

Factors Associated With The Adherence To Unsupervised Daily Dose To Seasonal Malaria Chemoprevention In Builsa North District, Upper East Region Of Ghana

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FACTORS ASSOCIATED WITH THE ADHERENCE TO UNSUPERVISED DAILY DOSE TO SEASONAL MALARIA CHEMOPREVENTION IN BUILSA NORTH DISTRICT, UPPER EAST REGION OF GHANA

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ABSTRACT

Background: Since 2015, SMC with amodiaquine–sulfadoxine-pyrimethamine (AQ–SP) has been implemented during the high malaria transmission season in three regions of Ghana. Adherence to the Seasonal Malaria Chemoprevention (SMC) is one of the critical determinants for successfully protecting children under five. In Ghana, SMC In Ghana, the SMC implementation was started in 2015. The purpose of this study was to determine the level of Adherence to SMC and the associated factors among caregivers in Builsa North District.

Methods: We conducted a cross-sectional study in four (4) sub-districts in the Builsa North District. The district was stratified into six, and four subdistricts were selected using simple random sampling. We started recruitment at the community chief's house the researcher randomly selected the direction of movement. The 435 participants were recruited via balloting using a random sampling procedure. The knowledge of caregivers on Malaria and SMC was assessed by scoring correct answers to questions related to malaria and SMC. The association between SMC adherence and independent variables was tested using Pearson's chi-square test and Fisher Exact Test. Simple and multiple logistic regressions were performed to determine associations between SMC adherence and the independent variables, with all results interpreted at 95 % confidence level.

Results: The SMC adherence rates among the caregivers in the Builsa North District was 95.36% (416/435) with an awareness level of 97.94%. The reasons reported for non-adherence were the child's refusal (38.46%), the child's vomiting of the drug (33.33%), the occurrence of an illness within the period of medication (15.38%), the forgetting to give the subsequent doses (12.82%). About half (49.31%) of caregivers had a good knowledge of malaria, while 66.51% had a fair knowledge of SMC. Significant predictors of SMC on multiple logistic regression were the place of residence aOR=3.59, 95% CI [1.02-12.56] caregivers dissatisfied aOR=0.10, 95% CI [0.01-0.74], and being informed by a friend aOR=0.04, 95% CI [0.00-0.51].

Conclusion: This study found a very high adherence rate to SMC in Builsa North District. The key factors associated with SMC Adherence were being aware of SMC through non-health professional source, place of residence, and caregivers' satisfaction with the previous SMC campaign.

Keywords: Malaria – Seasonal Malaria Chemoprevention – Children under five – Amodiaquine Sulfadoxine Pyrimethamine – Adherence.

Background

Intermittent Preventive Treatment in infants is a primary health intervention designed to prevent malaria in children under five years of age during high malaria transmission, which occurs during the rainy season. This intervention is commonly known as Seasonal Malaria Chemoprevention (SMC). During this period, SMC effectiveness has been shown in malaria prevention in children. The implementation of this chemoprevention is done through routine immunization services by admitting a combination of sulfadoxine-pyrimethamine and amodiaquine in children aged 3 to 59 months, regardless of whether the child is infected with malaria. The World Health Organization has recommended this combination since March 2012 for children living in areas of highly seasonal malaria transmission in the Sahel subregion of Africa [1]. In 2014, seven countries in sub-Saharan Africa (Burkina Faso, Chad, Mali, Niger, Nigeria, Gambia, and Guinea) had adopted this malaria control strategy [2]. According to the World Health Organization, 15.7 million children in 12 countries in Africa's Sahel subregion were protected through seasonal malaria chemoprevention (SMC) in 2017. This intervention is effective, cost-effective, safe, and feasible for preventing malaria in children under 5.

In Ghana, the National Malaria Control Program started the implementation in 2015 in the Upper West Region (UWR). Following the implementation of SMC in UWR, an impact assessment showed that SMC's efficacy was 45%. Based on this success, the intervention was extended to the Upper East Region (UER) in 2016.

