

# Evaluation of practices and attitudes of caregivers influencing adherence to seasonal malaria chemoprevention in children under five years of age: the case of Rural Embangweni, Mzimba District, Malawi

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## Abstract

This research aimed to investigate medication adherence to seasonal malaria chemoprevention (SMC) and to evaluate the caregivers' behaviors and attitudes throughout the 2022 SMC campaign in Embangweni, Mzimba District. SMC aims to administer a three-day course of anti-malarial drugs periodically during the months when malaria risk is highest. However, SMC's effectiveness relies on medication adherence, without which morbidity cannot be reduced. In this study, a random cluster sampling approach was employed to extract data from internal monitoring, with caregivers' self-reports as the primary information. The caregivers' adherence levels, beliefs, and behaviors were then assessed and analyzed using Bernard Vrijens' taxonomy. In total, 95% of caregivers ( $n = 2,457$ ) were knowledgeable about using drugs to prevent malaria at the outset of treatment when 93.0% of children ( $n = 2,299$ ) received their initial dose. However, only 66% of caregivers ( $n = 2,457$ ) indicated that the community health workers supervised the treatment directly. At the beginning of the treatment phase, 89.4% of the children ( $n = 2,127$ ) took their medication on the second day and 80.2% ( $n = 2,295$ ) took their medication on the third day. Caregivers cited "forgetting", "lack of time", and "absence of the mother" as the primary reasons for halting the three-day prescription. The results of this research indicated that caregivers demonstrated a high level of adherence in completing the entire three-day course of medication and ensuring SMC coverage. However, the survey also highlighted areas of improvement in some caregivers' attitudes, practices, and knowledge concerning adherence to medication throughout the SMC initiative.

**Keywords:** *adherence, practices, community health workers, caregivers, seasonal malaria chemoprevention, attitudes*

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## 1. Background

Malaria poses a significant threat to public health [1]. As a leading global reason for mortality and morbidity [2], it is estimated that in 2030, there will be 627,000 fatalities and 241 million new incidences [2, 3]. Approximately 95% of global cases and 96% of deaths from malaria occurred in the African Region, where 77% of all malaria deaths occurred in children under the age of five [4, 5]. In Malawi, which is projected to have 4.4 million cases in 2021, malaria remains a major public health concern, and it is expected to cause 7,392 deaths [1]. Although Malawi was on track to meet the Global Technical Strategy for Malaria incidence rate per 1,000 targets between 2015 and 2017, the nation has fallen short of the targets since 2018 due to an increasing annual difference between the incidence rate and its target [1]. Malawi ranks seventieth globally in terms of malaria deaths and seventh in terms of cases, within the top 10 most impacted nations [2, 6,

7]. With 244.4 cases per 1,000 people, children under the age of five have the highest incidence of malaria in Malawi [4]. According to the World Health Organization's (WHO) most recent data from 2020, malaria caused 6,308 fatalities in Malawi, accounting for 6.54% of all deaths. Malawi ranks high in the world on the age-adjusted death rate of 45.12 per 100,000 of the population [1, 8].

In 2012, the WHO recommended using seasonal malaria chemoprevention (SMC) in the sub-Saharan region, where the spread of malaria is primarily seasonal, to prevent young children from malaria [3–5, 9]. To prevent malarial illness and mortality, SMC entails administering a three-day course of anti-malarial drugs sporadically during the months when the risk of malaria is highest [2, 9]. In Embangweni, amodiaquine (AQ) was administered as a

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separate pill on days 1, 2, and 3 of the entire three-day regimen, along with sulfadoxine-pyrimethamine (SP) on day 1. Community health workers (CHWs) provided a blister pack containing four pills (three AQ and one SP) to every child in a household between the ages of 3 and 59 months on specified days in 2022, regardless of whether the child was a permanent resident or only visiting for the holidays. In 2022, four of these three-day courses were offered at intervals of 30 days between May and July.

The WHO has recognized the effectiveness of SMC in reducing episodes of both simple and complicated malaria in children by roughly 75% [2, 3, 9]. Studies have shown that SMC can be effective at a large scale when implemented under programmatic conditions [9, 10]. However, CHWs and caregivers must follow the correct procedure to achieve this reduction in morbidity. In the past, CHWs were instructed to give the medication to the caretakers and asked to give out one AQ and one SP pill immediately. However, to adhere to COVID-19 guidelines, CHWs were encouraged to observe the process while maintaining social

distancing. Similarly, caregivers would provide the second and third AQ pills on consecutive days, preferably at the same time of day, without the knowledge of the CHWs. Adherence to a medication regimen is essential for the effectiveness of SMC campaigns [2, 11, 12]. Researchers have expanded the meaning of “adherence to” comprises taking the prescribed medication dosage daily and within the recommended time frame [2, 6]. Non-adherence during SMC campaigns can lead to poor child safety. Several factors can influence adherence during SMC, such as CHW-related factors, patient-related factors, and patient-CHWs interaction [2, 12, 13]. Poor adherence can occur when CHWs fail to explain the correct medication administration method, its benefits, and adverse drug responses and to consider the caregivers’ living conditions, such as a lack of clean water at home [2, 14, 15]. Previous campaign experience and social networks, including friends and neighbors, who can alleviate concerns and boost faith in the effectiveness of medications, have been linked to the use of medications and adherence during SMC [16] (see **Table 1**).

