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The Influence of a Song on School Children's Knowledge Growth for Sustainable Malaria Prevention: Teacher Perspectives

Chad Anderson ^{1,*}, Taneshka Kruger ¹ and Irma Eloff ²

¹ University of Pretoria Institute for Sustainable Malaria Control, School of Health Systems and Public Health, Faculty of Health Sciences, University of Pretoria, Pretoria 0028, South Africa

² Department of Education Psychology, Faculty of Education, University of Pretoria, Pretoria 0028, South Africa

* Correspondence: cmande87@gmail.com

Abstract: Music as a potential prevention strategy can play a pivotal role in developing behavioural changes and creating awareness about malaria and malaria prevention. The study was conducted in a moderate-risk malaria district in sub-Saharan Africa. A comparative analysis and pre-and post-intervention evaluation of three teaching intervention methods to teach and educate young children about malaria, e.g., song intervention, drama intervention, and song-and-drama combination, was evaluated. Data were collected by means of pre-and post-intervention interviews with Grade 3 primary school children and teachers, as well as a post-intervention questionnaire with teachers, parents, guardians, and caregivers. The purpose of the study was to investigate knowledge gains on malaria in relation to malaria awareness interventions. The results revealed that the song-only intervention was the most effective learning intervention strategy in this population and that behavioural changes and knowledge growth occurred regarding malaria and malaria prevention in this population. Independent of the teaching styles of each teacher in teaching the song to the children, the findings established that culturally and age-appropriate songs contributed to increasing children's knowledge growth regarding sustainable malaria prevention.

Keywords: malaria prevention; malaria education; disease prevention; knowledge retention; music education; health interventions; health communication



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1. Introduction

Malaria, a global public health concern, is a vector-borne infectious disease caused by *Plasmodium* species and transmitted through the bite of an infected female *Anopheles* mosquito. Children below the age of five are highly prone to malarial infection, who reportedly account for 67% of malaria fatalities worldwide, approximately 272,000 deaths [1]. Sub-Saharan Africa is reported to have a devastating mortality rate that accounts for more than 90% of global malarial deaths. Malaria may result in asymptomatic or symptomatic infections with serious complications, including low- to high-grade intermittent fever, headache, chills, and fatigue. More severe complications include renal failure, pulmonary edema, acute respiratory distress syndrome (ARDS), jaundice, seizures, coma, and death [2]. Young children in primary schools and younger ages in sub-Saharan Africa are at high risk of being infected with malaria. Although various malaria prevention strategies are known, it has been shown that the population at risk is not always aware of the causes and prevention strategies required to mitigate the risk of malaria [1]. The Global Technical Strategy (GTS) for malaria by the WHO establishes a practical plan for malaria-endemic countries. It supports and guides government and regional programmes to work towards controlling and eliminating malaria. Its strategy will ensure universal access to treatment and drugs against malaria. It also provides a framework for countries to follow for the elimination of malaria. The strategy sets the promising target of a 90% reduction in global malaria incidence and mortality rates by 2030 [3].

The CDC defines health communication as “a study and use of communication strategies to inform and influence individuals and community decisions that enhance health” [4]. According to the US Department of Health and Human Services, health communication is critical in increasing knowledge and awareness regarding health issues. Using tools of communication can debunk myths regarding a belief that others may have and remove any stigma that could potentially be attached to the subject matter. The importance of educating the youth is to break potential cycles of misinformation that could be passed down from family members [5]. An example could be that malaria is passed from person to person like the flu or cold. Therefore, it is important to teach individuals that this is not true, and that malaria is transmitted through the bite of an infected mosquito from a specific genus.

Mass media have been used in the past for health behavioural change, for example, through anti-smoking campaigns. These mass media showcase the effects of smoking and the risks involved. When the public starts to notice the effects that smoking has on the lungs and the irreversible damage smoking can cause, then there is a chance that youth may not start smoking. Thus, many countries have passed legislation to place pictures of black lungs and the effects of smoking on packaging [6].

A study carried out in Nigeria showed that the youth reacted more proactively to radio exposure regarding preventative measures of malaria than any other medium. Behavioural change communication (BCC) messaging was put out on the radio, where the attitudes towards care and repair of nets were challenged, as well as preventative measures of malaria [7]. The global burden of disease is significantly affected by human behaviour. To address this burden, public health sectors in various regions have been working hard to devise programmes to address issues of public health by applying behavioural sciences [8].

