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Evaluation of Factors Associated with Malaria Infection Among Children Under-5 Years Who Received SMC

Muslim Adamu [1], Abdullahi Sabo Muhammad [2], Yahaya Saleh [3]
Department of Public Health Postgraduate School, Maryam Abacha American University Maradi, Niger Republic [1], Faculty of Health Science Maryam Abacha American University Maradi, Niger Republic [2].

Author for Correspondence: muslimgobir@gmail.com. DOI: 10.4314/sokjmls.v9i1.5

Abstract
Malaria is a major public health problem in Nigeria where it accounts for more cases and deaths than any other country in the world. Malaria is a risk for 97% of Nigeria's population. The remaining 3% of the population live in the malaria-free highlands. There are an estimated 100 million malaria cases with over 300,000 deaths per year in Nigeria. *The aim of this study was to* evaluate factors associated with malaria infection among children under-5 years who received SMC. This study was carried out as descriptive-analytical study. Inclusion criteria were strictly based on those children less than 5 years that were eligible for SMC. All those children above 5 years of age were excluded from the study. Few children were noted to come up with malaria fever despite taking the SMC medication which might be due to poor adherence to day 2 and day 3 medication (AQ), not combining SMC programme with other preventive measures against malaria such as the use of LLIN, fumigation and good environmental management. The most alarming was that some of the children coming up with malaria have been participating in the SMC programme for 2 or 3 years, and this might likely be due to the pfmdr1 86Y mutation which is associated with the AQ resistance which is very rare. Seasonal malaria chemoprevention is an intervention with great potential in Sokoto state, and along with other interventions. It could significantly contribute to approaching the threshold where elimination strategies will be envisioned. During the mass drug administration in all 23 LGAs, comprising 244 wards and 8269 settlements, the intervention significantly reduced hospital visit, admission, and malaria indicators among children.

Keywords: Factors Associated with Malaria Infection, Children Under-5 Years and Who Received SMC

Introduction

Malaria is a major public health problem in Nigeria where it accounts for more cases and deaths than any other country in the world (Strachan *et al*., 2016). Malaria is a risk for 97% of Nigeria's population. The remaining 3% of the population live in the malaria-free highlands. There are an estimated 100 million malaria cases with over 300,000 deaths per year in Nigeria. This compares with 215,000 deaths per year in Nigeria from HIV/AIDS (Strachan *et al*., 2016). Malaria contributes to an estimated 11% of maternal mortality. Malaria accounts for 60% of outpatient visits and 30% of hospitalizations among children under five years of age in Nigeria. Malaria has the greatest prevalence, close to 50%, in children age 6-59 months in the South West, North Central, and North West regions (Zongo *et al*., 2015). Malaria has the least prevalence, 27.6 per cent, in children aged 6 to 59 months in the South East region (Antwi *et al*., 2016).

Materials and Method

Study Location

Sokoto State was carved out of the then North-Western State on February 3rd, 1976 by the former regime of General Murtala Mohammed. Its capital and largest city is Sokoto. The state is named after it is capital Sokoto, a city with a long history and the seat of the Sokoto Caliphate.

Study Design
This study was carried out as descriptive-analytical study. Inclusion criteria were strictly based on those children under 5 years that were eligible for SMC. All those children above 5 years of age were excluded from the study.

Data Collection
Interviewer administered questionnaire through the research assistant were used which was adopted from the Sokoto state Malaria Elimination Agency SMC campaign for the purpose of this study. It consists of the following sections:

Data Analysis
SPSS Statistics version 22.0 (IBM Corp., Armonk, New York, USA) was used to analyse the data. The analysed data were presented in form of figures and tables and expressed as means ± SEM (Standard Error of Mean). Statistical differences were compared by simple descriptive analysis, a p-value of ≤ 0.05 was considered statistically significant.

Results
Few children were noted to came up with malaria fever despite taken the SMC medication which might be due to poor adherence to day 2 and day 3 medication (AQ), not combining SMC programme with other preventive measures against malaria such as the use of LLIN, fumigation and good environmental management. The most alarming was that some of the children coming up with malaria have been participating in the SMC programme for 2 or 3 years, and this might likely be due to the pfmdr1 86Y mutation which is associated with the AQ resistance which is very rare.

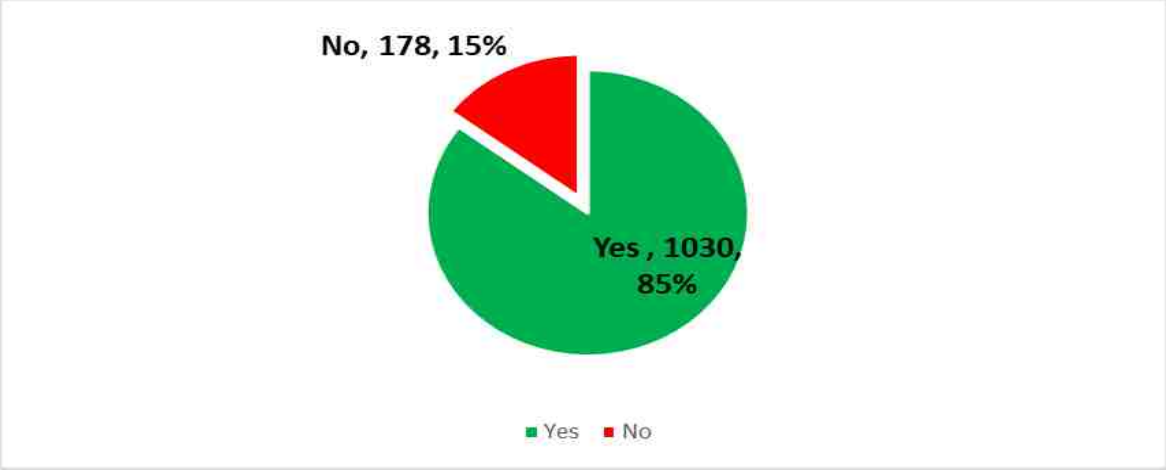

Figure 1: Is there at least one child from 3 months to 5 years old in the compound.

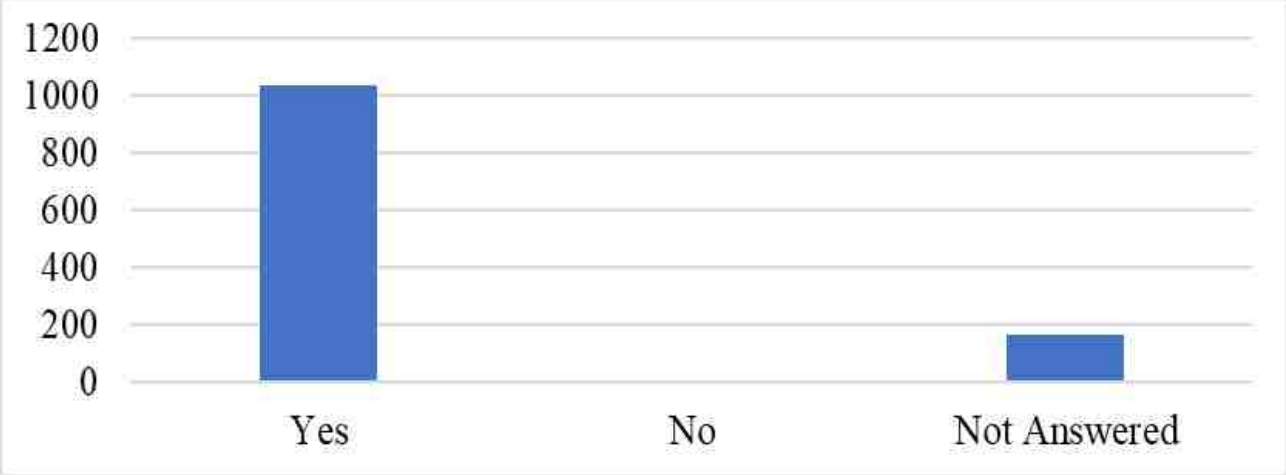

Figure 2: Was the compound ever visited by a CHWs/distributor this year for SMC.