**Table 1 •** The graphic overview summarizes the factors influencing drug adherence during SMC

Patient/caregiver-related factors	CHW-related factors	Factors related to the caregiver-CHW relationship
<ul style="list-style-type: none"><li>• Perception of the disease</li><li>• Perception of the treatment</li><li>• Taste</li><li>• Complexity of taking medication on side effects</li><li>• Propensity to forget</li></ul>	<ul style="list-style-type: none"><li>• Experience</li><li>• Practices (demonstration of administration, support to parents after administration)</li><li>• Interpersonal communication content and methods</li></ul>	<ul style="list-style-type: none"><li>• Trust and respect</li></ul>
	<div>Experiences from previous campaigns</div> <div>Area networks such as family, friends, and neighbors</div>	

The assessment of drug adherence is a topic that has received considerable attention in the literature, but there is no universally accepted “gold standard” method for evaluating it [1, 17]. There are two main types of methods available: direct and indirect [18, 19]. Examples of direct methods for assessing adherence include measuring the levels of a drug or its metabolite in the blood or urine, monitoring a biological marker for the drug in the blood, and administering the medication under close observation [17]. While direct methods are widely used, they are also costly, time-consuming, and prone to patient bias [17]. Indirect methods of assessing adherence include asking patients about their ability to take their prescribed medication, assessing clinical response, counting tablets, gathering patient questionnaires, employing electronic drug monitors, monitoring physiological markers, requiring patients to keep medication diaries, and assessing adherence in children with the help of a caregiver [2, 17, 19]. One such indirect method was used in a study conducted in Embangweni to assess adherence in children during SMC using an independent monitoring survey.

The researcher and the Department of Health Management Information System (HMIS) at Embangweni Mission Hospital have conducted a re-examination of the data from the routine internal monitoring of the 2022 SMC campaign using Bernard Vrijens’ taxonomy [1, 20, 21]. The taxonomy is based on three factors that are critical for adherence: “adherence to meds”, referring to the method by which patients take their prescription drugs on time [21]; “management of adherence”, which is the process by which

healthcare institutions, clinicians, patients, and their social networks monitor and assist patients in adhering to their drug regimens [22, 23]; and “adherence-related sciences”, which comprises the fields of study that aim to understand the reasons behind or effects of discrepancies between real and recommended drug exposures [4]. The research proposed that challenges in adhering to SMC medication could exist in Embangweni. During campaign supervision missions, discrepancies were observed in the conduct of CHWs and caregivers compared to the recommended or expected practices (e.g., not directly witnessing the administration of the medication on the first day, but leaving the blister pack with caregivers with instructions to administer the pills later if the child is absent at that moment; not visiting a health center to obtain an additional pill if the child vomits or spits out the medication on day 2 or 3).

Despite caregivers reporting to have administered the second and third doses of AQ, recent studies indicated low drug levels in children’s blood in Embangweni, which contrasts with the high adherence to SMC medication observed in the country [2, 11, 24]. It is important to note that factors other than non-adherence, such as ineffective dosing, inadequate absorption, and rapid metabolism, can also impact medication levels [2, 25–28]. The study’s goals were to assess caregiver attitudes and behaviors related to administering AQ on the second and third day, gauge adherence to anti-malarial medication in children aged 3–59 months during the 2022 SMC campaign in Embangweni, and

suggest measures to improve adherence during future campaigns. To achieve these objectives, the research team utilized a randomized cluster sampling approach to conduct a secondary analysis of household surveys that were collected during the four cycles of the campaign.

2. Materials and methods

2.1. Methods

The present analysis utilized data from the HMIS department and internal monitoring of the 2022 SMC campaign in Embangweni, which were employed to evaluate the intervention’s household coverage. Monitoring was conducted separately from the campaign’s execution to assess its effectiveness.