Most of the studies have analyzed SMC's efficacy, impact, accessibility, availability, and coverage. Few studies examining hidden sociodemographic, operational, individual, and seasonal factors within the household predict, encourage, or prevent the adherence to SMC [3,4]. These challenges in the non-adherence fail to protect the child from malaria infection. This interrupted protocol may induce AQ-SP resistant development,

which has devastating consequences of malaria burden in children under 5. The prevalence, the morbidity, and the mortality of malaria in children under 5 would be more likely to be perpetuated if studies are not delved into to fish out such factors or predictors that are associated with the adherence of SMC within caregivers, for appropriate recommendations and amendments, advocacy be tabled to control the situation [4].

According to the National Malaria Control Program (NMCP) reports, the SMC campaign coverage in 2018 was more than 99%, and children under five are still facing infections of malaria and its consequences. It is necessary to understand why some children under the age of five suffer malaria despite having a high SMC implementation coverage. This study investigated using a quantitative method the adherence to the three-dose finalization of SMC among caregivers in Builsa North in Ghana.

Methods

A cross-sectional household survey was conducted in four (4) subdistricts of Builsa North Districts, Upper East Region of Ghana.

Sampling Strategy: Multi-stage sampling procedure was used. As several sampling methods, it was used at various stages to get multiple sampling units right from the district level to the last smallest sampling unit—the respondents at the different households.

The Builsa North District was stratified into six (6) sub-districts (Sandema Central, Bilinsa- Bilimonsa, Wiaga Central, Chuchuliga Central, Siniensi-Yikpien, Suwarensa-Ndaasa) to ensure fair representation of some of the population's essential characteristics. At this point, simple random sampling by non-replacement balloting was used to select four (4) communities from the six (6) strata by balloting where the names of the different sub-districts or communities were written on pieces of paper, folded, and placed in a bowl.

Eyes closed; a hand was dipped into the bag to choose a folded paper without replacement. The sub-districts selected in this way were used as study sites where caregivers were recruited for the study. A proportionate sampling approach was used to assess the number of participants included per population.

At the community level, each community was stratified into four areas, east, west, south, and north. Starting from the community chief's house, the researcher randomly selected the direction of movement. Depending on the direction chosen, for instance, to the west, the researcher went from house to house in that direction, then to the south, east, and north in the same area.

At the household level, in each house, a caregiver who was 18 years of age or older and accepted to take part in the study and lived in a household and fulfilled all the inclusion criteria was interviewed. In the case that a house had more than one household, one of them was chosen randomly to complete a questionnaire. In the event that the sample size was not obtained from one area due to a lack of eligible participants on the population of each area, data collection proceeded in the next enumeration area. This method was repeated until the final size of the sample was collected.

The number of interviews was performed in each sub-district depended on the approximate proportion of women of reproductive age. We assumed that women around reproductive age (18-49) were the primary caregivers for drug administration during SMC campaigns for this study. In this study, we chose the age groups (15-54) as the target population. We used the World Bank demographic database on the distribution of age groups by sex.

Data Collection: This study used closed-ended structured questionnaire to collect data from the 435 participants from the four (4) sub-districts using a face-to-face interview. The questionnaire was designed in simple English to reflect the study variables and allow easy translation by research assistants (RAs). However, during the interview, the participants were asked to sign the informed consent form after the, the questions were asked or translated into local dialects (Buli language, Kantonsi language, Fulani language, Dagomba language, Mossi language, Agari language) for better understanding, especially for participants who did not receive formal education during the administration. The questionnaire questions focused on the respondents' specific vital demographic characteristics, general knowledge about malaria, and general knowledge about SMC. The tool was pre-tested with twenty (20) households in Navrongo (Kassena-Nankana District), which is an adjacent district of Builsa North District in the Upper East Region of Ghana. During the pre-test, all the ambiguities concerning supervision and asking questions were corrected.

Data Management and Data Analysis: The raw data of the field, was manually cross-checked to ensure completeness, and was entered in Kobo-collect using tablets, then downloaded as a Microsoft Excel file before being exported to STATA version 16 (Stata Corporation, College Station, Texas) for further management and analysis. To ensure accuracy and completeness, the data was further cleaned up by running the frequencies of all variables to verify incorrect coding using STATA.

The proportion of caregivers who adhered to SMC reported in proportion by dividing the number of caregivers who said their children completed the three doses of AQ+SP.

Basic descriptive statistics were obtained on the sociodemographic characteristics of the respondents and the knowledge variables.