Amongst the various possible ways to spread awareness about any specific disease to the large masses, music is a one of a kind technique. An idea arose when the first author lived in Botswana and saw the Botswana culture’s close relationship with music. The idea of teaching others through music was engendered with a rap video with a local artist to discuss the topic of malaria [9]. Through a pre- and post-intervention analysis, this research tested a developed song as an intervention method for informing young children about malaria. The song used in this study was developed for the Tshivenda culture to help young children learn about malaria. The song was developed through Participatory Action Research (PAR) and tested by experts in the field of malaria, education, and music for age and cultural appropriateness. Focus groups in Thohoyandou, in Limpopo Province, determined age and cultural appropriateness and whether the song would be accepted in the Vhavenda culture. It was found that the song could potentially work for malaria prevention purposes and that it was age and culturally acceptable. Findings were published in a peer-reviewed scientific journal [10]. The current study utilised the song as previously developed in order to determine whether a song could educate primary school children about malaria and malaria prevention as evaluated by teachers and children.

Thus, the present study is intended to compare, evaluate, and analyze three teaching intervention strategies to educate young children and spread awareness about malaria and its prevention. Moreover, the study validated the efficacy of the most effective intervention method. Specifically, Grade 3 primary school children of the Limpopo River Valley (LRV) region in Vhembe District, Limpopo Province, South Africa were enrolled in the study. This region has the highest malaria incidence and prevalence in South Africa [11]. The Limpopo Province had 740 malaria cases and 42 malaria-related deaths in 2018, and 4105 cases with 33 deaths in 2019 [12].

1.1. Literature Review

The United States Department of Health and Human Services reports that social media and digital media are key factors for the future of behavioral change in society, and new engagements must address these growing social aspects with respect to the youth [4]. Social and digital media are potent sources for spreading awareness using music, dramas,

advertisements, campaigns, etc. In the past, songs about Ebola and HIV/AIDS have been used to educate the public on how to prevent the transmission of disease [13,14].

In Uganda, Okello composed and sang a song to send a message about combating malaria and highlighting strategies that should be implemented to combat malaria, including malaria education through musical art [15]. In Botswana, a song was written and a rap music video was produced on malaria prevention in 2014. It was observed that people did not believe that malaria was a threat anymore. Therefore, a song was produced to educate about malaria. The Botswana music video not only talked about the importance of malaria and how deadly it could be, it showed what people could do to prevent malaria from spreading [9].

A song about preventing malaria was developed in South Africa. The song was written using expert opinion surveys and focus groups to ensure that the song would be accepted in all areas of focus. The focus groups consisted of local caregivers and malaria specialists, who concurred with what the experts had agreed on. All areas were able to come together by the end to agree that the researcher's song could be used in malaria prevention [10].

Music education for preschool children uses songs and dance as part of the learning habits that help children pay attention to the message in the song. A study carried out with autistic preschool children used music to study their attention behaviour. The study showed that while using music the children were able to hold eye contact longer, and their attention was focused on what was happening. With autistic children it can be challenging for them to focus, and this may cause learning gaps in many schools' education programmes [16]. This study indicated that when music was introduced in the classroom, children with autism were able to focus, and therefore to learn the material they were being taught. Therefore, music can be a potential learning tool that encourages children to fully pay attention to the song.

Another study [17] in the United States looked at music and children with learning disabilities. The children were able to learn while using a form of music therapy. The study showed that attentiveness, responsiveness, and being creative assisted the students in their learning process with a music therapist. Over time, working with the music therapist and using music in a positive environment supported the students to realize their full potential in all school contexts [17]. In Cambodia, a group called the Village Drama Against Malaria started performing music workshops, artwork, and dramas in the local villages in rural parts of Cambodia. During the event, many of the younger members of the communities discussed this as being the first time they had ever heard about malaria. The drama and music workshops were seen as a success and are well planned [18].

In 2019, The National Institutes of Health (NIH) started research in a new area of study called 'sound health' [19]. The study explored the potential of music to treat neurological disorders and brain development of children and their behavioural changes. The first aim of sound health research was to look at how repeated exposure to music can affect memory. The second area of focus would be to study musical rhythm synchronisation and how it can potentially change behaviour in children. The theory emanating from the NIH study is that sound health could be used in future research for more neurological disorders that are yet to be discovered [19].