Figure 2: If No, are there any children 3-59 months living in this compound

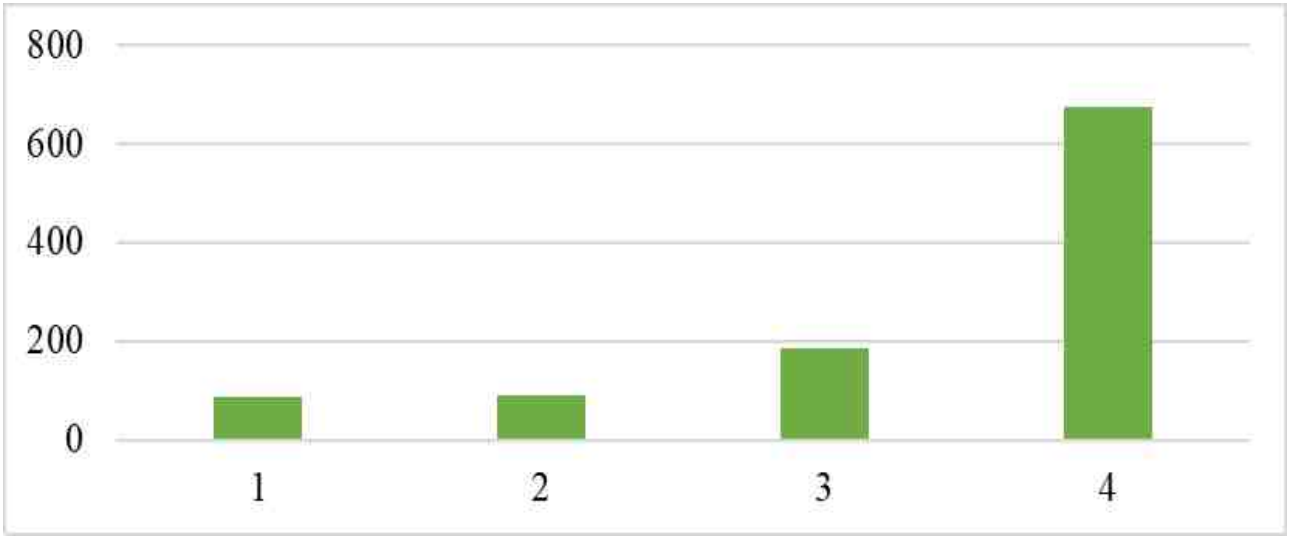

Figure 4: If yes, how many times have they visited

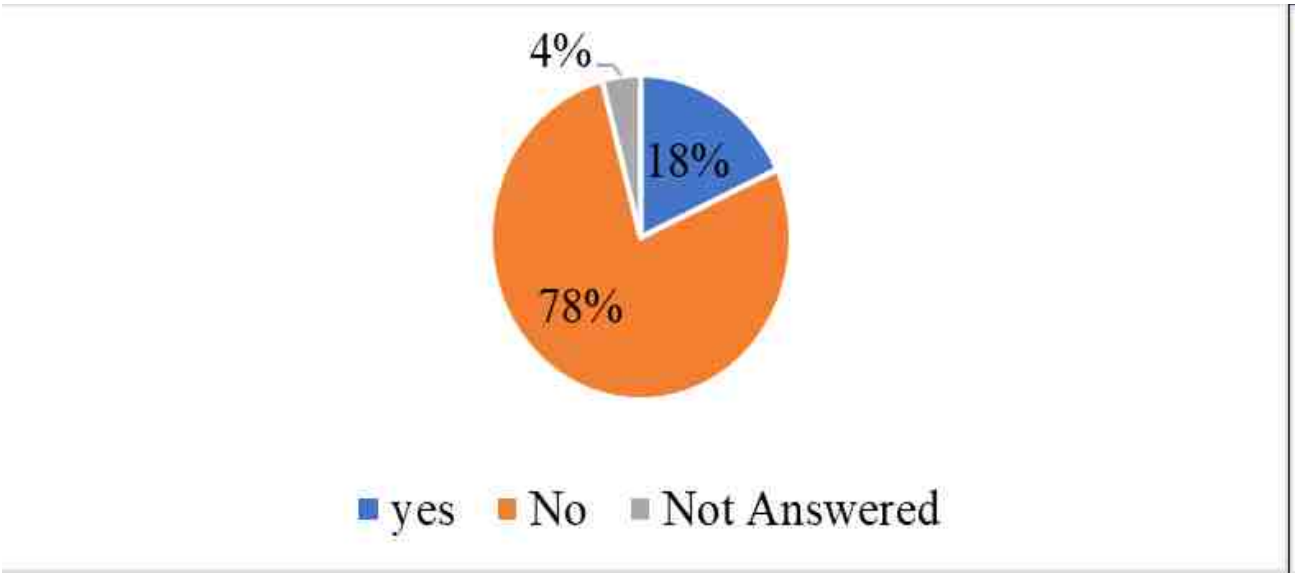

Figure 5: Were any of your children under 5 years of age sick with fever within the last month?

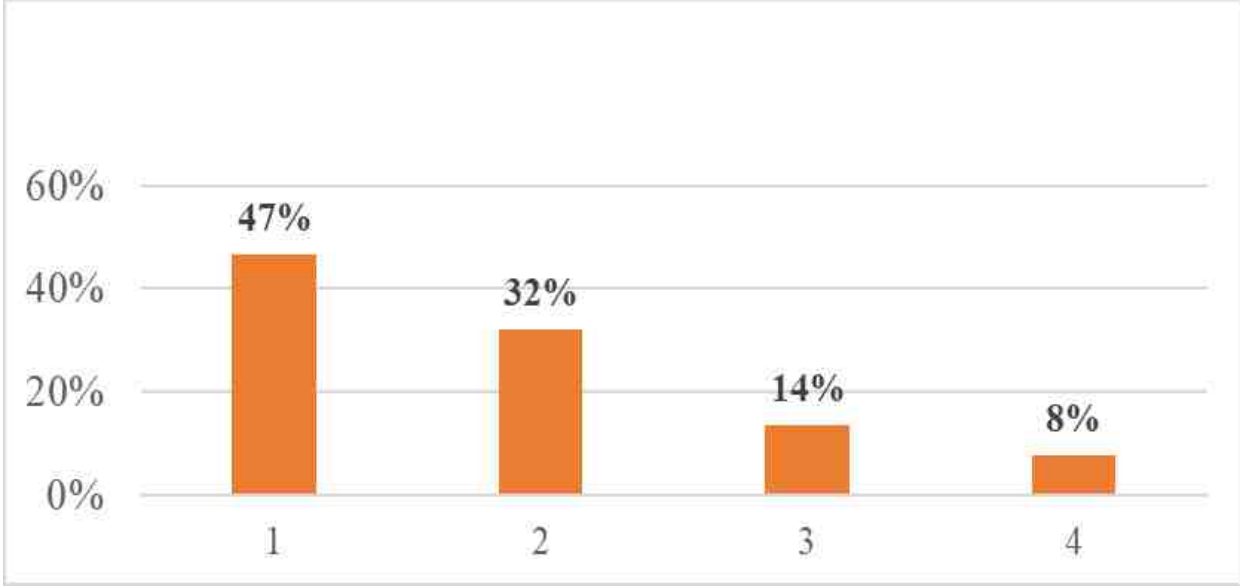

Figure 6: If yes, how many cycles of SMC have they take?

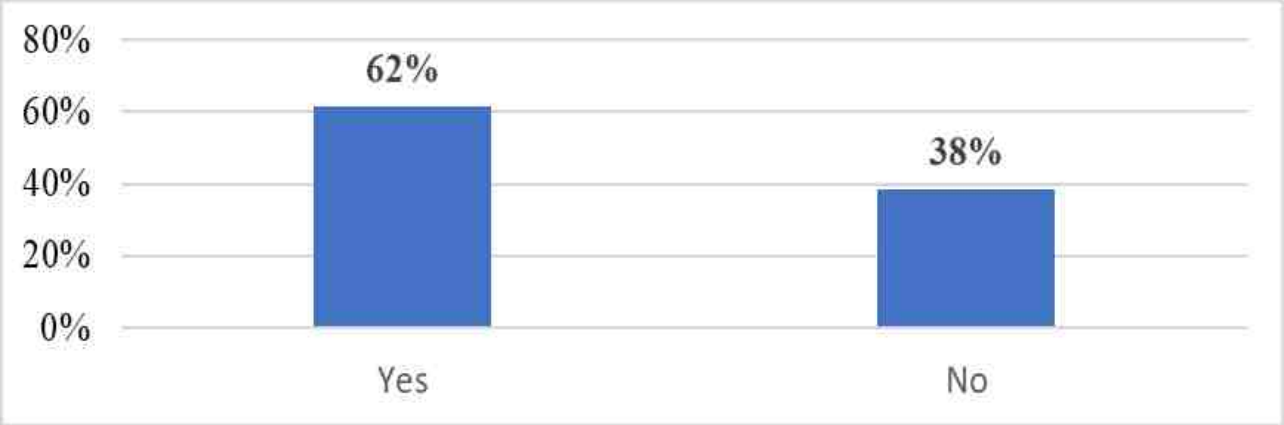

Figure 7: Did you bring/send them to the health centre.