Two derived variables on the malaria knowledge level and SMC knowledge level were generated in STATA by scoring the knowledge dichotomous knowledge variables. While a correct answer was given, it was scored as

1, and a wrong answer was scored as 0. Then total scores were categorized into four groups: poor knowledge, insufficient knowledge, good knowledge, and very good knowledge.

The results were presented in frequencies and percentages using tables and graphs. Frequencies were generated to describe categorical variables. Continuous variables were expressed as arithmetic means and standard deviations for normally distributed variables, median, and quartiles for variables not following the binominal distribution.

Pearson's chi-square (χ^2) test was used to compare the proportions in cross tables with high observed observation, and the Fisher exact test was used to compare the proportions with low observed observation. The bivariate analysis (Fisher exact test and Chi-square test) was used to assess the crude association between potential predictors of the adherence, while univariate analysis was performed to estimate the strength of associations between the adherence and its predictors after controlling for the covariates. After then, all the independent variables with p-value from 0% to 50% were used to perform different regressions models.

Results

A summary of the various characteristics of participants is in Table 1.

Table 1: Sociodemographic characteristic of caregivers in the Builsa North District

Sociodemographic Characteristic	Frequency	Percentage %
Age		
Median (minimum-maximum)	29(18-50)	-
<20	18	4.36
20 - 29	208	47.71
30 - 39	164	37.61
40 - 49	45	10.32
Marital Status		
Never married	80	18.35
Married	265	60.78
Cohabiting	60	13.76
Divorced	17	3.9
Widowed	14	3.21
Religion		
Christian	357	81.88
Muslim	55	12.61
Traditional	24	5.5
Ethnic		
Builsa	343	78.67
Mossi	40	9.17
Sissala	28	6.42
Others*	25	5.74
Educational Status		
No formal education	163	37.39
Primary	77	17.66
Secondary	99	22.71
Higher	97	22.25
Occupation		
Unemployed/Housewife	215	49.31
Formal work	122	27.98
Others**	99	22.71
Number of Children under five		
One child	281	64.45
Two children and more	155	35.55
Household Size		

Mean (\pm Standard deviation)	5.24 (\pm 1.63)	-
Median (minimum-maximum)	5 (3 - 8)	-
3 – 4	163	37.39
5 – 6	164	37.61
7 – 8	109	25.00

*: Fulani, Akan, dago; **: artisan, hairdressing, farming, buying, and selling.

Adherence level to the SMC first round in 2020

Most of the caregivers interviewed, 90.87% (396/435) reported that all their children received the AQ+SP from drug distributors during the first round of 2020. The adherence rate to SMC among caregivers of those whose children were covered during the first-round drug distribution was 95.36 (416/435) % (Figure1).