COVID-19 is the most recent pandemic to causing major turmoil all over the world because of how deadly and infectious it can be. This new disease brought a lot of confusion and miscommunication about the disease to people trying to prevent them from getting the disease. Therefore, there have been songs written about COVID-19 during the worldwide pandemic. Numerous songs have been written about the virus, how to prevent getting infected, and ways people can socially distance themselves to prevent the spread of the virus. The countries that have written songs range from Panama to Vietnam and Senegal to Hong Kong [20].

Therefore, considering the above studies, it has become quite clear that music can be used to educate the public about diseases, and can play a significant role in spreading awareness to combat disease.

1.2. Rationale

The rationale for the current study was to contribute to the scientific knowledge base on malaria prevention strategies for young children, teachers, parents, and caregivers in high- to moderate-risk malaria regions. The study builds on previous findings [21] that established the efficacy of a song-only intervention to raise awareness on malaria in a moderate-risk region. The study utilised accessible malaria prevention strategies that focus on knowledge growth on malaria prevention, focusing more strongly on subsequent behavioural changes and knowledge growth as viewed by teachers. The study made use of pre- and post-intervention interviews and a questionnaire to determine knowledge growth during the study in order to discover which intervention was the most effective during Phase 1 (song, drama, song-and-drama, and control). Later, the most effective intervention (song only) was used again against a control group to confirm whether it was significant in Phase 2. Additionally, parents, guardians, and caregivers of some of the children participated in the pre- and post-intervention questionnaires. The aim of having these additional questionnaires was to see whether any knowledge was passed along from the children to the parents themselves.

The study intended to interrogate knowledge about malaria and its prevention to educate young children. The underlying intention was to educate vulnerable populations about the causes of malaria spread and measures for its prevention in order to effectively induce behavioural changes in children and their community. The study assumed that children might be able to share their knowledge with family and friends using the intervention that was shown to be most effective to effect knowledge growth.

2. Methods

2.1. Study Design and Flow of the Study

The present exploratory study employed a mixed methods methodology using both qualitative and quantitative data collection. This exploratory mixed-methods study was conducted in two phases in the Limpopo River Valley (LRV) region in Vhembe District, Limpopo Province, South Africa. The Niani Circuit on the north side and Sambandou Circuit on the south side of the Soutpansberg mountain range were selected as the study areas to conduct Phases 1 and 2 of the study. Selection of the target schools was carried out by the Limpopo Department of Basic Education Circuit Managers for the Niani and Sambandou Circuits. Schools closest to each other were identified for each intervention group using Global Positioning System (GPS). Each study group was then assigned to the selected schools randomly based on their locations from the control group, which was ensured to be the farthest away from all other schools. Both students and their teachers were enrolled in the study. The initial purpose was to examine which intervention method was the most effective for teachers to educate young children about malaria and its prevention and for the young children to retain the maximum knowledge over the intervention period. The findings were then gathered using pre-intervention and post-intervention interviews with teachers and children to gain in-depth understanding of behavioural changes and knowledge growth regarding malaria in the population. Two local Vhavenda women trained to collect good-quality data using questionnaires administered the pre- and post-intervention interview questionnaires. The present study was conducted in two phases. During Phase 1, pre-intervention interviews were conducted using a questionnaire followed by three types of interventions given to all the participants. After six weeks of the intervention period, post-intervention interviews were conducted for both teachers and children to assess knowledge gain and retention. Post-intervention interviews were carried out using the same questionnaire as during the pre-intervention interview for both teachers and children, except for one additional questionnaire (Table 1) for the teachers used to obtain insight into the classrooms. Moreover, a few children's parents/caregivers/guardians were asked to participate in the study and were interviewed as well. These participants were only asked the questions, and were not introduced to any of the interventions before the post-intervention questionnaire (Questions listed in Tables 2–4). The purpose was to

determine whether the children shared their knowledge with their family members or retained it themselves.

Table 1. Questions asked of the teachers post-intervention during Phases 1 and 2.

Question Number	Questions
1	Did you do anything extra or different from the intervention method that was introduced for you to teach?
2	Did your children understand the intervention method that you used to teach them about malaria? Why do you say this?
3	Do you think that your children learned something important about malaria? Why do you say this?
4	Did any of the children answer anything else that was not in the pre-or post-intervention questionnaires? What interesting answer did any of the children give that is different from the questionnaire answers?
5	Did any of the children say that they spoke to their family members or friends about what they learned about malaria in school?
6	Who did they speak to and what did they say to this person or these people?
7	If you could improve this intervention method in any way, what would you change or what would you suggest be changed?
8	Say how this intervention can help you in the future to teach more young children about malaria?
9	Did any of the parents/caregivers/guardians talk to you about the intervention that you taught to your children? What did they say?