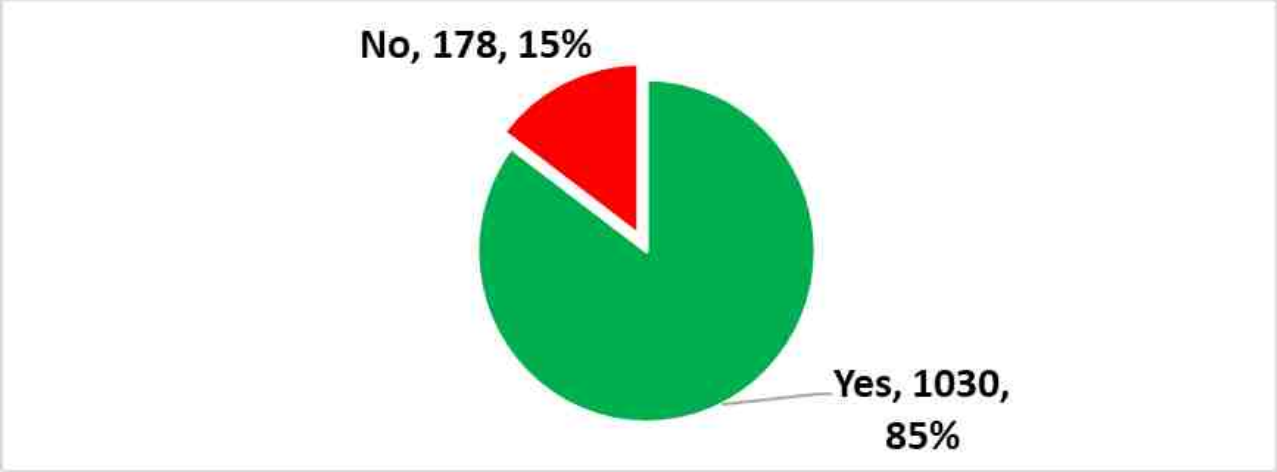

Figure 8: Did your children sleep under a mosquito net last night?

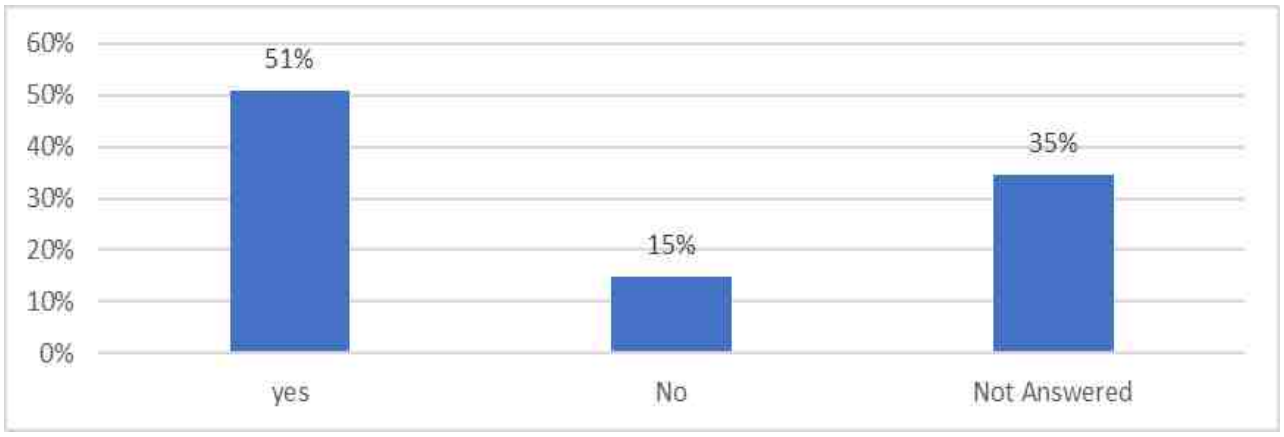

Figure 9: Has anyone sprayed the interior walls of your dwelling against mosquitoes at any time in the past 6 months.

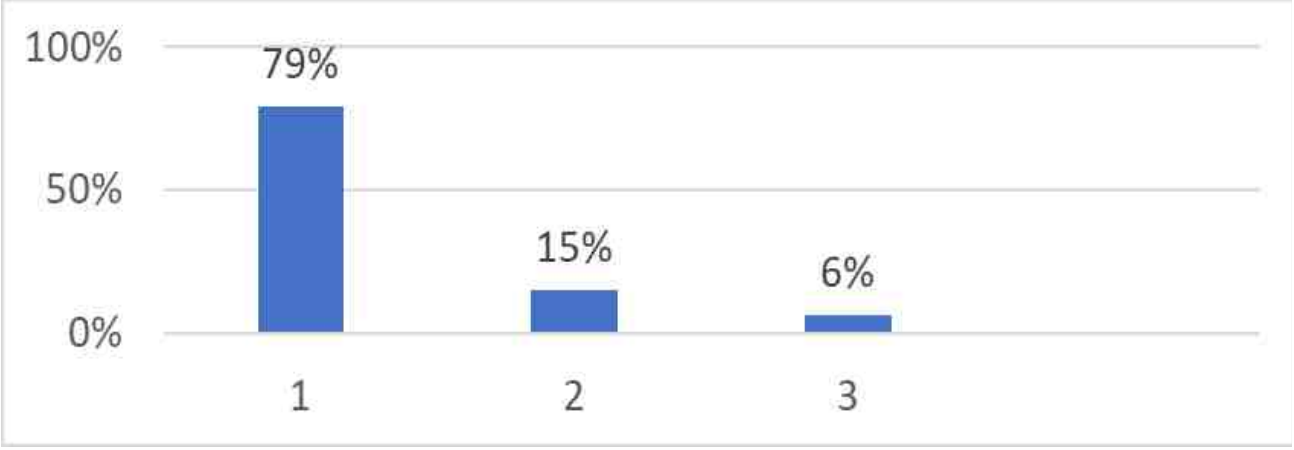

Figure 10: How many households are there in this compound?

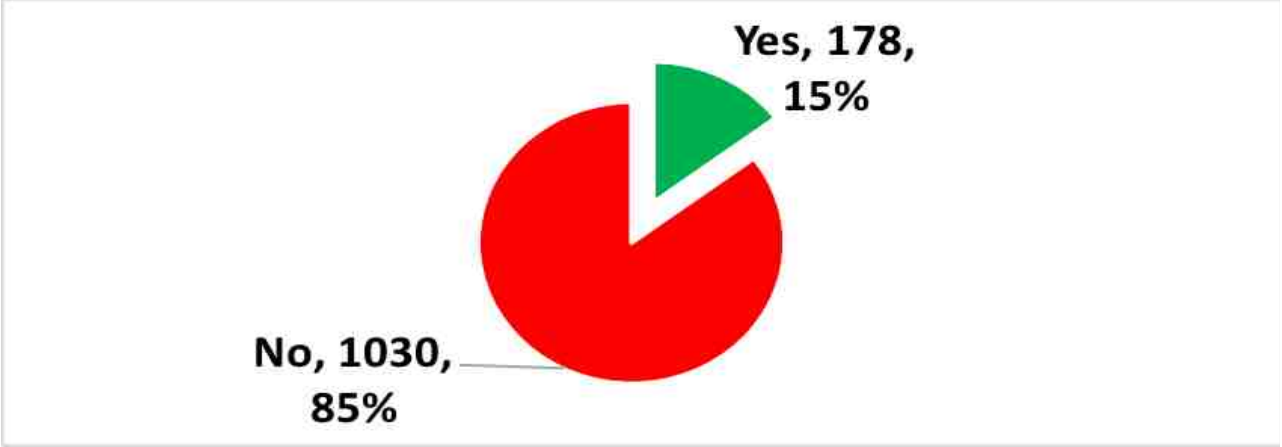

Figure 11: Was there any other child at any other time, who normally doesn't live in this compound, but who was there during one or more cycles, and was treated at least once.

