mosquito nets?" Out of the 20 households that were interviewed, 6 households answered bed bugs and one respondent even answered that their household had to burn their ITBNs because of bed bugs. The overall consensus from these 6 households was that ITBNs attract bed bugs.

This issue is not only experienced in Chilinda. Since 1968, bed bug infestations have caused issues in malaria eradication programs [12]. In other parts of the world, bed bugs have been found to gather on ITBNs in the morning (Mosquitoes and Bed Bugs- Unfortunate Bedfellows in the Fight against Malaria, n.d.) [13]. In addition, a study in 2018 found that participants in the Balaka

district in Malawi also said that bed bugs were a common and ongoing concern in malaria elimination. People would alleviate their discomfort by sleeping outside of their ITBNs and not on their mats, which undermines malaria prevention practices. In addition, during the day, bed bugs hide in cracks and crevices and come out at night, attracted to the warmth of the human body and carbon dioxide. Bed bugs are not attracted to ITBNs, unlike what was gathered from the interviews we conducted [12]. Instead the bed bugs are attracted to the humans under the ITBN, not the net itself.

Solutions to bed bugs gathering in and on ITBNs were identified in households. Out of the 15 households with nets that were interviewed, 6 families tie their ITBNs during the day and hang them to prevent any insects from entering the net during the daytime and to keep the bedroom space cleaner and neater. The other 9 households either leave the net as is during the day, fold the net, or hang the net, but do not tie the net.

While interviewing one household, the mother demonstrated with her hands how she ties up her net in her home she gathers the bottom of the net, twists it tightly, ties it into a knot, and hangs the net over a wire that is against the wall. By tying up the net during the daytime, the ITBN is not in the way during daily activities to be moved, dirtied, or damaged. This household purchased their ITBNs and so the mother wants the nets to last as long as possible, which requires taking care of the ITBN and preventing damage or dirtiness to the net. While the mother did not explicitly state where she learned these techniques, she said that she started doing this and does this consistently in order to keep their house more neat which as a result helps prevent bed bugs. As a result, she has not had to remove or burn her ITBN because of bed bugs. While this method of tying up the ITBN has not been tested scientifically, preventing bed bugs does require one to maintain a clean space. In addition, the WHO recommends tying up the ITBN during the daytime to promote long lasting use [14].

**Mphungabwi:** Another solution that arose from the community is the use of mphungabwi (an herb in the basil family classified as *Ocimum americanum* L.), a plant that is a natural mosquito repellent [15]. One household that we interviewed had nets that were used every day and by everyone although the mother noted that the nets had some holes. She identified that malaria is transmitted by mosquitoes and so as an extra precaution she and her household gathered mphungabwi and put the leaves around the bed to prevent mosquito bites. The leaves could be used for up to 3 days. The mother shared that she gathers the leaves, especially during the rainy season, to better protect against mosquitoes. This family lived closer to the main road where the mphungabwi, grows on the side similar to a weed. When asked where this practice was learned, she shared that she had learned from her parents since mosquito nets can be expensive.

The second household that mentioned mphungabwi stated that they were not used in his household because of the plant's proximity. The father sent his 15 year old son to go grab some mphungabwi to show us the plant. 30 minutes later his son came running back holding a knife and the leaves. Because of the far distance, his family does not use mphungabwi. Unlike the other family that lives near the main road, this household is further away from the main road, making access to mphungabwi harder and more inconvenient. The distance of the mphungabwi, from households is a deterring factor for using mphungabwi as a mosquito repellent.

Throughout the 20 interviews conducted these were the only two households that mentioned mphungabwi as a malaria preventative practice. When this malaria preventative practice was brought up to the village committee, many of the members knew what mphungabwi was and where one could find the herb. However, the overall consensus was that the herb was not being used as a mosquito repellent.

The only literature specific to mphungabwi is a 2004 report from the World Bank cited mpungabwi (note a slightly different spelling) as an “effective mosquito repellent” [15]. The World Bank also noted that mpungabwi, is an effective measure for mosquito control, although amongst more literate communities, this method is seen as “unmodern.” In addition, there is research that *Ocimum americanum L.* is an effective mosquito repellent [16].

Mphungabwi as a solution for malaria demonstrates the importance of identifying and understanding traditional knowledge. There are already solutions to malaria prevention in Chilinza and rather than forcing Western solutions, integrating the different spheres is an important step in preventing malaria for future generations [17-21].