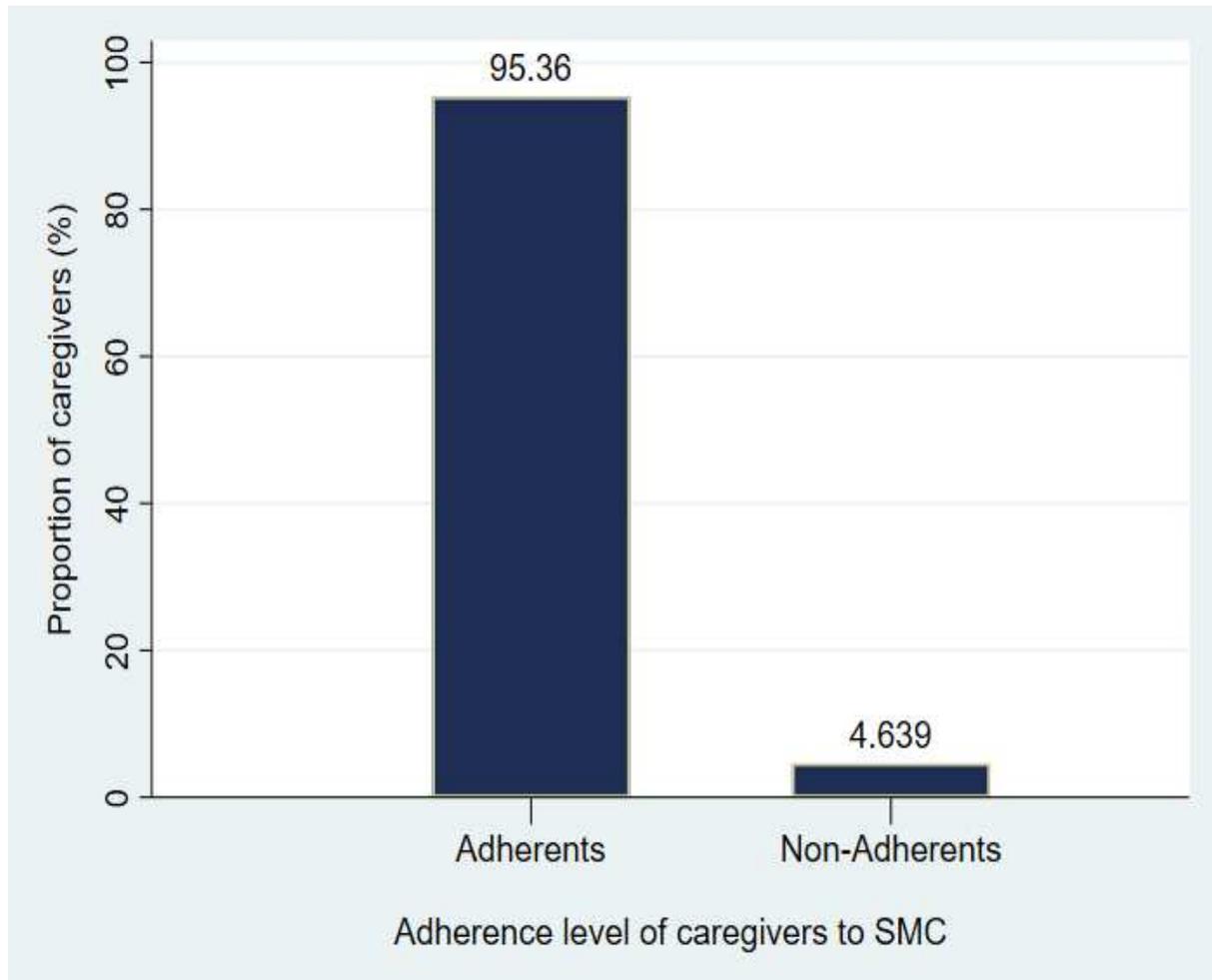


Figure 1: Adherence level of caregivers to SMC during the first in Builsa North District 2020

Reasons for non-adherence

Four main reasons were reported by the 18 caregivers who did not adhere to SMC during the first round of drug distribution. The primary cause they said for non-adherence was the child's refusal which represented 38.46% (7/18), followed by the child's vomiting of the drug administration, the occurrence of an illness within the medication period. Besides, 12.82% (2/18) reported that they forgot to give the drugs the subsequent two days. These results are shown in Figure 2 below.

