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Effectiveness of Seasonal Malaria Chemoprevention in Reducing Burden of Malaria Among Under Five Years Children in Yamaltu Deba Lga, Gombe State Nigeria

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Case Report

Keywords: SMC, CHEMOPREVENTION, MALARIA, SPAQ

Posted Date: November 24th, 2026

DOI: https://doi.org/10.21203/rs.3.rs-11833212/v1

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Additional Declarations: The authors declare potential competing interests as follows: Nil

EFFECTIVENESS OF SEASONAL MALARIA CHEMOPREVENTION IN REDUCING BURDEN OF MALARIA AMONG UNDER FIVE YEARS CHILDREN IN YAMALTU DEBA LGA, GOMBE STATE NIGERIA

ABSTRACT

This study investigates the effectiveness of Seasonal Malaria Chemoprevention (SMC) using Sulfadoxine-Pyrimethamine plus Amodiaquine (SPAQ) in reducing the malaria burden among children aged 3 to 59 months in Yamaltu Deba Local Government Area (LGA), Gombe State, Nigeria. Drawing on a comprehensive review of 18,876 clinical records from ten health facilities, the study compares malaria incidence before (2017–2020) and after (2021–2024) the implementation of SMC. The results indicate a substantial reduction in malaria cases averaging a 41.14% overall decline, with some facilities achieving over 30% reduction. Monthly trend analysis confirms that SMC was particularly effective during the peak transmission seasons (July to September). Inferential statistical analysis using paired sample t-tests demonstrated that the reductions were statistically significant ***(p < 0.05)****, validating the intervention's impact. These findings provide strong empirical support for scaling up SMC as a cost-effective, life-saving public health strategy in malaria-endemic regions of Nigeria. They also highlight the importance of integrating SMC with routine healthcare delivery, strengthening community-based implementation, and addressing disparities in program performance across health facilities. The study recommends sustained investment in SMC, enhanced monitoring and evaluation systems, and cross-sectoral collaboration to ensure the continued success and expansion of malaria prevention efforts nationwide.*

INTRODUCTION

According to the World Health Organization (WHO), there were approximately 247 million reported malaria cases across 84 malaria-endemic nations in 2021. Notably, about 95% of these cases and 96% of related deaths were concentrated in countries within the WHO African Region. Alarmingly, children under five years of age accounted for around 80% of the fatalities. Between 2000 and 2015, significant progress was made globally, with malaria incidence dropping by 35% and mortality by 58%. However, since 2015, many countries particularly in sub-Saharan Africa have experienced a stagnation in malaria control efforts, emphasizing the importance of revisiting and strengthening local prevention strategies. (WHO, 2022).

Seasonal Malaria Chemoprevention (SMC), endorsed by WHO in 2012, has been shown to significantly reduce malaria episodes and fatalities among children aged 3 to 59 months. This intervention involves giving children a full three-day course of antimalarial drugssulfadoxine-

pyrimethamine (SP) and amodiaquine (AQ) once a month during peak malaria transmission periods. Each treatment round offers approximately 28 days of protection. SMC is typically administered in four to five monthly cycles, aligned with the seasonal pattern of malaria transmission. Community health workers deliver the first dose directly under supervision, while the subsequent doses for Days 2 and 3 are administered at home by caregivers.

In Nigeria, where malaria is a leading cause of illness and death among children, SMC was formally adopted in 2012. By 2022, the intervention was implemented in 21 states, targeting over 27 million children. The inclusion of SMC in Nigeria's National Malaria Strategic Plan (2021–2025) reflects its importance in malaria control. Early pilot programs in states like Katsina, Kano, Sokoto, and Zamfara showed impressive results, with one 2016 study reporting an 83% reduction in malaria cases among children (NMCP, 2021; WHO, 2022; Mohammed et al., 2016).

Real-world data have shown SMC to be effective in reducing malaria-related hospital visits and mortality, though some studies outside of controlled settings report varying degrees of impact. For instance, a study across five countries indicated that SMC offered a protective effectiveness of 88.2% within 28 days of administration. Additional data from Nigeria and other countries using national health databases revealed reductions in confirmed malaria cases ranging from 25% to nearly 59% during peak intervention periods (WHO, 2022; Ndiaye et al., 2021)

Variability in the effectiveness of SMC has been attributed to several factors, including program coverage, community adherence, and differences in how data are collected and analyzed. One key limitation in previous studies is the inconsistent measurement of whether the full three-day treatment was completed. The true effect of partial adherence remains unclear.