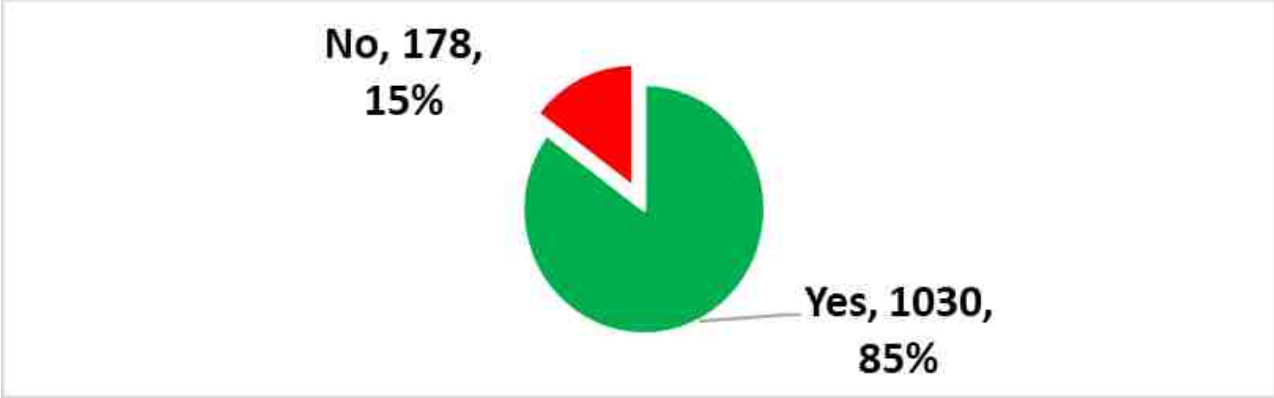

Figure 12: Does the child have an SMC card?

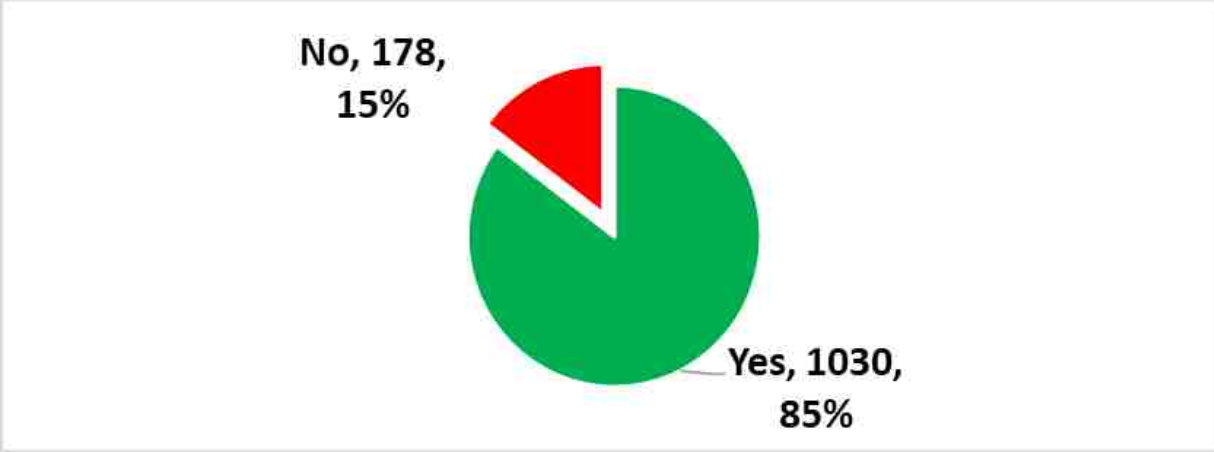

Figure 13: Do you / did you know the CHW/distributor who came to the compound to treat your child.

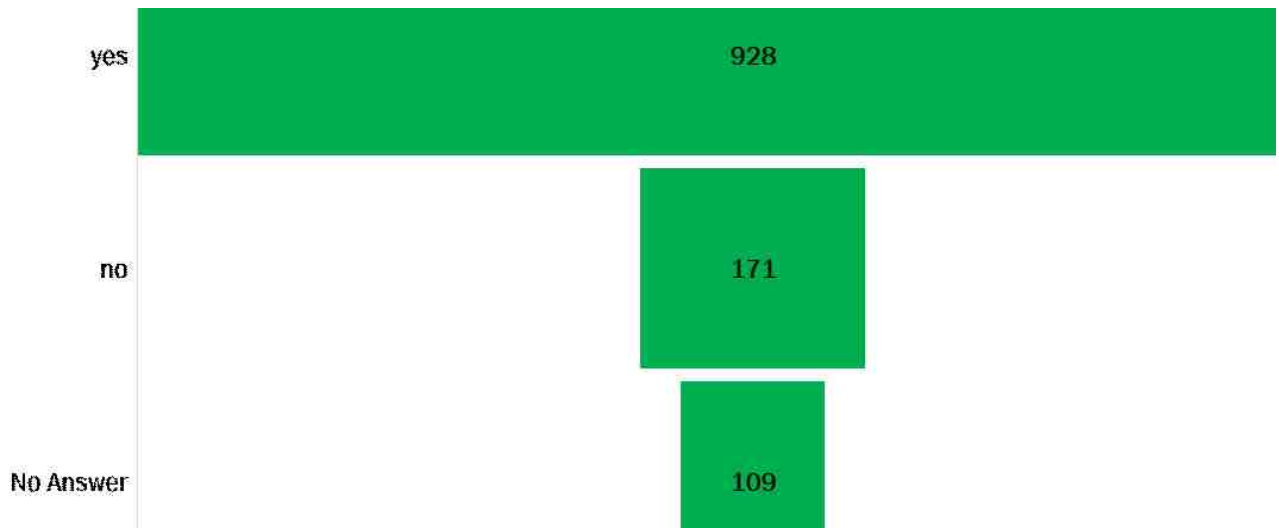

Figure 14: Is the CHW/distributor that treated your child from your community/village or is he coming from outside.

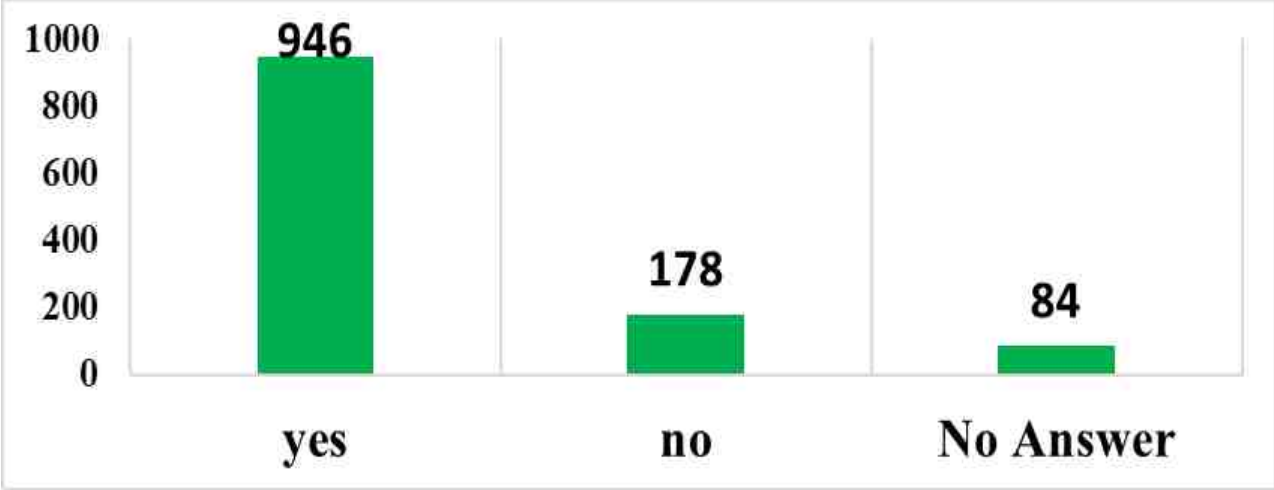

Figure 15: Can you confirm if the CHW/distributor did administer the first dose to the child on day 1?