2.2. Study area

The study area of Embangweni in Mzimba has consistently experienced a high incidence of childhood mortality due to malaria [29] (see **Tables 2** and **3**). The area’s three health centers, with an average illness incidence ranging from 450 to 350 cases per 1,000 residents, are all situated in either the short seasonal transmission area (less than four months) or the moderate transmission area [1]. Malaria is the primary reason for consultation at medical facilities and the leading cause of death in Mzimba, with 167,822 cases [29]. In 2022, the mortality rate for children under five years of age due to malaria was 0.3% [29]. The Mzimba District health office has been providing technical and financial support to the Embangweni Mission Hospital and its surrounding health centers to facilitate the implementation of the SMC campaign across the three facilities of Mabiri, Kalikumbi, and Mharaunda. Since 2015, Embangweni Mission Hospital has been conducting yearly SMC campaigns, starting from the main facility in 2015 and expanding to all three health centers in the catchment area in 2019. In 2022, the intervention aimed to reach 718,160 children between the ages of 3 and 59 months. Since the inception of Embangweni Mission Hospital’s interventions in 2015, nearly 90% of children in the intervention area have received SMC. Despite this, the prevalence of malaria in health centers remained high. As a result, concerns were raised about the effectiveness of SMC in the region. It was suggested that the persistently high rate of malaria could be attributed to caregivers’ inadequate adherence to the entire three-day medication regimen.

2.3. Data collection and study population

In Embangweni, caregivers of infants aged 3–59 months were contacted and interviewed using a semi-structured questionnaire. An invitation was extended to caregivers with children within the specified age range in Mabiri, Kalikumbi, and Mharaunda to participate in the survey.

2.4. Choice of sample

During each round of the 2022 SMC campaign in Embangweni, three health centers were targeted for independent monitoring, totaling nine cycles across the three rounds within the health centers. Three health areas were randomly selected from a list of all health areas in the district [30]. Eight localities were randomly selected from the list of localities (villages/neighborhoods) under each health center to be surveyed. By systematically visiting every other family compound in a locality, family compounds were randomly chosen, which may include extended family members

such as grandparents, multiple spouses’ children, nephews, and younger siblings of spouses. The parents of all eligible children in each selected family complex were methodically questioned.

Table 2 • Trends in morbidity in Mzimba District

Cases/period	2014	2015	2016	2017
Malaria	83,236	106,587	114,288	167,822
Pneumonia	18,139	19,648	16,845	13,592
Diarrhea	11,617	13,142	11,537	12,838
Oral condition	21,568	21,995	21,447	21,706
Skin infection	14,070	19,621	19,944	19,458
Eye infection	7,398	8,027	7,117	7,034
STI	5,610	6,173	8,215	9,705
Wounds	15,799	14,261	15,110	12,838
Ear infections	2,745	3,127	4,023	4,859
Dysentery	2,253	4,178	3,620	2,972
Malnutrition	1,156	1,434	1,839	3,431
Syphilis in pregnancy	23	44	18	60

Source: Social Economic Profile (SEP), 2017–2022.

Table 3 • Mortality trends in Mzimba District

Child mortality indicators	2013	2014	2015	2016
Under-five years mortality/1,000 live births	189	133	124	110
Infant mortality/1,000 live births	104	76	78	85
Neonatal mortality/1,000 live births	42	27		49
Child mortality/1,000 live births	95	62		50

Source: Social Economic Profile (SEP), 2017–2022.

The survey was conducted over three days for each cycle, with only questions about the first day being asked if the child received the first dose on day 3 of the distribution period and researchers visited on that day. The parents of eligible children were questioned about the current cycle by independent monitors who visited the family compounds. The monitors ensured that the SMC cards were correctly filled out and checked the data in the eight localities of Mabiri, Kalikumbi, and Mharaunda. Each health center and locality was observed only once during the campaign, so the homes visited after cycle 3 were distinct from those seen after cycle 1. Interviews were conducted with the caregivers rather than the younger children.

The caregiver was able to provide information for multiple children, as this was a program monitoring effort and not a research project. Therefore, data on the caregiver’s age or gender were not collected. The survey instrument used was a systematic questionnaire with pre-established response categories, based on a long-used survey tool in Niger, Dosso region by Koko et al. [2]. Before its use in the field, it was digitized in the Survey Collect, Transfer, and Organize (Survey-CTO) mobile application and evaluated. To maintain impartiality, the survey monitors were

independent of the SMC campaign and were selected from outside the health sector/health centers involved.

2.5. Data analysis

The taxonomy model developed by Bernard Vrijens [2, 21, 31] was used by the project team to examine the data. This method is advantageous because it breaks down the adherence process into manageable parts, facilitating a detailed analysis of any differences that may affect the intervention [2, 32]. In the “adherence to medications” stage, various levels of adherence may be present, such as:

1. At the beginning of treatment, the child may refuse to drink the medication, spit it out, or vomit it up, or by the advice of CHW it cannot be given.
2. During therapy implementation, caregivers may choose to stop giving medication for various reasons, they may forget to administer it on subsequent days, or fail to give the correct dosage (e.g., after experiencing minor or major side effects or when the child refuses to take the medication). The project team analyzed medication adherence on the first, second, and third days of the three-day course, as well as the attitudes and behaviors of the caregivers.