Table 2. Comparative analysis of pre- and post-intervention study for Phase 1 involving teachers ($n = 12$).

Questions	Pre-Intervention Correct Answers	Post-Intervention Correct Answers	Answer Improvement	p -Value *
Question 1: "Have you ever heard about malaria?"	100%	100%	0%	N/A *
Question 2: "What do you know about malaria?"	100%	100%	0%	N/A *
Question 3: "Which insect causes malaria?"	100%	100%	0%	N/A *
Question 4: "The insect causes malaria by:"	83%	100%	17%	0.500
Question 5: "What does malaria feel like (sickness)?"	75%	92%	17%	0.500
Question 6: "Where do mosquitoes come from?"	75%	100%	25%	0.250
Question 7: "What time do mosquitoes come outside?"	100%	100%	0%	N/A *
Question 8: "What are a few ways to stop malaria?"	50%	83%	33%	0.125
Question 9.1: "I know how I can protect myself from malaria?"	100%	100%	0%	N/A *
Question 9.2: "Why? Why not?"	100%	100%	0%	N/A *

* N/A indicates not applicable—where the before and after scores were identical.

Data obtained from the interviews in Phase 1 were then analyzed to develop the research plan for Phase 2 of the study. The most effective learning intervention method identified during Phase 1 was validated during Phase 2, in which all the participants received only the identified most effective intervention.

2.2. Ethical Aspects

Ethics approval (420/2018) was obtained from the Faculty of Health Sciences Research Ethics Committee at the University of Pretoria. Approval from the school principals was received as well. Moreover, parents provided consent and assent for their children to be

a part of the study. The reason the study needed both consent and assent was due to the children being under the age of 18. The parents were invited to be a part of the study, and they needed to consent as well if they wanted to participate in the study. Finally, the study obtained consent from the Grade 3 teachers who were part of the study.

Table 3. Pre- and post-intervention comparison of the teachers in control groups for Phase 2 (Teachers that had no intervention).

Questions	Pre-Intervention Correct Answers	Post-Intervention Correct Answers	Answer Improvement	p-Value *
Question 1: "Have you ever heard about malaria?"	100%	100%	0%	N/A *
Question 2: "What do you know about malaria?"	100%	100%	0%	N/A *
Question 3: "Which insect causes malaria?"	100%	100%	0%	N/A *
Question 4: "The insect causes malaria by:"	100%	100%	0%	N/A *
Question 5: "What does malaria feel like (sickness)?"	75%	25%	−50%	0.500
Question 6: "Where do mosquitoes come from?"	75%	75%	0%	N/A *
Question 7: "What time do mosquitoes come outside?"	100%	75%	−25%	1.000
Question 8: "What are a few ways to stop malaria?"	25%	25%	0%	N/A *
Question 9.1: "I know how I can protect myself from malaria?"	100%	100%	0%	N/A *
Question 9.2: "Why? Why not?"	100%	100%	0%	N/A *

* N/A indicates not applicable—where the before and after scores were identical.

Table 4. Pre- and post-intervention comparison of the teachers in the song-only group for Phase 2 (Teachers that taught the song intervention).

Questions	Pre-Intervention Correct Answers	Post-Intervention Correct Answers	Answer Improvement	p-Value *
Question 1: "Have you ever heard about malaria?"	100%	100%	0%	N/A *
Question 2: "What do you know about malaria?"	100%	100%	0%	N/A *
Question 3: "Which insect causes malaria?"	100%	100%	0%	N/A *
Question 4: "The insect causes malaria by:"	100%	100%	0%	N/A *
Question 5: "What does malaria feel like (sickness)?"	75%	50%	−25%	1.000
Question 6: "Where do mosquitoes come from?"	50%	100%	50%	0.5000
Question 7: "What time do mosquitoes come outside?"	100%	100%	0%	N/A *
Question 8: "What are a few ways to stop malaria?"	50%	100%	50%	0.500
Question 9.1: "I know how I can protect myself from malaria?"	100%	100%	0%	N/A *
Question 9.2: "Why? Why not?"	100%	100%	0%	N/A *

* N/A indicates not applicable—where the before and after scores were identical.