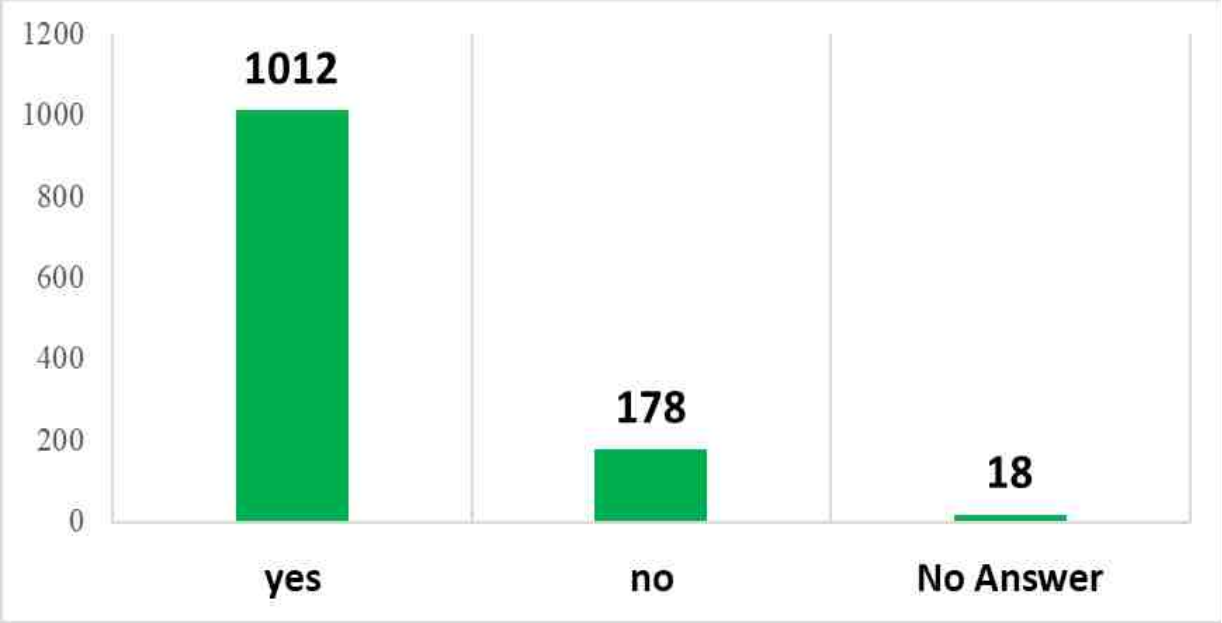

Figure 16: If the child vomited/spitted the drugs, did the CHW/distributor repeat the dose.

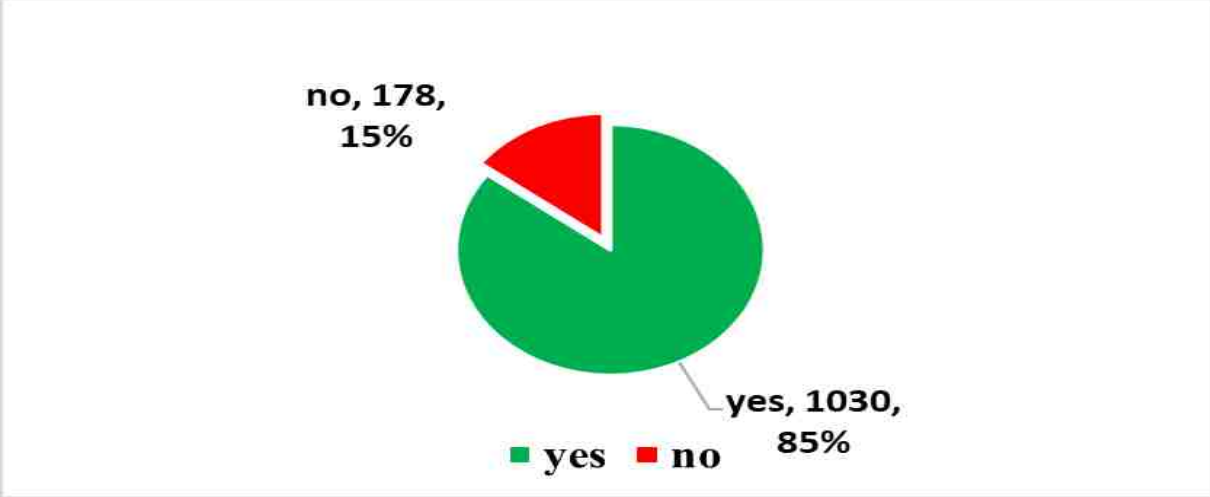

Figure 16: Did the CHW leave you some SMC medicines in a blister pack to give to the child.

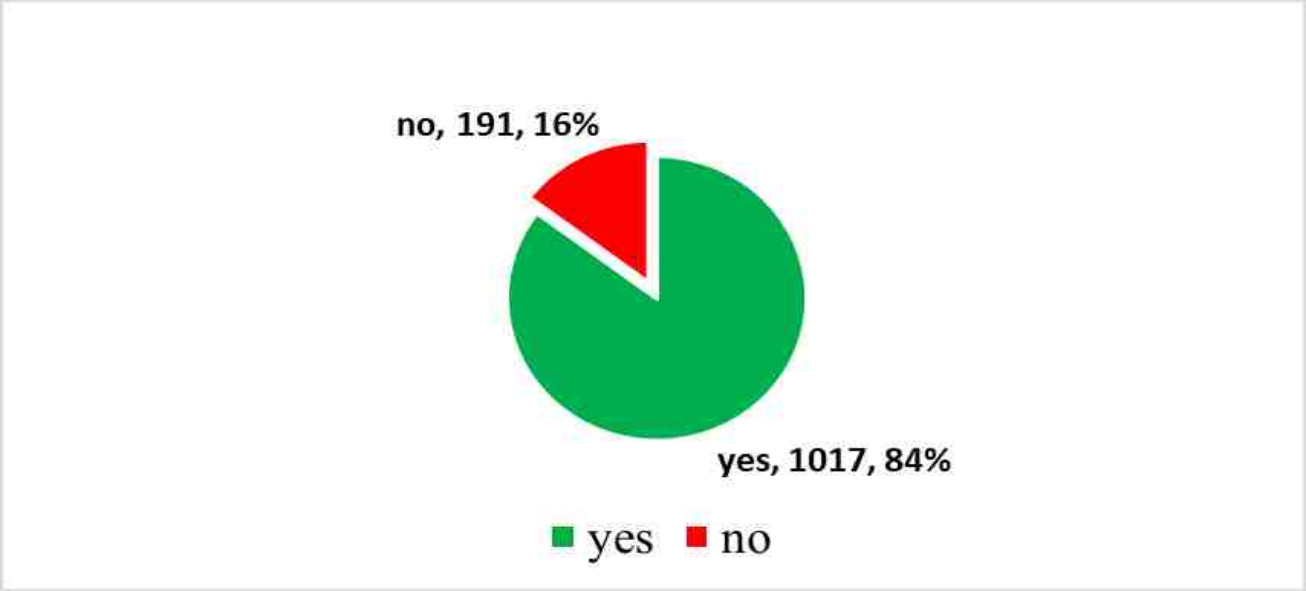

Figure 17: Do you remember how many tablets were in the blister pack?

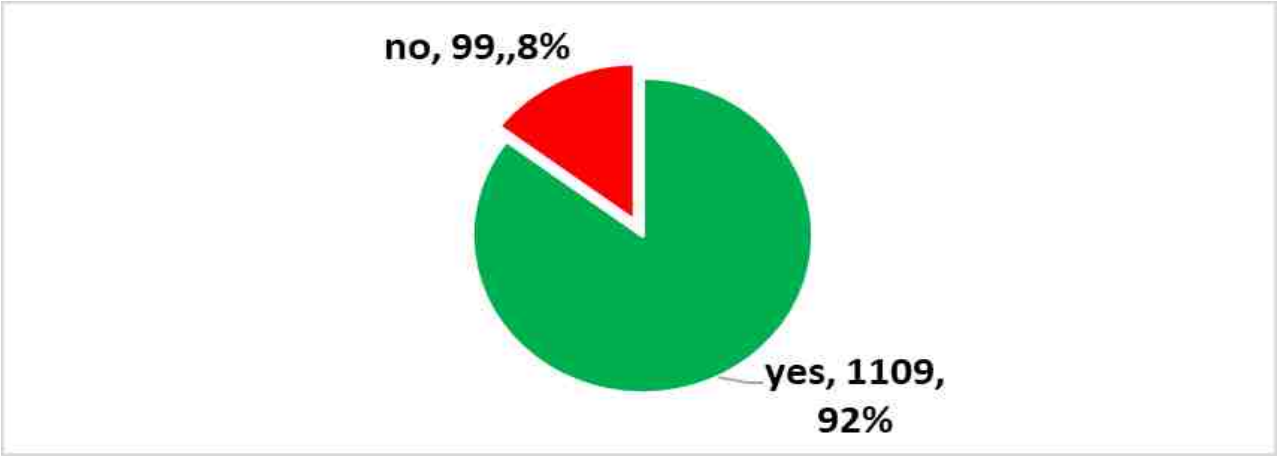

Figure 18: Can you explain what you should do with AQ (yellow) tablets at home?