2.6. An explanation of the indicators

The indicators for the evaluation of SMC implementation can be summarized as follows:

1. The proportion of target children who received the SP and AQ: this is calculated by dividing a number of children who received medication on day 1 of the three-day course among the total number of eligible children who visited.

2. The percentage of children who received medication on the first day of the third course under direct observation, out of all the eligible children under observation who were not given medication by CHWs.
3. The proportion of target children who received medication on the second day of the three-day course: this is calculated by dividing the total number of eligible children who received medication on the second day of the three-day treatment by the total number of eligible children.
4. The proportion of target children who received medication on the third day of the three-day course: this is calculated by dividing the total number of eligible children who received medication on the third day of the three-day treatment by the total number of eligible children.

The direct observation question consisted of two parts: (1) who gave the child the first dose of treatment if it was administered and (2) if the caregiver indicated that the child received the dose, whether the caregiver or CHW was responsible for administering the dose.

3. Results

The results showed that various family members, including a mother, father, grandmother, aunt, older sibling, or neighbor, could serve as caregivers. Regardless of their relationship with the child, 95% of caregivers answered that they were aware that SMC drugs were intended to treat malaria in children (see **Figure 1** for other analysis).

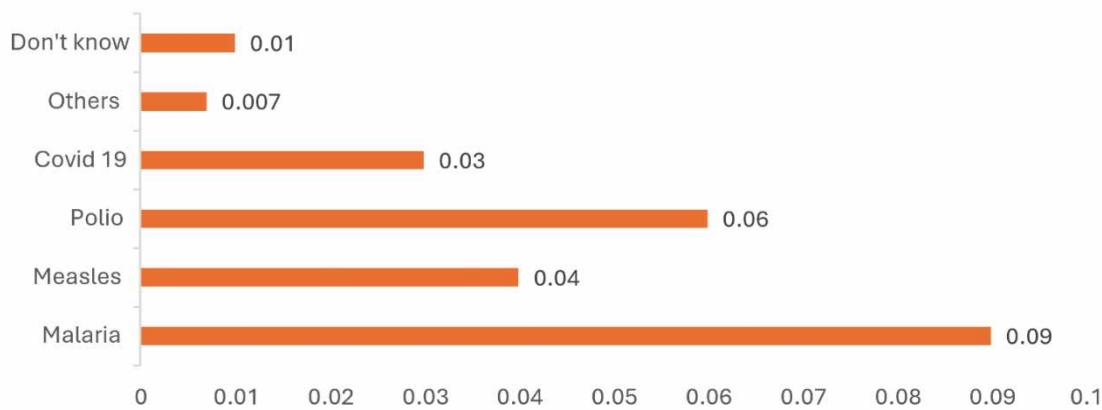


Figure 1 • Degree of awareness among caregivers of the illness managed during SMC.

3.1. Initiation of treatment

During the independent monitoring process, 2,299 children in Embangweni had their SMC treatment initiated and evaluated by CHWs. According to the caregiver’s statement, 93.0% of the children received medication on the first day of treatment, and this percentage remained consistent in subsequent cycles (see **Table 4**). The team observed identical patterns when the SMC card was marked as confirmed by the monitors. 66% of the caregivers surveyed indicated that the CHWs directly supervised the first day of treatment. There was an increasing trend in the observed administration of the initial dose in the first cycle (49%) to subsequent cycles.

Table 4 • Displays the proportion of children who received SP and AQ on the first day of the three-day course

Cycle 1	528	602	87.7
Cycle 2	560	596	94.0
Cycle 3	530	560	94.6
Cycle 4	520	541	96.1
Total	2,138	2,299	93.0



3.2. Implementation of the dosing regimen

The adherence to the dosing regimen was evaluated in 2,127 children on the second and third days of a three-day treatment course. The caregivers reported that 89.4% of the children took the medication on the second day and 80.2% on the third day. There was lower compliance with the medication on the second and third days during the first cycle compared to later cycles. The data are presented in **Tables 5** and **6**.

The caregivers documented only minor adverse drug reactions (ADRs), and the proportion of children who were under observation was 8.7% (446/5,111). Vomiting (36.6%), fatigue (34.6%), diarrhea (17.2%), and anorexia (20.2%) were the most reported ADRs (12.0%). The occurrence of itching (6.6%), fever (7.5%), abdominal pain (5.7%), and rash (3.3%) was less frequently reported ADRs. **Figure 2** displays the reasons for discontinuing treatment, as reported by the caregivers.