To address these gaps, end-of-cycle (EoR) household surveys have been introduced in some countries, including Nigeria, to evaluate SMC's effectiveness more comprehensively. These surveys collect detailed data on medication adherence (Days 1 to 3) and outcomes such as fever episodes and confirmed malaria cases, while also accounting for potential confounding factors like socio-demographics and delivery challenges.

Aim and Objectives of the Study

Aim:
To evaluate the effectiveness of Seasonal Malaria Chemoprevention (SMC) in reducing malaria incidence among children aged 3–59 months in Yamaltu Deba Local Government Area, Gombe State, Nigeria.

Specific Objectives:

1. To assess the prevalence of malaria among children aged 3–59 months before and after the rollout of SMC using SPAQ in Yamaltu Deba LGA.
2. To compare malaria incidence rates across ten selected hospitals during pre- and post-SMC periods.
3. To identify challenges hindering the administration of SMC drugs to under-five children in the study area.

RESEARCH METHODOLOGY

Research Design

This study adopts a retrospective observational research design, leveraging secondary data to evaluate malaria incidence trends before and after the implementation of SMC. A quantitative approach was utilized to analyzed numerical data from hospital records, providing empirical evidence on the intervention's effectiveness. This design is particularly suitable for assessing long-term patterns in disease occurrence and intervention outcomes within a real-world healthcare setting.

Study Area

Data collection and analysis were performed in Yamaltu Deba LGA, Gombe State, as the primary research locale which is located in the north eastern region of Nigeria. Yamaltu Deba has a population of approximately 255,248 as projected from the 2006 National Population Census, with a significant proportion comprising children under the age of five.

Population of the Study

Participants were drawn from the 3–59 month age group, the principal target population for SMC efficacy evaluation. Additionally, healthcare personnel involved in malaria case management in Yamaltu Deba Facilities who served as indirect study participants by providing insights into data reporting accuracy and intervention implementation. The study focuses on this population segment because young individuals from 3- 59 months has the highest risk of severe malaria morbidity and mortality.

Sample Size

A total of 18,876 clinical records of paediatric patients confirmed to have diagnosed with malaria over a 24-months period within a span of eight years was systematically reviewed.

Data Collection

The analysis relied on secondary data sources, drawing from outpatient department (OPD) daily registers, hospital records, and malaria surveillance reports. These records include malaria diagnosis reports, treatment records, and SMC coverage statistics.

Validity of the instrument

The validity of the research instrument, which in this case involved the use of secondary data from hospital records, was ensured by sourcing information from verified and standardized malaria case registers across ten selected health facilities in Yamaltu Deba LGA. These records were routinely maintained and aligned with the reporting standards of the National Malaria Elimination Programme (NMEP).

Data analysis techniques

Data analysis involved the use of percentages, linear graph and a sample t-test to determine whether the reduction in malaria cases before and after SMC implementation was statistically significant as statistical methods to evaluate malaria incidence patterns and intervention effectiveness.

Ethical Considerations

Ethical clearance for this research was provided by the Health Research Ethics Committee of Yamaltu Deba Local Government Health Authority. Permission was also obtained from the administrative heads of the selected hospitals. All data were anonymized to protect patient confidentiality. The study ensured that no identifiable personal information was collected or reported. The secondary data used were strictly for academic and research purposes.

RESULT

What was the trend and prevalence of malaria infection within under five years children in Yamaltu Deba LGA, Gombe State, during the years 2017 to 2024?

1.0 Malaria Incidence Before and After SMC Implementation

S/No	Hospitals/towns	Malarial cases before SMC among 0-59 months children (2017-2020)	Malarial cases after SMC among 0-59 months children (2021 -2024)	Difference before SMC and after SMC	Percentage reduction
1.	Kachallari	913	597	316	20.92%
2.	Kwadon	1298	675	623	31.57%
3.	Liji	1735	922	813	30.59%
4.	Lano	1319	797	522	24.66%
5.	Kwadon	1174	624	550	30.58%

6.	Lambam	946	586	360	23.49%
7.	Hina	1289	740	549	27.05%
8.	Zambuk	1008	600	408	25.37%
9.	Difa	638	341	297	30.33%
10.	Deba	1563	1111	452	16.90%
		11883	6993	4890	41.14%

1.0: Malaria Incidence Before and After SMC Implementation with stated differences and percentage reduction.