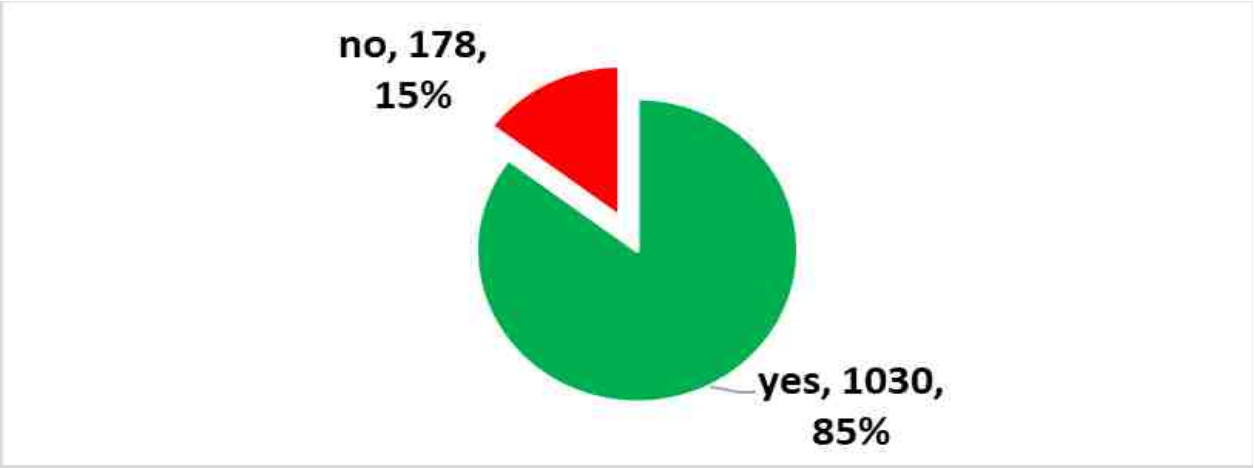

Figure 19: Have you (caregiver) given Day 2 medicine to your child/children?

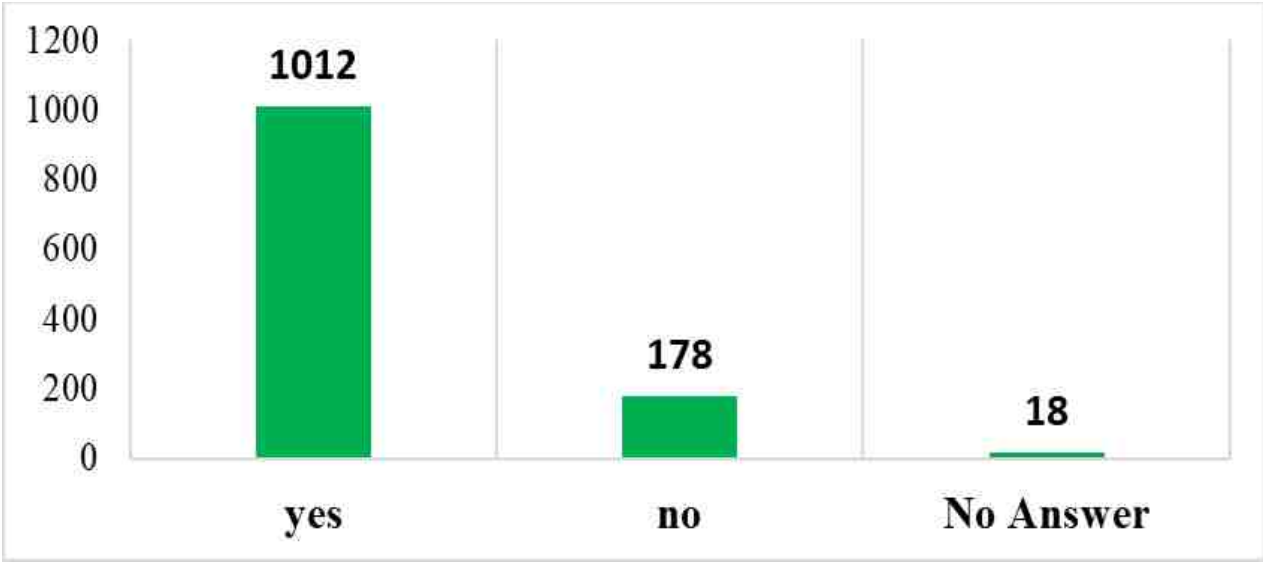

Figure 20: Have you (caregiver) given Day 3 medicine to your child/children?

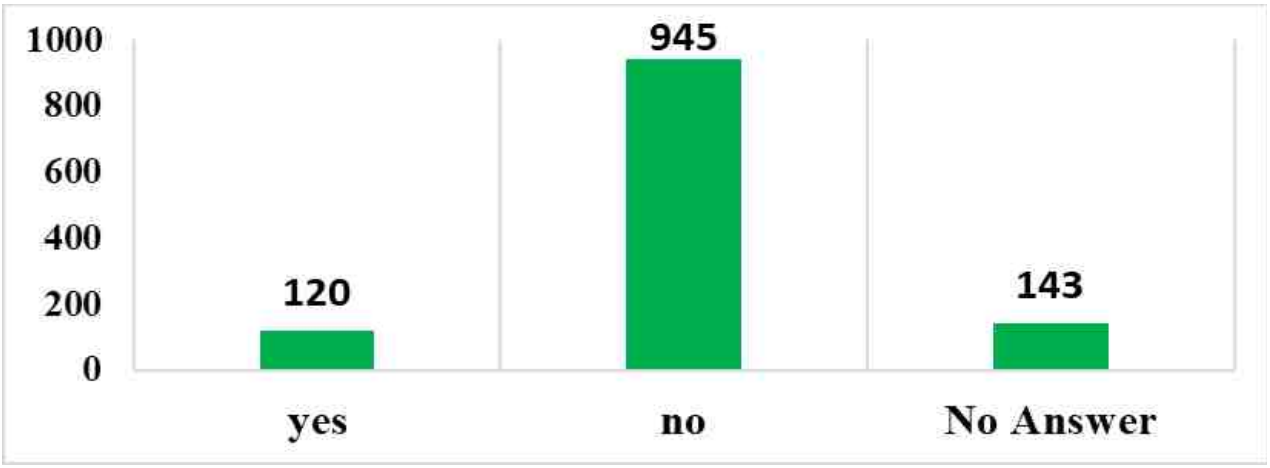

Figure 21: Are there tablets remaining in the blister?

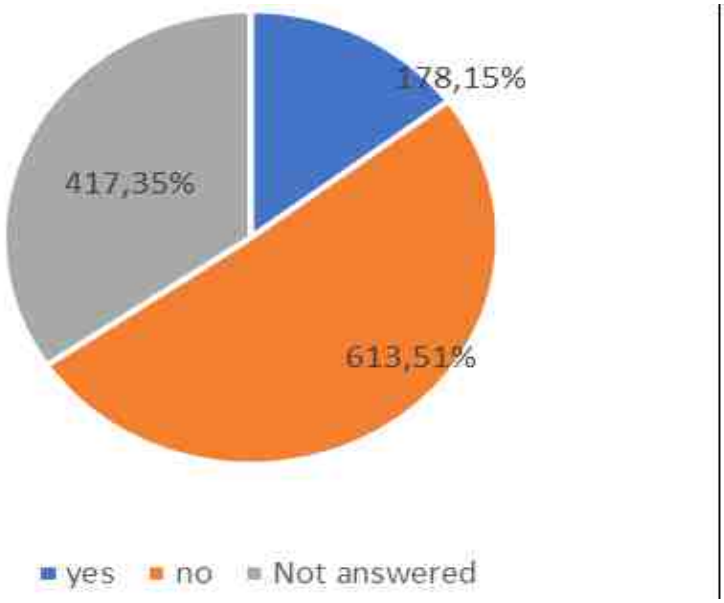

Figure 22: Nobody reminds you to give this/these tablet(s)?