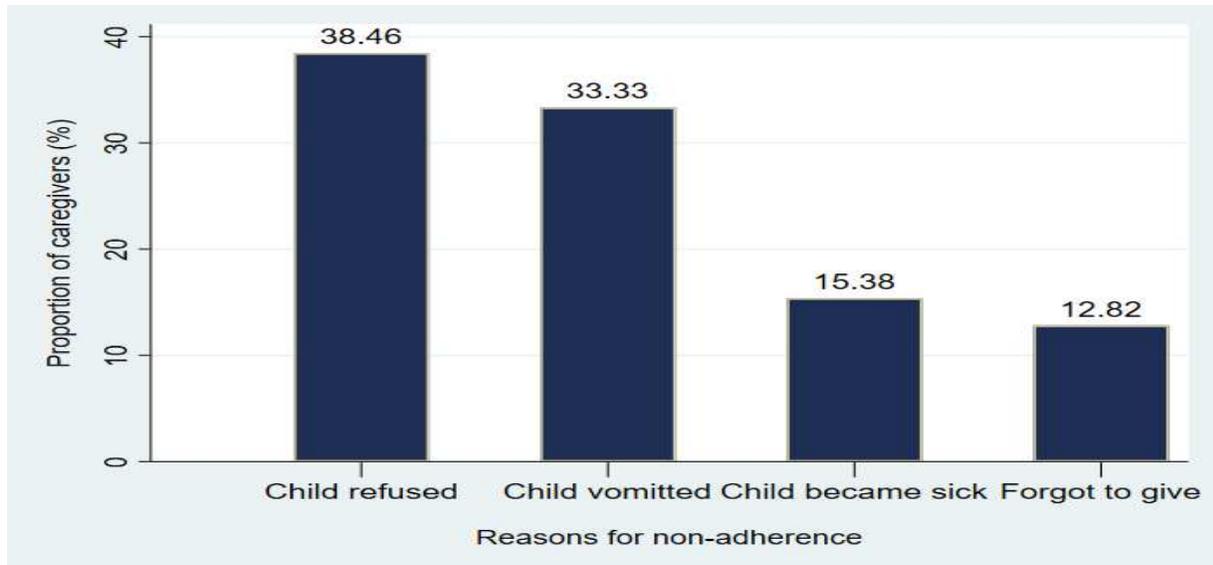


Figure 2: Reasons for non-adherence to unsupervised daily treatment doses of SMC

Awareness and Knowledge levels

Almost all the respondents, 97.94% (427/435), reported having ever heard of SMC, as seen in Figure 3. Among those aware of SMC, the responses were collected from the knowledge assessment on malaria in children and SMC summarized in table 2.

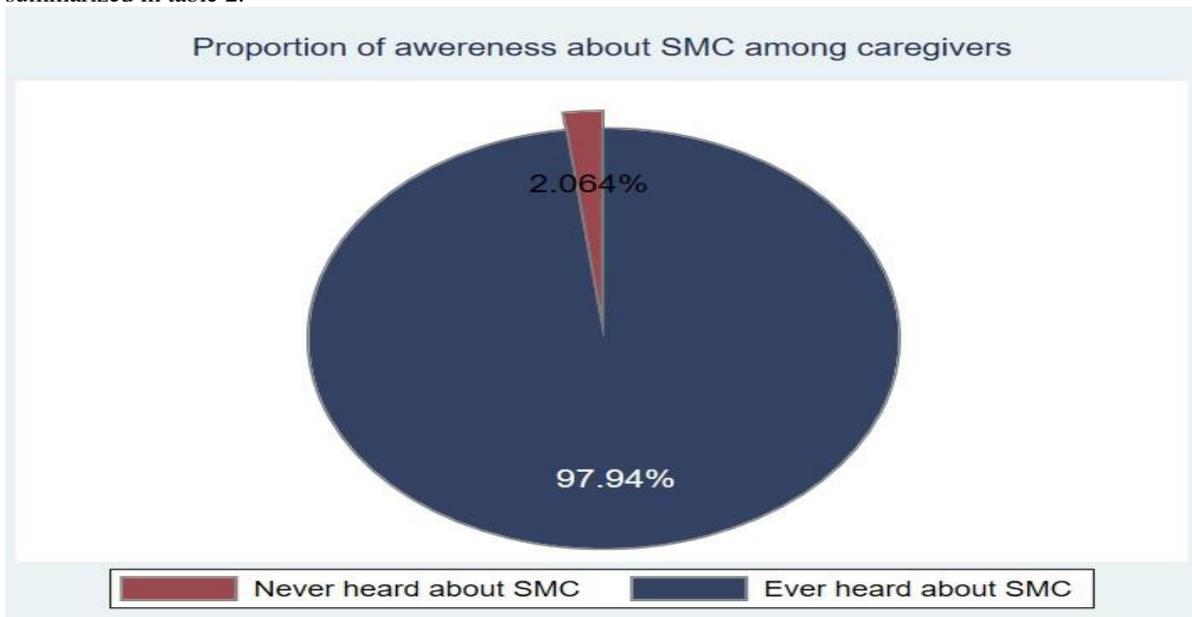


Figure 3: Levels of awareness of Seasonal Malaria Chemoprevention

Table 2: Knowledge of Malaria and SMC among caregivers

Knowledge Variables	Responses	Frequency (%)
Malaria		
Cause of malaria	Mosquito bite	430 (98.62)
Effect of untreated malaria on child	Anemia	395 (90.60)
	Convulsion	409(93.81)
	Mental Confusion	400 (91.74)
	Death	401 (91.97)
Malaria Preventive methods		
	Insecticide Treated Nets	403 (92.43)
	Daily use of mosquito repellent	405 (92.89)
	IRS during the rainy season	203 (46.67)
Seasonal Malaria Chemoprevention		
Purpose of SMC	Prevent malaria in children under five	288 (78.69)
Number of regimens	3 doses	242 (66.12)
Intervention season in the year	Only raining season	255 (69.67)
Number of days for a child	Three days	295 (80.60)
Minimum age required for SMC medication	Three months	18 (4.92)