3.3. Treatment discontinuation

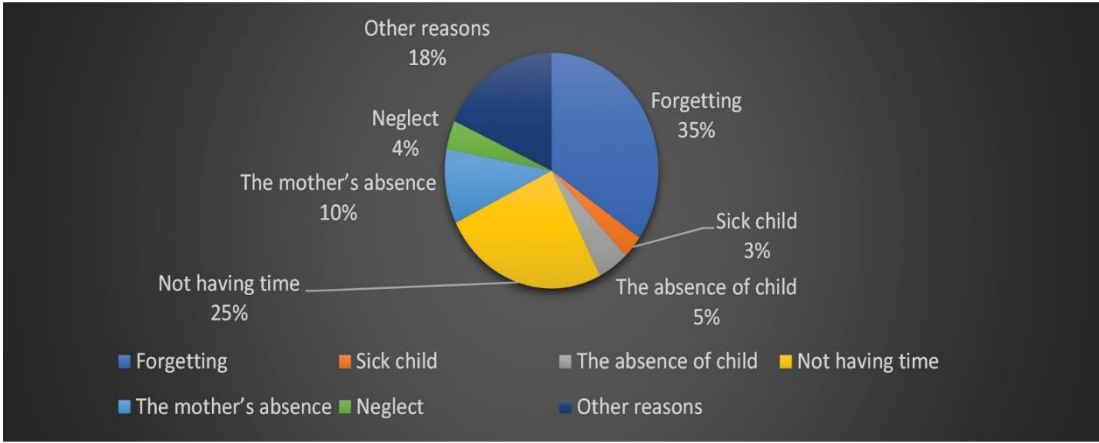
Only a small percentage of caregivers, totaling 152 out of 2,457 (0.06), discontinued their child’s treatment. Forgetting accounted for 35% of these discontinuations, while 25% occurred due to a lack of time and 10% were a result of the mother’s absence.

**Table 5 •** Adherence to AQ on the second day as reported by the caregiver

Cycle 1	508	600	84.7
Cycle 2	500	574	87.1
Cycle 3	447	470	95.1
Cycle 4	446	483	92.3
Total	1,901	2,127	89.4

**Table 6 •** Adherence to AQ on the third day as reported by the caregiver

Cycle 1	480	603	79.6
Cycle 2	560	590	94.9
Cycle 3	500	561	89.1
Cycle 4	300	541	55.5
Total	1,840	2,295	80.2



**Figure 2 •** Reasons given by caregivers who discontinued the treatment (n = 2,457).

4. Discussion

The administration of SMC has been proven to significantly reduce clinical episodes of malaria in children during periods of high transmission [2, 33, 34]. Therefore, one of the key factors in evaluating the effectiveness of the treatment is the adherence to the SMC medication. Non-adherence could potentially contribute to the spread of drug resistance [7, 33, 34]. Our analysis of the data from the Embangweni health catchment area revealed various levels of adherence. A high percentage of children, 93.0%, received their initial doses of SP and AQ at the start of therapy, indicating strong acceptance and high coverage of SMC among the target population. These coverage levels were like those reported in many sub-Saharan African studies [2, 34, 35]. This high level of acceptance could be attributed to the familiarity of caregivers with SMC as a malaria treatment and the fact that SMC has been shown to improve the health of children in the past [16, 30]. The good adherence to the full three-day course suggests that the intervention was well accepted. However, it should be noted that the study by Baker et al. found that mothers were willing to adhere to the treatment regardless of their level of knowledge or positive experiences [1, 35].

In the context of making decisions about treatment adherence, even when patients or caregivers are “conscious of the risk” and motivated by the child’s welfare, the process can be complex and fraught with challenges [1, 2, 11]. Decision-making may be influenced by a range of factors, including the caregiver’s priorities (e.g., work or the child’s well-being), their life philosophy (e.g., treatment as protection), perceived effectiveness, and history (e.g., malaria is a risk for everyone) [2, 30]. Thus, while the program is well received, distributors need to adhere to the recommended dosage and maintain communication with caregivers to emphasize the importance of taking medications as prescribed on subsequent days, potential adverse events, and appropriate actions to take if they occur [7, 21, 32]. However, our data suggest that only 66% of caregivers reported starting the first dose while the distributor was directly observing the patient, indicating that distributors may have left the entire blister pack in the house with instructions for a later caregiver to administer the medication, as observed in Mozambique, Burkina Faso, and Chad [10, 11, 15]. In a qualitative study by Kajubi et al. [18], CHWs attributed this inconsistency to their heavy workload, which prevented them from returning to the home later in the day to ensure that they could administer the medication while the child was present.

The results of numerous studies indicate that the personal observation of the first dose by CHWs and the completion and accuracy of information by caregivers can significantly improve adherence to anti-malarial therapy [2, 5, 11, 14]. To address the issue of inaccurate knowledge among caregivers, role-playing common interactions between CHWs and caregivers could be a useful tool in reinforcing CHWs' training. Additionally, interpersonal communication tools, such as memory aids and flipcharts with images, could be employed by CHWs to enhance their house visits. Lastly, supervisors could utilize a monitoring checklist to ensure that essential campaign messages are being conveyed during interactions between distributors and caregivers.