### Threats

Although malaria is a threat to the health and wellness of the people of Chilinza, their greatest concern is food insecurity. In February 2022, it was reported that over 5.4 million Malawians (33% of the population) faced moderate or severe chronic food insecurity [22]. Specifically in Chilinza, families can go up to 4 months without a stable source of food. Despite improvements in the economy over the last decade, Malawi is still very dependent on rainfed agriculture, and as such, is vulnerable to climate irregularities such as prolonged dry seasons or flooding [23-30]. And with over 80% of Malawians being smallholder farmers, droughts and weather changes greatly impact the majority of the population [31-34]. As a result, malaria is not as immediate of a concern and instead is put on the back burner in many people’s minds. Until food insecurity is no longer an immediate concern, malaria and malaria prevention will be pushed to the side. In order to fully address malaria prevention, food insecurity also has to be addressed.

### CONCLUSION

My findings show that there are solutions within the community of Chilinza for combating malaria transmission. These solutions ultimately stem from a knowledge and understanding of malaria and how it is transmitted. Solutions include using ITBNs regularly, tying up the ITBN during the daytime to preserve the net, and using mphungabwi as a natural mosquito repellent. The data we gathered supports the idea that solutions within the community are effective and can be practiced by other households. The results also show that wealth is not the only predictor of malaria prevention wealth and accuracy of knowledge is an indicator of who is actively practicing malaria prevention techniques and who is not. For those that were not able to purchase ITBNs either due to finances or access, certain families that were identified as positive deviants found other ways to protect themselves and their families from malaria.

### ETHICAL CONSIDERATIONS

The data were statistically analyzed with SPSS 25.0 software. Ethical approval for this study was obtained from the Institutional Review Board (IRB) (CPHS Protocol number: 2022-03-15097).

## IMPLICATIONS AND NEXT STEPS

The importance of this study is that the findings can be used to find more effective ways of addressing malaria in the village of Chilinza. The study itself will most likely not be able to be applied globally or even nationally. But there may be certain practices and approaches that could potentially be applied to other villages or other countries. If this is the case, and the strategies and approaches used in this study are applied successfully in other villages and countries, then there could be large implications in the eventual eradication of malaria in Chilinza, Malawi, and globally. This study would be a small step in that direction as without a true understanding of the people of Chilinza, a lasting impact can’t be made.

## LIMITATIONS AND FUTURE RESEARCH

Although this research project was carefully constructed and carried out, there are limitations to this study that can be addressed in future research.

Firstly, no households with only adults were surveyed or interviewed. For the sake of time, these households were not included in this study. However, in future research it would be important to include those households because there might be other methods or understandings amongst the singles and childless couples of Chilinza. In addition, there were a handful of older people that live alone and there may be more indigenous knowledge and practices amongst these households that was not explored in this study.

In addition, one discovery was that ultimately malaria is not perceived as large of a threat because food insecurity is a more pressing issue. Future research on if there are solutions for addressing food insecurity within Chilinza should be explored.

## AVAILABILITY OF DATA AND MATERIALS

Data will be made available on reasonable request to Sayana Lee.

## REFERENCES

1. Fact sheet about malaria. (n.d.). Retrieved 2022.
2. Amimo F, Lambert B, Magit A. What does the COVID-19 pandemic mean for HIV, tuberculosis, and malaria control?. *Trop Med Health.* 2020;48:1-4.
3. Marsh DR, Schroeder DG, Dearden KA, Sternin J, Sternin M. The power of positive deviance. *Bmj.* 2004;329(7475):1177-1179.
4. Ghazinoory S, Abdi M, Azadegan-Mehr M. SWOT methodology: A state-of-the-art review for the past, a framework for the future. *J Bus Econ Manag.* 2011;12(1):24-48.
5. Smith JM. Analyzing the mosaic structure of genes. *J Mol Evol.* 1992;34:126-129.
6. Berthe S, Harvey SA, Lynch M, Koenker H, Jumbe V, Kaunda-Khangamwa B, et al. Poverty and food security: Drivers of insecticide-treated mosquito net misuse in Malawi. *Malar J.* 2019;18:1-1.
7. Kalinga-Chirwa R, Ngongondo C, Kalanda-Joshua M, Kazembe L, Pemba D, Kululanga E. Linking rainfall and irrigation to clinically reported malaria cases in some villages in Chikhwawa District, Malawi. *Phys Chem Earth, Parts A/B/C.* 2011;36(14-15):887-894.
8. Mburu MM, Mzilahowa T, Amoah B, Chifundo D, Phiri KS, van den Berg H, et al. Biting patterns of malaria vectors of the lower Shire valley, southern Malawi. *Acta Trop.* 2019;197:1050-1059.
9. Fosah S, Mbouna AD, Efon E, Achu DF, Andre L, Dikande AM. Influences of rainfall and temperature on malaria endemicity in Cameroon: Emphasis on Bonaberi District. *J Geosci Environ Prot.* 2022;10(3):46-66.