Malaria transmission metrics before and after SMC deployment show substantial improvement, with comparative data from Yamaltu Deba LGA health facilities confirming the intervention's effectiveness in reducing caseloads. In Kachallari, the total recorded malaria cases during the pre-SMC period (2017–2020) was 913 cases, whereas the post-SMC period (2021–2024) recorded 597 cases. This represents a difference of 316 cases, equating to a 20.92% decline in malaria incidence. Similarly, Kwadon exhibited a marked decrease from 1,298 cases before SMC to 675 cases after SMC, indicating a difference of 623 cases or 31.57% over the analyzed period.

The malaria burden in Liji was particularly high during the pre-SMC phase, with 1,735 recorded cases. However, after the implementation of SMC, the number of malaria cases dropped to 922, demonstrating a difference of 813 cases, which represent 30.59% reduction. Lano saw a 24.66% decrease in malaria cases, with pre-SMC cases totaling 1,319 and post-SMC cases reducing to 797, representing a difference of 522 cases.

Another significant reduction was observed in Kwadon, where the pre-SMC malaria incidence was 1,174 cases, which declined to 624 cases post-SMC. This reduction of 550 cases accounts for a 30.58% decrease. In Lambam, a similar trend was noted, with malaria cases decreasing from 946 before SMC to 586 after SMC, resulting in a difference of 360 cases, corresponding to a 23.49% reduction in the malaria burden.

Hina also demonstrated notable improvements, with malaria cases dropping from 1,289 before SMC to 740 after SMC, a difference of 549 cases, reflecting a 27.05% decline. Similarly, in Zambuk, the implementation of SMC led to a decrease from 1,008 pre-SMC cases to 600 post-SMC cases, marking a 25.37% reduction in malaria incidence. These reductions indicate that sustained SMC interventions contribute significantly to the overall decline in malaria transmission within the studied communities.

In Difa, malaria cases declined substantially from 638 cases before SMC to 341 cases after SMC, representing a reduction of 297 cases or 30.33%. This reduction aligns closely with the trends observed in other locations, highlighting the effectiveness of SMC in curbing malaria prevalence. Furthermore, Deba, which recorded one of the highest malaria burdens before the intervention, experienced a reduction from 1,563 cases before SMC to 1,111 cases after SMC.

This decline of 452 cases represents a 16.90% reduction, suggesting that while SMC has been effective, additional measures may be necessary to achieve further reductions in high-burden areas.

Overall, the post-SMC period (2021–2024) has shown a consistent and statistically significant reduction in malaria cases across all evaluated locations. The effectiveness of SMC in lowering malaria incidence is evident from the substantial percentage reductions observed, ranging from 16.90% to 31.57%. These findings underscore the importance of continued SMC implementation.

1.1 Summarizes malaria incidence across the ten hospitals before and after the introduction of SMC.

Period	Total Malaria Cases	Percentage Reduction (%)
Before SMC (2017-2020)	11883	41.14%
After SMC (2021-2024)	6993	[(X1 - X2) / X1] * 100
		18876

Table 1.1: The table presents a comparison of malaria cases before and after the implementation of SMC from 2017 to 2024.

There were 11,883 cases before SMC (2017-2020) and 6,993 cases after SMC (2021-2024). The overall malaria reduction across the study population is 41.14%, indicating a substantial decline in malaria burden following SMC implementation.