2.3. Phase 1

Phase 1 of the study involved the identification of the most effective learning intervention method out of three methods and the control group. Grade 3 children from twelve primary schools of Niani Circuit were selected and divided into four groups based on three interventions they received and a control group that received no intervention. These interventions included a song-only group, drama-only group, and a song-and-drama

group. The schools selected and divided into four groups of three schools each, which included Masisi, Madavhila, and Mutele B (song-only group), Madimbo, Masea, and Tshiungani (drama-only group), Manenzhe, Bale, and Matshena (song and drama group), and Malale, Sigonde, and Gumbo (control group with no intervention). The purpose of the control group in the study was to determine whether children from the control schools obtained any knowledge about malaria through the pre-intervention questionnaire.

Pre-intervention questionnaire-based interviews (Questions listed in Tables 2–4) were conducted for all the participants, including both the Grade 3 teachers and young children. Examples of questions included, for instance, ‘What time do mosquitoes come outside?’, and ‘Where do mosquitoes come from?’. Answers were provided in tick boxes, and participants could tick several options where relevant. It is to be noted that the questions on the pre-intervention questionnaire were kept the same for both teachers and young children. The purpose of interviewing teachers was to examine their level of knowledge about malaria and prevention strategies. Grade 3 teachers were instructed to determine the impact of their intervention administration on the ability of the young children to gain knowledge from the intervention. This pre-intervention questionnaire-based interview served as the baseline for assessment of the basic knowledge of the participants about malaria.

Pre-intervention interviews were followed by three types of interventions, including a song, a drama piece, and both the song and the drama piece. Each intervention type was provided to the selected schools belonging to their respective assigned study group. The intervention period was maintained for six weeks, which was followed by a post-intervention questionnaire to determine any knowledge gained by the participants using the same questionnaire as for the pre-intervention questionnaire. The purpose of using the same questionnaire was to determine the extent of knowledge retention by the participants. For the teachers, there was an additional post-intervention questionnaire that included questions about what they noticed during the intervention period before post-intervention interviews. Each teacher provided feedback on the different intervention methods.

Pre- and post-intervention data were obtained from all the participants in order to determine whether any knowledge growth occurred in the children. Teachers were asked to observe behavioural changes in the young children and to capture behavioural changes and knowledge growth during and after the class. Data analysis was performed on the findings obtained pre- and post-intervention. A statistical significance was indicated as $p < 0.05$, between the pre- and post-intervention data, indicating the most effective intervention.

2.4. Phase 2

Phase 2 of the study was conducted with Grade 3 teachers and children from eight schools in the rural Vhembe District, Limpopo Province, south of the Soutpansberg. The primary schools identified were divided into two groups based on intervention received including Karel Ngigideni, Khavhambe, Lamvi, and Lavhurala (song-only group), and Mavunde, Tshikalange, Tshikondeni, and Vhuri-vhuri (control group with no intervention). The most effective intervention method, as identified based on the results of Phase 1, was validated during Phase 2 to assess the efficacy of the intervention in terms of knowledge gain and retention.

The eight schools were divided into two groups, with four schools per group, with one group receiving the song-only and the other group, the control group, receiving no intervention. The pre- and post-intervention questionnaire-based interviews were conducted as in Phase 1 to determine the level of malaria knowledge. Pre-intervention interviews were followed by the administration of the most effective intervention, i.e., the song-only intervention. In Phase 2, the intervention period was maintained for six weeks, followed by the post-intervention interviews using the same questionnaire.

After the introduction of the intervention, the schoolteachers continued with their normal school curriculum, including any malaria interventions, for a six-week period. After the six-week period, the field assistants administered the post-intervention interviews.

Participants were asked the same questions during the post-intervention interviews as during the pre-intervention interviews using the same questionnaires.

The teacher intervention groups were interviewed separately with another questionnaire (Table 1) in addition to that of the main pre- and post-intervention questionnaire (Questions listed in Tables 2–4) The teachers individually participated in a post-intervention interview to provide feedback on their specific intervention method. The teachers' post-questionnaire answers allowed them to provide insight into their classrooms and on what worked and what did not during the implementation of their respective interventions. In addition, it allowed the teachers to indicate whether they had noticed anything else that was worth mentioning, especially whether information about malaria was shared through other means.