According to the statements provided by caregivers, a high level of adherence to the dosing regimen was observed among the children, with 89.4% taking their second dosage and 80.2% taking their third. These findings are consistent with previous research conducted in Mozambique and Chad by Wharton-Smith et al. [11] and Ward et al. [15], who assessed adherence using caregiver testimonies. The high level of adherence may be attributed to the fact that the SMC drugs were well tolerated by the children. Caregivers reported a small number of mild adverse medication responses among the children under observation; this was considered to be small as compared to other studies like Koko et al. [2], with nausea (25%), vomiting (36.6%), sleepiness (21%), diarrhea (13%), and loss of appetite (9%) being the most common. Caregiver education, prior doses' perceived benefits, and a positive patient-provider relationship were all found to positively impact adherence. Therefore, providing caregivers with encouragement and easy-to-understand information is crucial in addition to the relevant and appropriate medication. Only 152 (0.06%) caregivers out of the total of 2,457 stopped their child's treatment. In Embangweni, caregivers cited "forgetting" (35%), "not having time" (25%), and "the mother's absence" (10%) as the primary reasons for stopping the SMC treatment.

Embangweni and its surrounding health centers are in rural areas, where many residents are farmers. Due to the demands of their fieldwork, these individuals may forget to administer medication or not be at home at the scheduled time. As a result, developing behavioral interventions or a combination of behavioral interventions may be necessary to increase caregivers' adherence to medication regimens on subsequent days at home [2, 12, 32]. These interventions could involve other family members, neighbors, and social support, such as community outreach, to ensure timely and appropriate dosing of children [15, 26–28, 33].

#### 4.1. Limitations

This study aimed to assess the factors affecting adherence to anti-malarial therapy in children aged 3–59 months during the 2022 SMC campaign in Rural Embangweni, Mzimba District, Malawi. The study utilized observational methods to minimize selection and observation biases, which are common in such research. Participants were chosen randomly, and data were gathered from individuals who were not involved in the SMC campaign's implementation or aware of the study's purpose. However, interpreting the results required consideration of potential biases, such as memory bias and social desirability bias, which were addressed by collecting data during the campaign or examining SMC cards and bare blister packs. The study's findings apply to similar rural areas with mixed malaria loads but may be less relevant in metropolitan settings with diverse populations.

## 5. Conclusion

The study found that each three-day session had high levels of adherence at the beginning and a slight decline on the second and third days. Forgetting, not having time, and the mother's absence were the main causes of non-adherence. However, caregivers' acceptance of the prescriptions and the SMC pills' good tolerability were the main attitudes and practices that influenced high levels of adherence. The study recommends that CHWs should continue to oversee the first dose's administration even after the caregivers accept SMC. They should also take advantage of this in-person opportunity to reinforce the caregivers' understanding of potential ADRs, how to handle them, and how to adhere to the medication on subsequent days. The study advises that malaria programs should carefully consider the possible advantages and costs before implementing measures to boost full adherence, including three days of directly observed treatment, based on the available data. The investigation outcomes do not indicate a considerable problem with compliance.

## Abbreviations

ADR: adverse drug reactions

AQ: amodiaquine

CHW: community health workers

COVID-19: Coronavirus Disease 2019

HMIS: Health Management Information System

SMC: seasonal malaria chemoprevention

SP: sulfadoxine-pyrimethamine

Survey-CTO: Survey Collect, Transfer, and Organize

WHO: World Health Organization

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## Authors' contributions

Conceptualization, C.S.; methodology, C.S. and R.M.; software, C.S.; validation, C.S., R.M. and L.M. and V.N.; formal analysis, C.S.; investigation, L.M. and V.N.; resources, C.S.; data curation, V.N. and L.M.; writing—original draft preparation, C.S.; writing—review and editing, C.S. and R.M.; visualization, C.S.; supervision, C.S.;

project administration, C.S.; funding acquisition, C.S. All authors have read and agreed to the published version of the manuscript.

## Conflict of interest

The authors declare no conflict of interest.

## Data availability statement

Data supporting these findings are available within the article or upon request.

## Institutional review board statement

The Office of Postgraduate Studies at Copperbelt University's ethical approval committee granted the study procedure ethical permission.

## Informed consent statement

Before their involvement in the research process, all participants provided written informed consent. The study participants were made aware of their complete autonomy to choose whether or not to engage in the study, and that they could even choose to stop answering questions at any point throughout the interview. No names are mentioned in the interview or reports, and responses are kept private.

## Sample availability

The authors declare no physical samples were used in the study.