In General, half of the respondents, 49.31% (215/435), had good knowledge of malaria in children, while 2.29% (10/435) had poor knowledge. The Knowledge level on SMC was mainly fair for respondents 66.51% (290/435), while a few had good knowledge of 8.26% (36/435). Those who had very good knowledge of SMC represented the minority 4.13% (18/435) Table 3.

Table 3: Level of Knowledge of caregivers on Malaria and SMC

	Malaria	SMC
Level of Knowledge	Frequency (%)	Frequency (%)
Poor knowledge	10 (2.29)	92 (21.10)
Fair knowledge	59 (13.53)	290 (66.51)
Good knowledge	215 (49.31)	36 (8.26)
Very good knowledge	152 (34.86)	18 (4.13)

Nearly half of the respondents, 43.56%, reported that local radios are their source of knowledge on SMC, followed by health centers 29.04% and community health workers 11.71%. However, some minorities reported public announcements, friends, and TV as their source of knowledge on SMC presented in Figure 4.

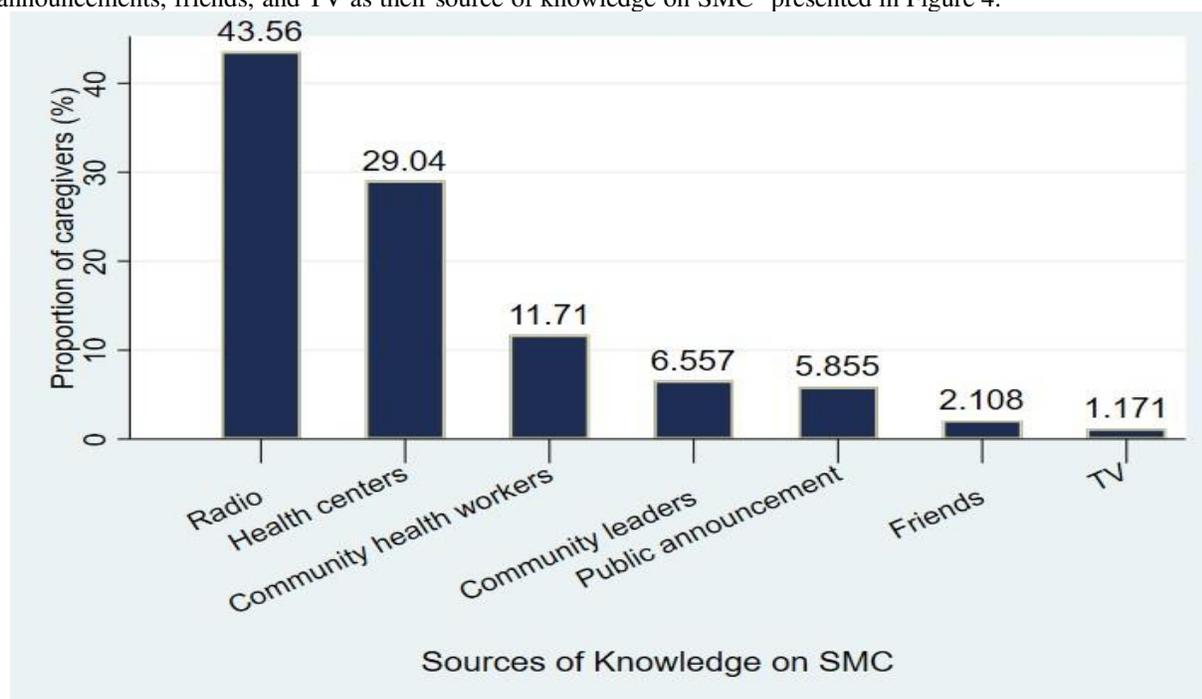


Figure 4: Source of Knowledge on SMC

Sociodemographic and adherence to unsupervised daily treatment doses

Respondents under the age of 20 (5.26 %), Muslims (10.42 %), married (61.34 %) trained (35.51%), single and widowed (8.33 %), those with primary education (7.04 %), housewife (5.38 %), those residing in smaller households (5.88 %) and those with two or more children were more likely to be non-adherent. However, there was no statistically significant relationship between age, gender, marital status, race, educational degree, profession, household size, number of children under five, SMC knowledge level, Malaria knowledge level, and adherence (p-value?). There was statistical significance for adherence with source of knowledge (p-value = 0.007) and satisfaction level (p-value = 0.000). These results are illustrated below in Table 4.

Table 4: Sociodemographic factors and adherence to unsupervised daily treatment doses of SMC.

Sociodemographic Characteristic	Frequency	Percentage %
Age		
Median (minimum-maximum)	29(17-50)	-
<20	19	4.36
20 - 29	208	47.71
30 - 39	164	37.61
40 - 49	45	10.32
Marital Status		
Never married	80	18.35
Married	265	60.78
Cohabiting	60	13.76
Divorced	17	3.9
Widowed	14	3.21
Religion		
Christian	357	81.88
Muslim	55	12.61
Traditional	24	5.5
Ethnic		
Builsa	343	78.67