2.5. Statistical Analysis

Statistical analysis was performed using both qualitative and quantitative data in a mixed methods methodology. IBM SPSS 2 was used to analyse closed-ended responses statistically, whereas open-ended responses were sorted, coded, and analysed quantitatively in Microsoft Excel. Any improvement in the children's knowledge post-intervention was assessed using the McNemar test using the pre-and post-intervention results as test variables [21]. Statistical significance was indicated as $p < 0.05$ between the pre-and post-intervention data indicating the most effective intervention.

3. Results and Discussion

3.1. Phase 1

The most effective learning intervention method out of three (song-only, drama-only, song, and drama) was identified in Phase 1. Pre- and post-intervention data analysis of the Grade 3 children indicated the song-only intervention as the most effective intervention among all the intervention groups, i.e., song-only, drama-only, and song-and-drama.

Similarly, findings obtained from the teachers' groups indicated the song-only intervention as the most effective for teaching Grade 3 children about malaria, its spread, and its prevention. These findings endorsed those of several previous studies that employed music to spread awareness about diseases, especially among children. In the past, songs about Ebola and HIV/AIDS have been used to educate the public on how best to prevent transmission of disease [13,14].

For the pre- and post-intervention interviews, in the first nine questions the teachers were provide with the same questionnaire that the children received (Table 2). However, the post-intervention questionnaires for the group of teachers that received the intervention asked additional questions about what happened during the six-week intervention period. The teachers provided insight into what the children said during the interventions, what additional methods, if any, were used, such as using props, or any additional information, as well as anything else they needed to know about the study. Therefore, their post-intervention questionnaires involved additional information for the teachers to allow the researcher insight into their class and provide feedback on what happened while the researcher was not on site.

There was no statistical significance found in any of the questions for the teachers. However, all the teachers were found to be quite well-informed on the situation for most of the questions. Several teachers showed knowledge growth on a few questions, for instance, those who did not know how malaria is transmitted or how to prevent malaria post-intervention.

Teacher Group Post-Intervention Findings from Phase 1

The post-intervention findings revealed that the song-only intervention was the most effective among the rest of the three interventions. In this group, the teachers were provided with only the song to teach. The teaching methods or ways to teach the song were up to the teacher. Each teacher had a different teaching style for the song; some used repeated singing

as a group, while another teacher used a one-on-one approach to ensure the students were learning the song. Whatever the teaching style, the group of schools that received the song-only intervention performed the best in all areas regarding knowledge growth, and the song mixed with these teaching methods could have been why scores were so high.

According to the teachers, they found a substantial increase in knowledge growth in the children that were taught through the song-only intervention. Previous studies [10,13] have emphasised the importance of teaching children with an appropriate song about a disease and its prevention. It has been established in a previous study [20] that information containing music is the easiest way to remember specific information about a particular disease. The rhythm of music often results in alliteration that helps in storing information in the brain cells, where music serves as a cue. The melody urges repetition, and thus facilitates memorisation [22].

The teachers expressed that they observed the children singing the song during breaks, apart from learning the song in the classroom. Teacher AA1 expressed that the children had told their parents about the song at home as well. While the goal of using the song was to teach the Grade 3 children, the song ended up teaching the parents, teachers, and children in other grades as well. These teachers observed continuous learning outside of the classroom at break time as well as during school time. It appears that the children were engaged enough with this intervention to practice and play with each other outside. The most important factor is that they were not forced to practice the song or instructed to do so, and they were having fun and learning from each other at the same time. The observation validated the findings of a previous study in which neuroscientists showed that repetition of a song helps information to be encoded by rhythm, aiding memory retention; the authors highlighted this aspect of why song memorisation is easy as compared to schoolwork [23].

3.2. Phase 2

As in Phase 1, the teachers in all the school groups were asked to participate in Phase 2 of the study. Similarly, the post-intervention questionnaires included additional information for the teachers who used the song as an intervention in order to provide the researcher with information on what happened in the class while the researcher was not there. The teachers were provided with the same questionnaire that the children received for Questions 1 to 9. The answers are shown in Tables 3 and 4 regarding the teachers' scores for the control and intervention groups, respectively.

In Table 3, there was no statistical significance in any questions for the control teachers; the sample size was small, with only four participants. There was, however, a decrease in knowledge in Question 5 and Question 8. The reason the teachers answered correctly in the pre-intervention questionnaire and not in the post-intervention questionnaire is unknown.