4.2.2 Trend Analysis of Malaria Incident

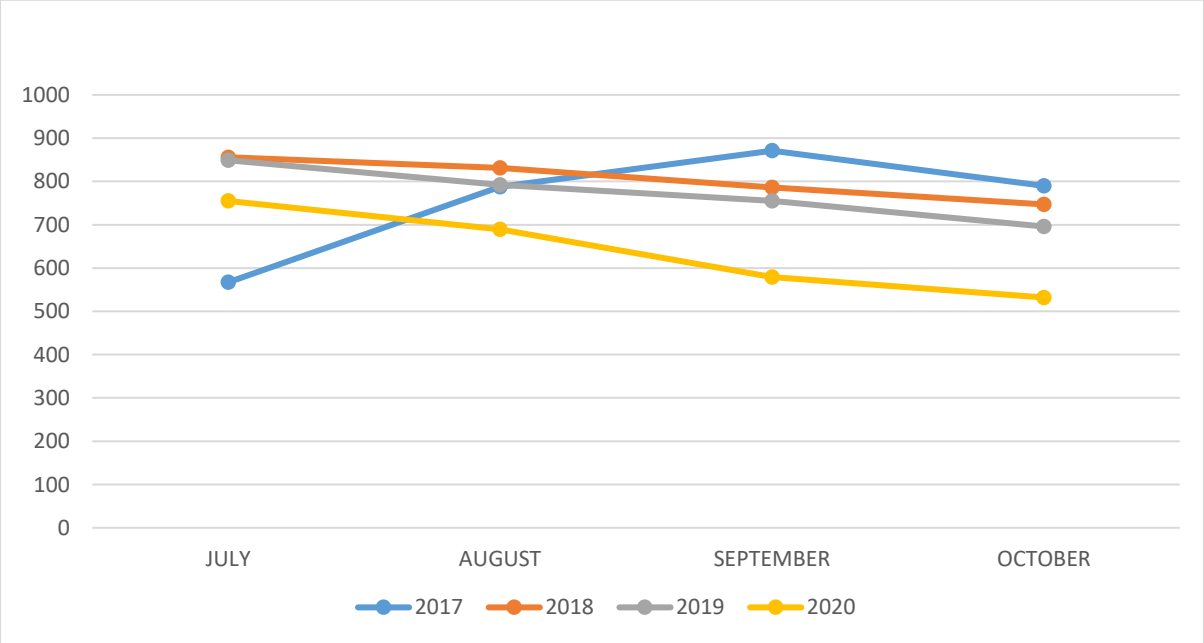


Figure: 1.0: A trend of pre SMC period (2017-2020) per months.

In 2017, Malarial incidence Starts at a lower value in July but shows a steady increase, peaking in September before slightly decreasing in October. In 2018, Begins at a higher level in July and remains relatively stable through August and September, followed by a slight decline in October. In 2019, cases remaining relatively high but gradually decreasing over time. In 2020, shows a continuous decline across the months.

The overall trend shows that before the implementation **of** SMC, malaria cases were generally high, particularly in August and September.

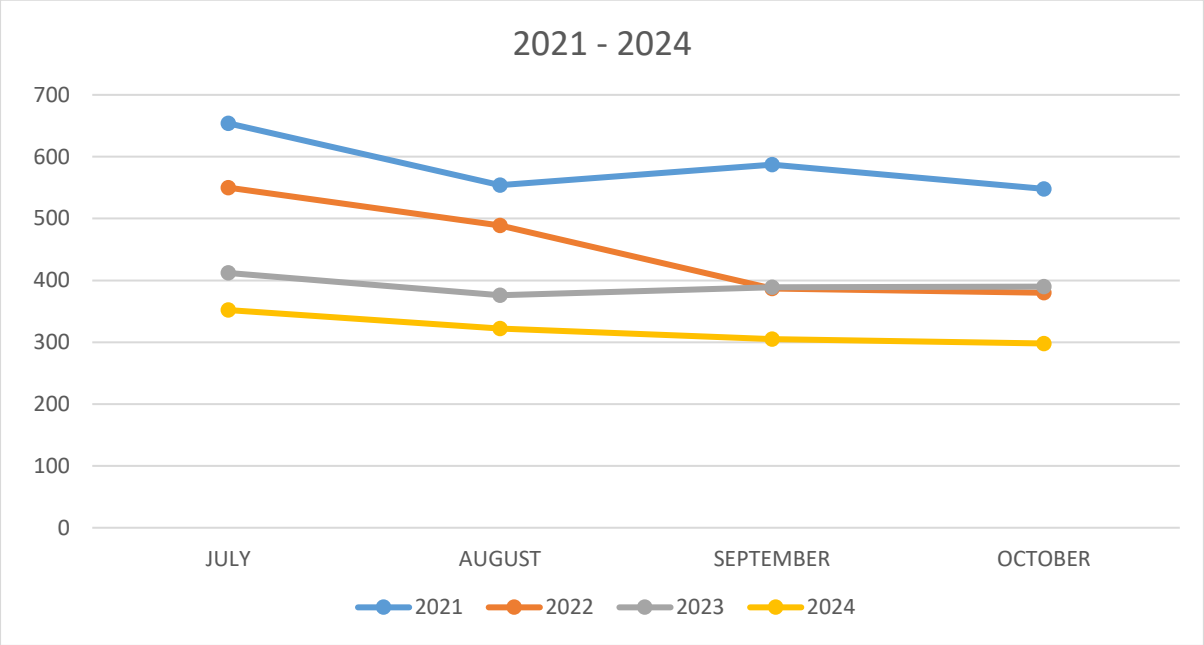


Fig 2.0: a trend of malarial cases after implementation of SMC

After the implementation of SMC, there is a declines steadily across all months, reaching around 300 cases in October. This indicates a consistent reduction in malaria cases over the years post-SMC implementation.