10. Savadori L, Lauriola M. Risk perception and protective behaviors during the rise of the COVID-19 outbreak in Italy. *Front. Psychol.* 2021;3822.
11. Chang SJ, Choi S, Kim SA, Song M. Intervention strategies based on information-motivation-behavioral skills model for health behavior change: A systematic review. *Asian Nurs Res.* 2014;8(3):172-181.
12. Fourie J, Crafford D. The bed bug resurgence in Africa. *Advances in the biology and management of modern bed bugs.* 2018;87-94.
13. Takken W, Knols BG. Malaria vector control: current and future strategies. *Trends Parasitol.* 2009;25(3):101-104.
14. World Health Organization. Guidelines for monitoring the durability of long-lasting insecticidal mosquito nets under operational conditions. 2011.
15. A guide to the world bank. World Bank; 2007.
16. Tisgratog R, Sanguanpong U, Grieco JP, Ngoen-Kluan R, Chareonviriyaphap T. Plants traditionally used as mosquito repellents and the implication for their use in vector control. *Acta Trop.* 2016;157:136-44.
17. Centers for Disease Control and Prevention. About Child & Teen BMI. Centers for Disease Control and Prevention. 2022.
18. Bhatt S, Weiss DJ, Cameron E, Bisanzio D, Mappin B, Dalrymple U, et al. The effect of malaria control on *Plasmodium falciparum* in Africa between 2000 and 2015. *Nature.* 2015;526(7572):207-211.
19. Chanda E, Mzilahowa T, Chipwanya J, Mulenga S, Ali D, Troell P, et al. Preventing malaria transmission by indoor residual spraying in Malawi: Grappling with the challenge of uncertain sustainability. *Malar J.* 2015;14(1):1-7.
20. Malawi IPC Chronic Food Insecurity Report, February 2022. ReliefWeb 2022.
21. Elsen CJ. Heath, Chip & Dan Heath. *Switch: How to Change Things When Change Is Hard.* Libr J. 2010;135(2):77-8.
22. Klootwijk L, Chirwa AE, Kabaghe AN, van Vugt M. Challenges affecting prompt access to adequate uncomplicated malaria case management in children in rural primary health facilities in Chikhwawa Malawi. *BMC Health Serv Res.* 2019;19(1):1-8.
23. Laurens MB. RTS, S/AS01 vaccine (Mosquirix™): An overview. *Hum Vaccines Immunother.* 2020;16(3):480-9.
24. Live Love Malawi. 2021.
25. Malawi Overview: Development news, research, data | World Bank. (n.d.). 2022.
26. Mathanga DP, Walker ED, Wilson ML, Ali D, Taylor TE, Laufer MK. Malaria control in Malawi: current status and directions for the future. *Acta Trop.* 2012;121(3):212-217.
27. Miller LH, Good MF, Milon G. Malaria pathogenesis. *Science.* 1994;264(5167):1878-1883.
28. Mohandas N, An X. Malaria and human red blood cells. *Med Microbiol Immunol.* 2012;201:593-598.
29. Mosquitoes and bed bugs- unfortunate bedfellows in the fight against malaria. 2022.
30. Musiime AK, Smith DL, Kilama M, Rek J, Arinaitwe E, Nankabirwa JI, et al. Impact of vector control interventions on malaria transmission intensity, outdoor vector biting rates and *Anopheles* mosquito species composition in Tororo, Uganda. *Malar J.* 2019;18(1):1-9.
31. Steinhardt LC, Chinkhumba J, Wolkon A, Luka M, Luhanga M, Sande J, et al. Quality of malaria case management in Malawi: Results from a nationally representative health facility survey. *PLoS One.* 2014;9(2):e89050.
32. Wangdi K, Furuya-Kanamori L, Clark J, Barendregt JJ, Gattton ML, Banwell C, et al. Comparative effectiveness of malaria prevention measures: A systematic review and network meta-analysis. *Parasites & vectors.* 2018;11(1):1-3.
33. World Health Organization. World malaria report 2022. World Health Organization; 2022.
34. Zamawe CO, Nakamura K, Shibamura A, Jimba M. The effectiveness of a nationwide universal coverage campaign of insecticide-treated bed nets on childhood malaria in Malawi. *Malar J.* 2016;15:1-8.