In Table 4, there was no statistical significance in any questions for the teachers. The sample size was too small with only four participants in Phase 2. There was, however, knowledge growth in Question 6 and Question 8. Both questions saw the teachers score half correct in the pre-intervention questionnaire, while all the teachers answered correctly in the post-intervention questionnaire. There was, however, a decrease in Question 5. Teacher TA2A admittedly informed the researcher and field assistants that he did not teach the song with the children after the initial training.

Teacher Group Post-Intervention Findings from Phase 2

The post-intervention questionnaires for all the teachers that received the song as an intervention asked additional questions about what happened during the six-week intervention period. The teachers provided insight into what the children said during the interventions, what additional teaching methods they may have used during this time, and anything else the research team needed to know about the study. The responses from the teachers regarding different aspects of the song-only intervention group are gathered in Tables 5–9.

Table 5. Teachers' responses about learning methods with their intervention for Phase 2.

Group A	
Teacher TA2B	"After singing the song, we discuss the song together with learners, and they ask more questions about the song."
Teacher TA2C	"I ask them questions every day about malaria, and they all could answer the questions"
Teacher TA2D	"I expanded on how malaria can cause death. When you are sick and keep quiet without telling your parents, they will die from this disease."

Table 6. Teachers' feedback on their respective interventions outside the classroom for Phase 2.

Group A	
Teacher TA2B	"They speak to their family members. They told me the parents were not aware of some causes and prevention of malaria. So, the song was very helpful to them."
Teacher TA2C	"They spoke to their parents; they advised them about the dangers of malaria with this song."
Teacher TA2D	"I saw them introduce the song for malaria to their friends."

Table 7. Teachers' feedback about children asking additional questions in their classroom from their respective intervention methods for Phase 2.

Group A	
Teacher TA2C	"They said they thought coughing is a sign of malaria, so we discussed it."
Teacher TA2D	"They ask me if malaria can kill, so I explain it can, if not treated."

Table 8. What the individual teachers suggested they will do in the future regarding their intervention for Phase 2.

Group A	
Teacher TA2B	"The intervention of using a song can help in the future to teach young children about malaria because the song indicates the insect that causes malaria, symptoms, and prevention. This is a good tool for us to use this for."
Teacher TA2C	"This intervention helps a lot by singing the song with others. I will use it to help others be aware of malaria next year."
Teacher TA2D	"It can help in the future because learners know how to protect themselves from mosquitoes when we continue to sing this song."

Table 9. Requests by the teachers from Phase 2 on what they suggested for the song-only intervention in the future.

Group A	
Teacher TA2C	"I think a demonstration would be helpful."
Teacher TA2D	"I would like the malaria people to introduce the learners to malaria in the classroom for discussion questions."

The teachers were each provided the song only to teach. The teaching methods or ways of teaching the song were up to the teacher. Each teacher had a different teaching style for the song. Each teacher seemed to have a lesson plan of their own to accompany the song and ensure that the children were learning the materials. Regardless of teaching style, the results indicate all the children managed to increase their knowledge growth.

Teacher TA2D stated that even when not learning the song in the classroom, the children were singing the song outside the classroom. Teacher TA2D mentioned how

she witnessed children singing in the courtyard and hearing the song during break time. Moreover, the children introduced the song to other children in different classes and grades. Thus, it motivated students to spread the information further within the community. This validates the revelation by Jäncke [23] on the influence of song and music to motivate young children to learn English. Their study employed pre- and post-intervention questionnaires to examine how young children are motivated by music and the results in terms of learning English through songs. Their results demonstrated the positive influence of songs in motivating children to learn the songs themselves, with the children even continued to practice it outside the classroom [24].

Teachers TA2B and TA2C expressed that the children had told their parents or family members at home about the song. This finding was seen in the parents' response, as well; they mentioning hearing the song at home. Teacher TA2B went on to say that parents even addressed learning about prevention from their children. Similar findings were found in a study carried out on dementia patients, where it was found that music therapy has a potential "ripple effect" on the well-being of dementia patients. Moreover, it was found that music impacts both dementia patients and the surrounding people, even people from outside the dementia community [25].

The only teachers to talk about their children asking questions were Teachers TA2C and TA2D. In both classes, it seems the children were asking questions and eager to know more about malaria. Teacher TA2D, in Table 5, discussed the danger of malaria if untreated, and discussed the importance of telling their parents about the symptoms of malaria if they are sick. In both situations, the teacher stressed how important malaria is to children's health. In School A2C, the children had more questions about malaria and the symptoms of malaria. However, it is not clear whether the teacher taught coughing as a sign of malaria or not. Similar findings have been observed in other studies, with students becoming motivated both to memorize the taught song and to discover more about the song and encourage others to learn it [24].