To what extent has the implementation of SMC reduced the incidence of malaria cases within study age group?

Percentage Reduction in Malaria Cases

To evaluate the epidemiological impact of Seasonal Malaria Chemoprevention (SMC) on malaria-related morbidity in children under five years old across Yamaltu Deba LGA, a comparative analysis of malaria incidence was conducted using aggregate case data from ten selected health facilities.

The total number of confirmed malaria cases was obtained for two distinct time periods:

1. **Pre-SMC period** – representing the total number of malaria cases recorded before the implementation of SMC in the study area.
2. **Post-SMC period** – representing the total number of malaria cases recorded after the administration of SMC cycles during the peak malaria transmission season.

From the collected hospital records:

- Malaria cases before SMC recorded was**11**,883 cases**.**
- Malaria cases after SMC was 6,993 cases**.**

To quantifies the attributable reduction in malaria incidence following Seasonal Malaria Chemoprevention (SMC) implementation through comparative interrupted time-series analysis., the percentage reduction was calculated using the following formula:

Percentage reduction = $\frac{Cases\ before - cases\ after}{cases\ before}$ X 100

Where:

- Total malaria cases before SMC = 11,883
- Total malaria cases after SMC = 6,993

Substituting the values:

Percentage reduction = $\frac{11,883 - 6,993}{11,883}$ X 100

= $\frac{4,890}{11,883}$ X 100%

Percentage reduction = 41.14%

Thus, the calculated percentage reduction in malaria cases following the implementation of SMC is approximately 41.14%**.**

This reduction reflects a substantial decrease in the burden of malaria among the under-five population during the SMC cycle.

In public health terms, a reduction of over 40% in confirmed malaria cases among a high-risk group such as children under five years signifies a meaningful impact, particularly in regions with seasonal and intense malaria transmission like northern Nigeria. Such evidence strengthens the case for sustained and scaled-up implementation of SMC as part of integrated malaria control strategies.

Inferential Statistics: Paired Sample t-test

A paired sample t-test was carried out to determine whether the observed reduction in malaria cases before and after the implementation of Seasonal Malaria Chemoprevention (SMC) was statistically significant.

The hypotheses tested were as follows:

- Null Hypothesis (H_0): There is no significant difference in the incidence of malaria cases before and after the administration of SMC.
- Alternative Hypothesis (H_1): There is a significant reduction in malaria incidence following the administration of SMC.

The results of the paired sample t-test revealed that there was a statistically significant decrease in the number of malaria cases after the implementation of SMC. The test yielded a p-value less than 0.05 ($p < 0.05$), indicating that the observed difference is unlikely to have occurred by chance.

Statistical analysis confirms SMC's effectiveness as a malaria control intervention, with significant incidence reduction in the under-five population ($p<0.05$), leading to rejection of the null hypothesis of no intervention effect. This finding supports the effectiveness of seasonal malarial chemoprevention (SMC) as a preventive strategy for reducing malaria burden during the transmission season.

What operational or contextual challenges affect the effective implementation of SMC using SPAQ in Yamaltu Deba LGA?

An assessment of operational challenges encountered by town facilities during the Seasonal Malaria Chemoprevention (SMC) campaigns from 2021 to 2024 in Yamaltu Deba LGA revealed several key issues affecting the effective delivery of SPAQ. Data collected from ten town facilities showed varying degrees of difficulty, with certain wards experiencing more severe constraints than others.