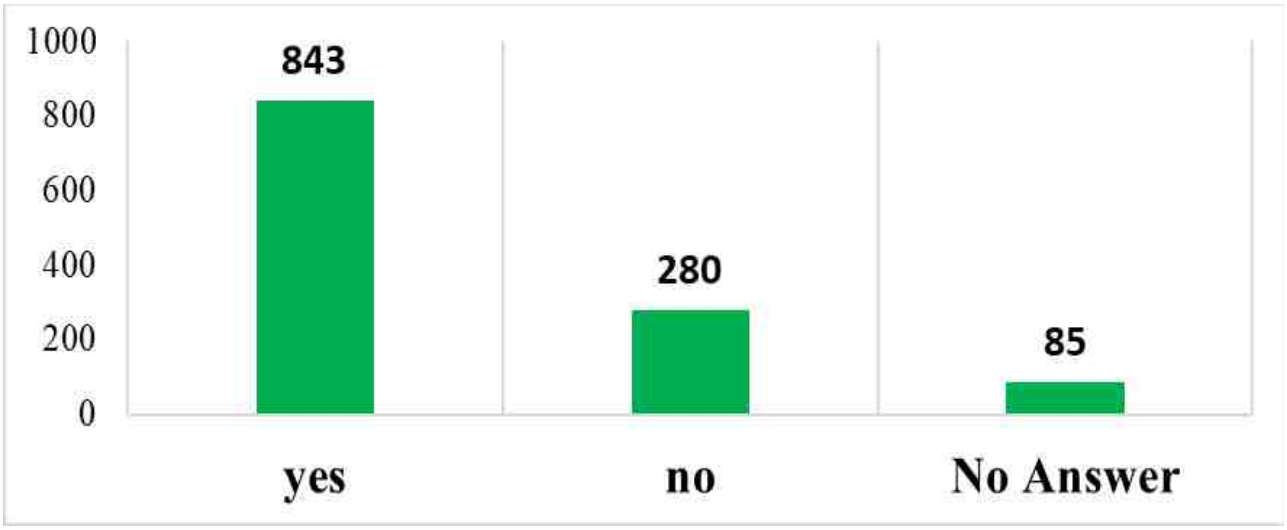

Figure 23: Can you tell what is SMC for?

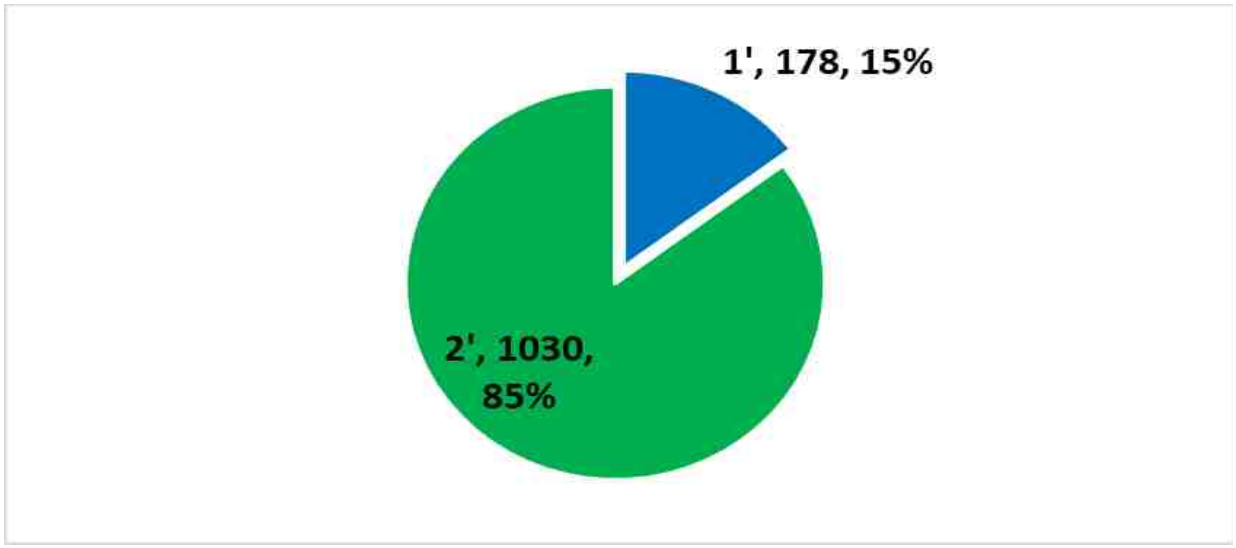

Figure 23: How many tablets should the child take on the first day?

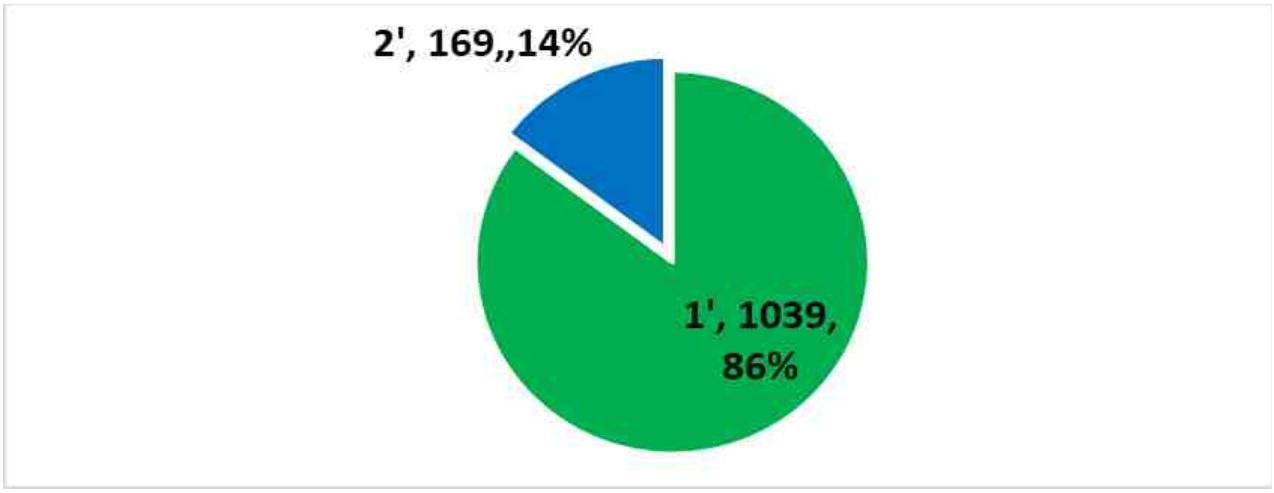

Figure 24: How many tablets should the child take on the Second day?

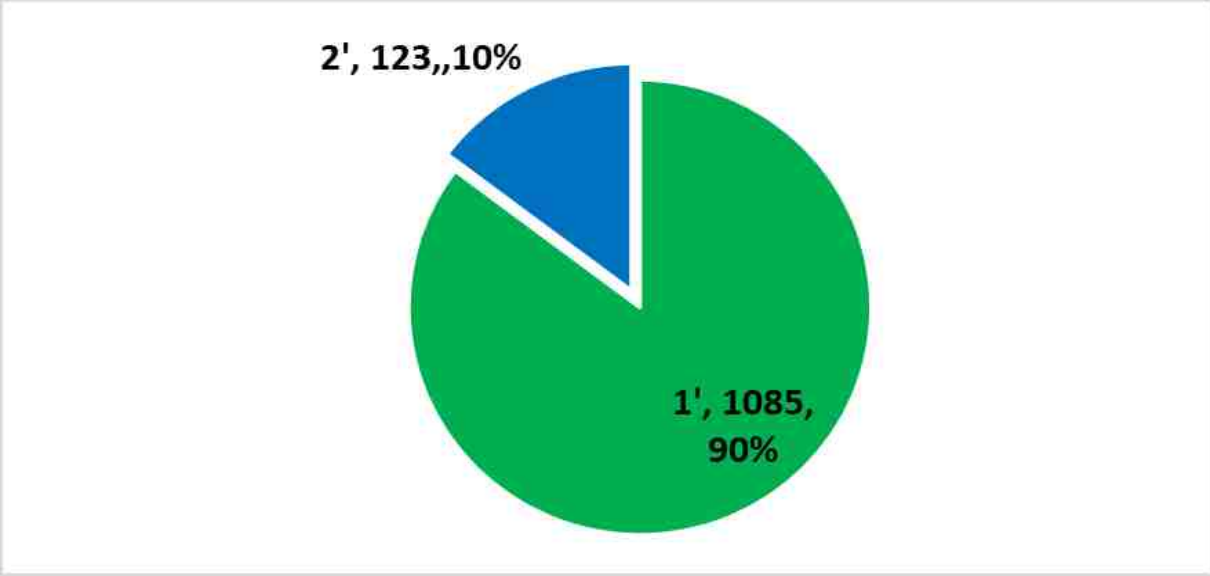

Figure 25: How many tablets should the child take on the third day?