The three teachers quoted in Table 8 all liked the song as an intervention. They all believed the song helped the children to learn the information. Teacher TA2B said it was a good tool to use in the future. The hope would be to incorporate it into the life skills lesson on malaria the following year. Teachers TA2C and TA2D mentioned singing the song with others in the future. This idea for singing the song in the future would be great for the teachers to continue using it, as the results have shown that singing is effective and future children could learn from using the song as well. These results strengthen the observations of previous studies that have investigated childhood songs versus information in college. One study highlighted the concept of "cement memory", and stated that the older one grows, the harder it is to remember things or learn things. However, these researchers nullified any potential effect of songs and lyrics on this cement memory. Therefore, they concluded that the younger one is when learning a song, the easier it is to learn even more, and not fill up the cement memory [26].

When asked about what else could be done, the teachers said a demonstration would be helpful, along with more informative sessions. The other two teachers had no recommendations for the song intervention. A demonstration was performed along with the song in Phase 1; however, this did not show the same effects as the song-only intervention in terms of knowledge growth. Teacher TA2D suggested using experts in the field of malaria to help answer questions about malaria. If this is a desire, the hope would be for the local clinic or malaria team to stop by and answer the questions. It is great to see children asking follow-up questions and wanting to learn. Therefore, the best resources and educational tools should be available for follow-up. Recently, much research has been carried out on the importance of different means of teaching songs to children with the melody. One of these studies highlighted the creative execution of a class project directly or indirectly connected with music [27].

4. Conclusions

The findings of this study lead us to conclude that an age and culturally appropriate song about malaria approved by experts is able to influence knowledge growth in Grade 3 children to better prevent their contracting malaria. In addition, this study shows how a song developed through a scientific methodology can educate children, and potentially other members of the community, about disease, helping them learn to protect themselves from getting sick. The positive influence on learning behaviour about malaria prevention in just one person's life can enable the song to achieve its objective. This practice can assist other regions or countries in developing their own songs for particular diseases and start the implementation process for songs to instill behavioural changes and knowledge growth. This study can enlighten the disease awareness and prevention path using the probable positive effect of such songs to combat highly prevalent diseases, for instance, Knowlesi malaria, which is caused by *Plasmodium knowlesi* transmissions in Southeast Asia, primarily in Malaysia.

Using a longitudinal study to determine the effect of a song on malaria morbidity and mortality in children in the study area was beyond the scope of this study. In the future, researchers should enact a longitudinal study to see how songs can affect behavioural change and knowledge growth regarding malaria in children that learn them at a young age. The underlying reason is that if young children are taught first, the surrounding community could potentially either learn the song from the young children; it may cause a "ripple effect" over time. It can be hypothesised from the above findings that a song teaching about malaria could potentially save lives, and reduce malaria morbidity and mortality in the long term.

Study Challenges, Limitations, and Recommendations

There were a few limitations to this study that highlight of the challenges experienced in these rural environments and when working with children. These impacted data collection, and must be factored in when similar studies are repeated in other regions or countries to ensure maximum results.

- Parents may not necessarily be the primary caregiver.

Parental and caregiving responsibilities may shift over time within the population. This means that a different parent or caregiver might not participate in the beginning, or may not come back for the post-test questionnaire. In such instances, the results could not be used if a different parent or caregiver returned for the post-test questionnaire, because knowledge growth could not be assessed.

- Access to schools in rural or remote areas.

The remoteness of schools in high to moderate malaria risk regions creates practical challenges for data collection.

- School schedules or timetables must be factored into the study.

When designing the schedule for the pre-test or post-test, the research team must have the school's schedules or timetables to work around exams and school holidays. Having these schedules assists with advance planning and ensures that regular teaching schedules of the teachers or schools are not disrupted. Furthermore, researchers need to plan for varying school closure times during examinations.

- Service delivery challenges can potentially be a setback to the study.

When conducting a study in remote locations, backup plans regarding access to service delivery are essential. For instance, having more than one accommodation option can ensure timely completion of the study.

- Study conducted in bounded system.

This study was conducted within one region and within the bounds of one school system. Therefore, although the findings may resonate elsewhere, they might not be generalizable.

- Well-trained research assistants

Because this study assesses knowledge gains, it is critical that research assistants are trained to refrain from asking leading questions while conducting the questionnaire interviews.

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