## Additional information

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## References

1. World Health Organisation (WHO). Country disease outlook Malawi. World Health Organisation African Region. 2023. Available from: <https://www.afro.who.int/publications/country-disease-outlook>
2. Koko DC, Maazou A, Jackou H, Eddis C. Analysis of attitudes and practices influencing adherence to seasonal malaria chemoprevention in children under 5 years of age in the Dosso Region of Niger. *Malar J.* 2022;21(1):375. doi: 10.1186/s12936-022-04407-z
3. ACCESS-SMC Partnership. Effectiveness of seasonal malaria chemoprevention at scale in the west and central Africa: an observational study. *Lancet.* 2020;396:1829–40.
4. World Health Organisation (WHO). World malaria report. Geneva: World Health Organization; 2021 [cited 2024 Jan 25]. Available from: <https://www.who.int/teams/global-malaria-programme/reports/world-malaria-report-2021>
5. Barry A, Issiaka D, Traore T, Mahamar A, Diarra B, Sagara I, et al. Optimal mode for delivery of seasonal malaria chemoprevention in Ouelessebougou, Mali: a cluster randomized trial. *PLoS ONE*;2018;13:e0193296.
6. Camara A, Moriarty LF, Guilavogui T, Diakité PS, Zoumanigui JS, Sidibé S, et al. Prescriber practices and patient adherence to artemisinin-based combination therapy for the treatment of uncomplicated malaria in Guinea. *Malar J.* 2019;18:23.
7. Sondo P, Kaboré B, Rouamba T, Compaoré E, Tibiri YNG, Kaboré HALF. Enhanced effect of seasonal malaria chemoprevention when coupled with nutrients supplementation for preventing malaria in children under 5 years old in Burkina Faso: a randomized open-label trial. *Malar J.* 2023;22:315. doi: 10.1186/s12936-023-04745-6
8. World Health Organisation (WHO). World health rankings. Geneva: WHO; 2020 [cited 2024 Jan 25]. Available from: <https://www.worldlifeexpectancy.com/malawi-malaria>
9. World Health Organisation (WHO). Seasonal malaria chemoprevention with sulfadoxine-pyrimethamine plus amodiaquine in children: a field guide. Geneva: World Health Organization; 2013 [cited 2024 Jan 25]. Available from: <https://www.who.int/malaria/publications/atoz/9789241504737/en/>
10. Kirakoya-Samadoulougou F, De Brouwere V, Fokam AF, Ouédraogo M, Ye Y. Assessing the effect of seasonal malaria chemoprevention on malaria burden among children under 5 years in Burkina Faso. *Malar J.* 2022;21:143.
11. Wharton-Smith A, Baker K, Roca-Feltrer A, Rodrigues M, Richardson S, Bonnington CA, et al. Assessment of the feasibility, acceptability, and impact of implementing seasonal malaria chemoprevention in Nampula Province, Mozambique: protocol for a hybrid effectiveness-implementation study. *JMIR Res Protoc.* 2021;10:e27855.
12. Gilmartin C, Nonvignon J, Cairns ME, Milligan P, Bocoum FY, Winskill P, et al. Seasonal malaria chemoprevention in the Sahel subregion of Africa: a cost-effectiveness and cost-savings analysis. *Lancet.* 2021;9(2):e199–208.