Mossi	40	9.17
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Educational Status		
No formal education	163	37.39
Primary	77	17.66
Secondary	99	22.71
Higher	97	22.25
Occupation		
Unemployed/Housewife	215	49.31
Formal work	122	27.98
Others**	99	22.71
Number of Children under five		
One child	281	64.45
Two children and more	155	35.55
Household Size		
Mean (\pm Standard deviation)	5.24 (\pm 1.63)	-
Median (minimum-maximum)	5 (3 - 8)	-
3 - 4	163	37.39

5 – 6	164	37.61
7 – 8	109	25.00

*: Fulani, Akan, dago; **: artisan, hairdressing, farming, buying, and selling.

Multivariable logistic regression (MLR) analysis for adherence to SMC

Table 5 shows the results of MLR, SMC adherence analysis, and selected independent variables. Data from the 388 caregivers in Builsa North District who said they received the AQ+SP in July 2020 were used to perform this logistic regression model.

Place of residence, level of satisfaction, marital status, number of children under five, occupation, SMC Level of knowledge, knowledge of SMC's purpose, source of knowledge on SMC, household size was used to perform a simple and logistic regression.

The place of residence, the level of satisfaction, knowing SMC through a friend, residing in a household of at least five other persons, affected the SMC adherence.

The odd of adherence is 2.62 times higher among caregivers residing in urban areas than caregivers residing in rural areas. This finding was not found to be significant while unadjusted, but it was found to be statistically significant when adjusting for other factors (Adjusted OR = 2.62, 95% CI = [0.96, 7.14]).

Participants who reported being very dissatisfied with drug distributors had 98% lower adherence odds than those who reported being very satisfied (Crude OR=0.02; 95% CI = [0.00-0.27]).

Respondents reporting their knowledge source as a friend had 93% lower odds of adherence than those reporting their knowledge source as health centers (Crude OR=0.07, 95% CI = [0.01-0.41]). Respondents who indicated that their household composition is six or more is 3.24 times more likely to adhere than those who indicated that their household size is less than six (Crude OR=3.24, 95% CI = [1.04-10.04]).

Table 5: Factors associated with adherence to SMC for logistic regression.