Discussion

The responses of the respondents if there is at least one child from 3 months to 5 years old in their compound, 85% respondent selected yes while 15% of the respondents selected no. This finding is consistent with report from the joint study conducted in Sokoto, Jigawa, Katsina and Zamfara by Malaria Consortium in 2018 of which about 99% of the compound heads confirmed to have children under 5 in their compounds (Malaria Consortium, 2018). From our current study, 86% of the respondents interviewed reported that SMC Community Drug Distributors visited their households, while only 13.9% choose not to respond to the question, none of the respondents reported no to the interviewed question. This was also similar to the result obtained during the end of the SMC round survey in 2018 in which 88.2% of all responding compounds with children under 10 was reached by SMC teams while 92.9% of children 3-59 months (programme population target) were treated during the programme. More children were reached and treated in Jigawa (94.5%) than in the other three programme states. Out of all the children within the programme's target age (3-59 months) across the four states, about 6.9% of them were never reached by the SMC programme. This was most common in Katsina (8.2%) and Sokoto (7.0%) and least common in Jigawa (5.5%). From the results obtained in this study work almost all the houses with children aged 3 to 59 months were reached with none skipped during the Mass Drug Administration within the study period.

On the frequency of visits during the SMC drugs delivery to ensure completeness of the campaign and effective coverage, the data obtained in this current study shows that 8.4% of the respondents interviewed reported that the community drugs distributors visited their households only once in the cumulative data, while 8.8% recorded two visits, 17.9% recorded three visits, while the majority of the respondents reported recording complete four visits depicting 64.9%. This finding is consistent with the evaluation report in the four north western states (Sokoto, Jigawa, Katsina and Zamfara state) in 2018. Out of the proportion of under 5 children (93%) that received SMC treatment at any of the program's cycles, about 82% reported receiving just one visit and 1 treatment, 76% received two visits and 2 treatments, 66% received three visits and 3 treatment and about 57% received four visit and 4 complete treatments across the survey states. A progression in the coverage rate was observed in Jigawa and Zamfara states from cycle one to two with about 4% and 1% increase for the second cycle respectively, while other states reported a decrease in the proportion of the children that received the cycle two treatment indicating two visits within each round relative to cycle one response. Across states, sixty-eight per cent of caregivers in Katsina reported that children received two visits indicating

two treatments while 69% of caregivers in Sokoto state reported dose administration in cycle two. There was a slight coverage increase in Katsina from cycle three to four of about 2%. Across the states, Zamfara reported the highest percentage of children 3–59-month-old, who received at least three cycles (73%). About 68% of respondents in Jigawa state reported having received at least 3 cycles of the SMC treatment whilst 53% and 52% in Katsina and Sokoto respectively also received 3 cycles. Most of the caregiver of children 3-59 months reported not receiving the four-cycle treatment. About 37% of children 3-59 months were reported to have received all four cycles across all the surveyed states (Richardson *et al*., 2020). These ranges from 53% in Zamfara, 41% in Jigawa, 30% in Katsina and 26% in Sokoto state, the obtainable data show a wide margin in the percentage scores in the current study. In the current study, the proportion of children that come-up with fever after taking SMC medication was equally analysed and the obtainable data shows that the caregiver that responded Yes to that were18.7%, 80% of the respondents said No to that and 1.3% decline to respond to the question, this is not unconnected to the fact that SMC is often implemented alongside other malaria preventing measures that strengthen the effectiveness of the campaign, such as the ownership and intensive use of Long-Lasting Insecticidal Net (LLIN), mosquito vector control strategies and adherence to full course of the SMC medication, a high proportion of children coming up with malaria fever after taking SMC medication were not sleeping under the long-lasting insecticidal net to compliment the SMC medicine taking, not sleeping under LLIN negatively affect the effectiveness of the chemoprevention as children keep coming-up with malaria after treatment and the reasons given by the caregivers is that the net was temporarily unavailable (62%), while about 15% said the net was damaged and same proportion said they forgot to prepare the net for the child to sleep under. In contrast to the present study, in their study non-adherence to LLIN use following successful malaria control in Tororo, Uganda reported non-adherence was greater among children under the age of 5 years and school-aged children between the ages of 5 and 17 years, while inhabitants of poorer families were less adherent (Rek *et al., 2020)*. From the observation made on the child record card that was issued to caregivers and the interviewed conducted the result obtained shows 18.7% of respondents that said yes from the previous response depicting 219 caregivers, it was noted that 47% of the respondents' children only took one cycle of treatment, 32% took only the two cycles of treatment, 14% took three cycles of while only 8% took the full four-cycle of treatment. This shows non-compliance to the three days course of treatment which contradicts the concept of SMC medication with only the 18% that complies. Moreover, the effectiveness of SMC goes in line with adherence and compliance to the full course of treatment. Coverage of SMC among eligible children in the study area was relatively high. Over 80% of children received at least the first day's SMC treatment either in their household which is the gold standard or in the health facility after referral during the first cycle of treatment. However, this proportion decreased over the consecutive cycles based on interviews conducted and SMC cards observation. This was similar to the result obtained during Malaria Consortium annual survey in 2014 where the result obtained show coverage per cycle slightly declined at subsequent cycles from 75 per cent in cycle one through to 55 per cent in cycle four (Janin, 2004). This is in cases where information could be obtained, SMC distribution at each cycle was equitable. 61.8% of all children for whom data was collected received at least 3 cycles of SMC. Several factors could explain the limited coverage for households and children, notably their absence during the rainy season. Indeed, it is common for some household members to spend all day in the fields. Some even leave their homes and temporarily live in shelters closer to the fields as reported by (Janin, 2004). Also, it is common practice in both rural and urban communities for young children to stay with their mother during the day and accompany her wherever she goes. This could explain why, even if a household was visited, some children did not receive SMC treatment.

The result of the interview conducted with the healthcare providers on if they sent their children to healthcare centre after a referral from the community revealed 62% of respondents selected yes they ensure the referral linkage is sustained and the affected children were taking to the health facility while 38% of responded selected no, this was because not all the health facilities are PMI supported site that provides both testing with

mRDT and treatment with the first line antimalarial (ACT) is provided free with no payment required to assess such services. Most caregivers in this study work sought treatment from health facilities after referral or when their children fail sick with symptoms of malaria. This finding is similar to the result obtained in 2018 survey by the Malaria Consortium which indicated that 67% of caregivers visited health centres for the care of their sick children in Katsina while 61% visited in Jigawa and Sokoto. Still on the 2018 survey information on the health outcome for children under 5 whose caregivers sought treatment at health facilities were also considered. Amongst those treated with SMC drugs, caregivers reported that about 78% on average were tested at the health facility during the child's visit. The proportion among those who were reported to have tested positive for malaria was 84% across all states. Sokoto state had the highest rate of positive cases reported by the respondents 90% which is contrary to the result obtained in this current study. These results are based on respondents recall; no record was accessed to confirm the malaria incidence (Malaria Consortium. 2019b).

On the use of Long-Lasting Insecticidal Net (LLIN) the proportion of children under 5 years of age that sleep under the LLIN on the previous night, it was reported that 85% of children within the required age bracket sleep under a mosquito net last night, while 15% selected no implying that they did not sleep under a mosquito net as obtained from the result of the interview with the caregivers in the study area. A similar study conducted by indicated that the use of mosquito net among children treated and not treated during the cycles after assessment shows that the majority of the children who were treated across the states sleep under a mosquito net on the average (74%). Also, a very high proportion of sleep under a mosquito net among those not treated (70%). In another survey conducted in 2014, the result shows that in all the households visited, 80.7% of all children at baseline and 73.1% at end line slept under a net the previous night. However, in only net owning households, 90.8% of children slept under a net. This proportion significantly increased to 93.8% at the end line. Usually, about 90 per cent of children sleep under a net in these communities which is similar to the result obtained in our current study (Lim *et al.,* 2012).

From the study conducted on the issue of vector control the result obtained from the participants when asked if anyone had sprayed the interior walls of their houses in the study areas shows that 52% responded Yes to the question, 15% responded No, while 35% of those who responded has no answer to the interviewed question. Occasionally, Indoor residual spray exercise and larviciding are being conducted by the state in the LGAs in Sokoto state aimed at reducing the vector density and to clear the breeding sites of the mosquito vector. The 2018 survey result shows that about 95% of the compounds visited were not sprayed by anyone in the past 6 months before the survey. This was also the case for compounds not visited during the treatment period as it equally depicts 98% of the respondents during the survey. Although, few respondents had disclosed having received visits from personal intending to spray houses but were prevented by some households due to cultural reasons. In this current study the number of households presents within each compound were inquired on the number of households in the respondents' compounds and Information gathered from respondents on the survey shows that 79% of them are 1 householder, 15% are 2 householders while 6% of them are 3 householders (Dicko *et al.,* 2011).

Conclusion

Seasonal Malaria Chemoprevention is an intervention with great potential in Sokoto state, and along with other interventions. It could significantly contribute to approaching the threshold where elimination strategies will be envisioned. During the mass drug administration in all 23 LGAs, comprising 244 wards and 8269 settlements, the intervention significantly reduced hospital visit, admission, and malaria indicators in children.

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