13. Diawara F, Steinhardt LC, Mahamar A, Traore T, Kone DT, Diawara H, et al. Measuring the impact of seasonal malaria chemoprevention as part of routine malaria control in Kita, Mali. *Malar J.* 2017;16:325.
14. Nikiema S, Soulama I, Sombié S, Tchouatieu A, Sermé SS, Henry NB, et al. Seasonal malaria chemoprevention implementation: effect on malaria incidence and immunity in a context of expansion of *P. falciparum* resistant genotypes with potential reduction of the effectiveness in Sub-Saharan Africa. *Infect Drug Resist.* 2022;15:4517–27.
15. Ward C, Phillips AS, Oresanya O, Olisenekwu G, Arogunade E, Moukéné A, et al. Delivery of seasonal malaria chemoprevention with enhanced infection prevention and control measures during the COVID-19 pandemic in Nigeria, Burkina Faso, and Chad: a cross-sectional study. *Malar J.* 2022;21(1):103.
16. Antwi GD, Bates LA, King R, Mahama PR, Tagbor H, Cairns M, et al. Facilitators and barriers to uptake of an extended seasonal malaria chemoprevention programme in Ghana: a qualitative study of caregivers and community health workers. *PLoS One.* 2016;11:e0166951.
17. Cissé B, Ba EH, Sokhna C, Ndiaye JL, Gomis JF, Dial Y, et al. Effectiveness of seasonal malaria chemoprevention in children under ten years of age in Senegal: a stepped-wedge cluster-randomised trial. *PLoS Med.* 2016;13:e1002175.
18. Kajubi R, Ainsworth JA, Baker K, Richardson S, Bonnington CA, Rassi C, et al. A hybrid effectiveness-implementation study protocol to assess the effectiveness and chemoprevention efficacy of implementing seasonal malaria chemoprevention in five districts in Karamoja region, Uganda. *Gates Open Res.* 2023;7:14.
19. Molina-de la Fuente I, Sagrado Benito MJ, Lasry E, Ousley J, García L, González V, et al. Seasonal malaria chemoprevention in a context of high presumed sulfadoxine-pyrimethamine resistance: malaria morbidity and molecular drug resistance profiles in South Sudan. *Malar J.* 2023;22(1):345.
20. Sondo P, Tahita MC, Ilboudo H, Rouamba T, Derra K, Tougri G, et al. Boosting the impact of seasonal malaria chemoprevention (SMC) through simultaneous screening and treatment of household members of children receiving SMC in Burkina Faso: a protocol for a randomized open-label trial. *Arch Public Health.* 2022;80(1):41.
21. Vrijens B, De Geest S, Hughes DA, Premyslaw K, Demonveau J, Ruppar T, et al. A new taxonomy for describing and defining adherence to medications. *Br J Clin Pharmacol.* 2012;73:691–705.
22. Bakai TA, Thomas A, Iwaz J, Atcha-Oubou T, Tchadjobo T, Khanafer N, et al. Effectiveness of seasonal malaria chemoprevention in three regions of Togo: a population-based longitudinal study from 2013 to 2020. *Malar J.* 2022;21(1):400.
23. Ndiaye JL, Diallo IT, Ndiaye Y, Kouevidjin E, Aw I, Tairou F, et al. Evaluation of two strategies for community-based safety monitoring during seasonal malaria chemoprevention campaigns in Senegal, compared with the national spontaneous reporting system. *Pharmaceut Med.* 2018;32:189–200.
24. Druetz T, Corneau-Tremblay N, Millogo T, Kouanda S, Ly A, Bicaba A, et al. Impact evaluation of seasonal malaria chemoprevention under routine program implementation: a quasi-experimental study in Burkina Faso. *Am J Trop Med Hyg.* 2017;98:524–33.
25. de Cola MA, Sawadogo B, Richardson S, Ibinaiye T, Traore AO, Compaoré CS, et al. Impact of seasonal malaria chemoprevention on prevalence of malaria infection in malaria indicator surveys in Burkina Faso and Nigeria. *BMJ Global Health.* 2022; 7:e008021.
26. Kirsch F, Becker C, Kurz C, Schwettmann L, Schramm A. Effects of adherence to pharmacological secondary prevention after acute myocardial infarction on health care costs – an analysis of real-world data. *BMC Health Serv Res.* 2020;20:1145. doi: 10.1186/s12913-020-05946-4
27. Konaté D, Diawara SI, Touré M, Diakité SAS, Guindo A, Traoré K, et al. Effect of routine seasonal malaria chemoprevention on malaria trends in children under 5 years in Dangassa, Mali. *Malar J.* 2020;19:137. doi: 10.1186/s12936-020-03202-y
28. Lee YK, Low WY, Ng CJ. Exploring patient values in medical decision making: a qualitative study. *PLoS One.* 2013;8:e80051.
29. Socio Economic Profile (SEP). M'mbelwa District Council (2017-2022), local government developmental planning manual. Lilongwe: Government Press; 2017.
30. Tabachnick BG, Fidell LS. Using multivariate statistics. 4th ed. New York: Harper Collins; 2001.
31. Rieder M. Adverse drug reactions in children: pediatric pharmacy and drug safety. *J Pediatr Pharmacol Ther.* 2019;24(1):4–9. doi: 10.5863/1551-6776-24.1.4
32. Sottas O, Guidi M, Thieffry B, Schneider M, Décosterd L, Mueller I, et al. Adherence to intermittent preventive treatment for malaria in Papua New Guinean Infants: a pharmacological study alongside the Randomized controlled trial. *PLoS One.* 2019;14:e0210789.
33. Cairns ME, Ceesay SJ, Sagara I, Zongo I, Kessely H, Gamougam K, et al. Effectiveness of seasonal malaria chemoprevention (SMC) treatments when SMC is implemented at scale: case-control studies in 5 countries. *PLoS Med.* 2021;18:e1003727.
34. Manga IA, Tairou F, Seck AF, Kouevidjin E, Sylla K, Sow D, et al. Effectiveness of seasonal malaria chemoprevention administered in a mass campaign in the Kedougou region of Senegal in 2016: a case-control study. *Wellcome Open Res.* 2022;7:216.
35. Baker K, Aide P, Bonnington CA, Rassi C, Richardson S, Roca-Feltrer A, et al. Feasibility, acceptability, and protective efficacy of seasonal malaria chemoprevention implementation in Nampula Province, Mozambique: protocol for a hybrid effectiveness-implementation study. *JMIR Res Protoc.* 2022;11:e36403.