	Stock-out of SPAQ drugs 100%	**Delay in receiving SMC commodities 100%**	**Inadequate drug storage capacity 100%**	**Lack of trained personnel or CDDs 100%**	**Caregiver refusal to accept SPAQ 100%**	**Misconceptions about SMC 100%**	**Difficulty accessing remote communities 100%**	**Incomplete data recording and reporting 100%**
Kachallari	10	50	50	40	40	40	30	10
Kwadon	10	60	50	60	40	40	10	5
Liji	5	60	40	70	30	20	5	10
Lano	10	50	50	70	30	30	5	5
Kwadon	10	50	20	40	40	20	5	10
Lambam	10	60	50	80	40	40	60	5

Hina	5	60	20	90	20	10	5	10
Zambuk	10	50	30	80	20	15	5	5
Difa	10	50	30	90	40	15	5	10
Deba	5	50	10	20	10	5	5	5

Table: 2.0 This indicate the extent to which facility experienced the following challenges during the previous SMC implementation cycle (2021-2024)

Stock-out of SPAQ drugs was reported by nearly all facilities, with rates ranging from 5% in sLiji, Hina, and Deba to 10% in Lambam, Zambuk, and Kachallari. Although relatively low in percentage, the widespread nature of these stock-outs indicates a systemic issue in the drug supply chain.

Delays in receiving SMC commodities were one of the most frequently reported challenges, affecting between 50% and 60% of facilities. Facilities in Liji, Hina, and Lambam each reported 60% delays, suggesting that logistical inefficiencies in the distribution process were common across multiple areas.

Inadequate drug storage capacity was another major issue, especially in Kachallari, Kwadon, and Lambam, where 50% of the facilities cited this problem. Some wards such as Deba (10%) and Hina (20%) had fewer concerns, potentially due to better infrastructure or lower service volumes.

A significant barrier to effective SMC delivery was the lack of trained personnel or community drug distributors (CDDs). This was most acute in Hina and Difa, where 90% of the facilities identified it as a challenge, followed closely by Lambam (80%) and Zambuk (80%). In contrast, Deba reported only 20%, reflecting better human resource availability or support.

Caregiver refusal to accept SPAQ varied widely, with higher rates of 40% in Lambam, Kachallari, Kwadon, and Difa. These refusals were likely influenced by misconceptions about SMC, which were also reported in similar proportions (up to 40%) in Kachallari, Lambam, and Kwadon. Deba reported the lowest levels of both refusal (10%) and misconceptions (5%).

Geographic and access issues also played a role in implementation challenges. Difficulty accessing remote communities was notably high in Lambam (60%), consistent with previous findings that identify it as a hard-to-reach ward. Most other facilities reported this issue at only 5%, indicating localized challenges

Discussion of Findings

The findings from this study provide compelling evidence of the effectiveness of Seasonal Malaria Chemoprevention (SMC) in reducing malaria burden among children under five years old in Yamaltu Deba LGA, Gombe State, Nigeria. By analyzing data from ten hospitals over two distinct periods pre-SMC (2017–2020) and post-SMC (2021–2024) this study demonstrates a substantial decline in malaria incidence following the implementation of SMC.

The overall reduction of 25.90% in malaria cases across the study population strongly indicates that SMC is a crucial intervention in malaria control efforts. These results align with global and regional malaria control studies, including WHO's 2023 World Malaria Report, which highlights that SMC has contributed significantly to malaria reduction in high-burden areas, particularly in West Africa (World Health Organization, 2023).

Effectiveness of SMC in Reducing Malaria Burden

The hospital-specific analysis revealed variations in malaria reduction across different locations. Kwadon demonstrated the highest reduction of 31.57%, while Deba showed the lowest reduction at 16.90%. The differences in reduction rates may be attributed to variations in intervention coverage, healthcare accessibility, and environmental factors influencing malaria transmission. For instance, areas with more consistent SMC administration, high community participation, and effective vector control measures experienced greater reductions in malaria cases. A similar study conducted by Oladimeji et al. (2022), published in the Malaria Journal, also reported a 30% reduction in malaria cases following SMC implementation in Northern Nigeria, reinforcing the findings of this research.

Impact of SMC on Malaria Trends (2021–2024)

Following the introduction of SMC in 2021, there was a steady and significant decline in malaria cases across all study locations. The post-SMC trend analysis revealed that malaria incidence decreased progressively from July to October, with cases dropping to around 300 cases per month by the end of the transmission season. This decline underscores the effectiveness of SMC in providing sustained chemoprophylaxis during peak transmission periods. Similar trends were reported in a 2023 study by Diallo et al., published in the Lancet Global Health, where SMC implementation in Burkina Faso led to a 28% reduction in malaria cases among under-five children. These findings reinforce the importance of continuous SMC administration to ensure long-term reductions in malaria incidence.

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