Characteristics	Observations		Crude Odd Ratio		Adjusted Odd Ratio	
	Non-Adherent	Adherent	OR (95% CI)	p-value	OR (95% CI)	p-value
Place of residence						
Rural (Ref.)	12	160	1		1	
Urban	6	210	2.62 (0.96 - 7.14)	0.059	3.59 (1.02 - 12.56)	0.045**
Satisfaction Level						
Very satisfied (Ref.)	2	81	1		1	
Satisfied	8	264	0.81 (0.17 - 3.91)	0.798	0.74 (0.13 - 4.10)	0.735
Dissatisfied	6	23	0.09 (0.01 - 0.50)	0.006**	0.10 (0.01 - 0.74)	0.024**
Very dissatisfied	2	2	0.02 (0.00 - 0.27)	0.003**	0.02 (0.00 - 0.37)	0.008**
Marital Status						
Single (Ref.)	6	66	1		1	
Married	9	229	2.31 (0.79 - 6.73)	0.124	3.68 (0.93 - 14.60)	0.063
Cohabiting	2	48	2.18 (0.42 - 11.28)	0.352	4.45 (0.49 - 40.03)	0.183
Divorced /Widowed	1	27	2.45 (0.28 - 21.36)	0.416	1.67 (0.15 - 18.35)	0.673
Number of Children Under-five						
One child (Ref.)	10	232	1		1	
Two and more child5 under five	8	138	0.36 (0.28 - 1.92)	0.542	0.51 (0.15 - 1.69)	0.272
Occupation						
Unemployed (Ref.)	10	176	1		1	
Formal work	4	109	1.54 (0.47 - 5.06)	0.469	2.7 (0.55 - 13.05)	0.216
Others	4	85	1.20 (0.36 - 3.96)	0.756	1.57 (0.36 - 6.84)	0.546
SMC Knowledge Level						
Low knowledge (Ref.)	17	320	1		1	
Good knowledge	1	50	2.65 (0.34 - 20.40)	0.348	1.93 (0.18 - 20.03)	0.582
Knowing the purpose						
No (Ref.)	4	53	1			
Yes	14	317	1.70 (0.54 - 5.38)	0.361	1.03 (0.20 - 5.31)	0.966

Source of knowledge on SMC

Health Centers (Ref.)	4	106	1		1	
Community Leaders	0	46	0.86 (0.09 - 8.12)	0.901	0.43 (0.03 - 5.56)	0.519
Public announcement	1	23	0.37 (0.06 - 2.20)	0.279	0.30 (0.02 - 3.30)	0.327
Friends	2	20	0.07 (0.01 - 0.41)	0.003**	0.04 (0.00 - 0.51)	0.013**
Radio	3	6	0.88 (0.25 - 3.11)	0.855	0.36 (0.08 - 1.62)	0.187
TV	7	165	0.15 (0.01 - 1.67)	0.124	0.72 (0.02 - 19.33)	0.85
Household Size						
< six people (Ref.)	10	232	1		1	
Six people and more	8	138	3.24 (1.04 - 10.04)	0.041**	8.26 (1.81 - 37.62)	0.006**

** : p-value < 0.05 ; For all observations less than 5, the p-value used was Fischer exact

Discussion

This study has identified some factors that significantly influenced the adherence to unsupervised daily doses of SMC among caregivers in Builsa North District during the first SMC campaign in 2020.

The study shows that the adherence rate to the SMC equal to 95.36%. This study also provides further evidence that having more than one child under five, inquiring information on SMC through any other sources deafferents from health professionals and being dissatisfied with the SMC are associated with a decrease of the odds of adherence to SMC.

In this study, the caregivers who adhered to SMC represented 95.36% Diawara et al. reported that self-reported adherence to SMC is similar to 95%, but the reliability in this regard is uncertain [6]. While this was not in SMC's setting, a study comparing various malaria preventive regimens in Ugandan children showed that adherence to a 3-day course of dihydroartemisinin-piperazine was much higher when reported by the caregiver (~100%) compared to the unbiased concentration of drugs [7]. A lower adherence was found using a longitudinal study in Nigeria by Ward et al. Their research found that the adherence was 83.8% [8]. Several factors may explain these observations, and a mix of these reasons rather than one alone is likely responsible. First, there may have been a good understanding of SMC in the Ghanaian community than Nigerian because the Ghanaian health system is better in terms of coverage than Nigerian's [9]. It is possible that the SP-AQ intervention improvements over the years contributed to increasing the adherence in Builsa North District by reducing the frequency and/or severity of infections among participating children. A similar study in southern Ghana and other African countries using AS+AQ also found a high adherence level (81% – 97%) among caregivers [10]. These findings indicate that high adherence to AS+AQ can be reached in remote areas where a successful treatment education program is in place. However, the adherence rate found in this sample could be an overestimation.

A randomized, placebo-controlled SMC trial in Ghana showed nearly 100% self-reported adherence to SMC's 3-day course across all research communities. However, some caregivers were found to have residual SMC tablets that had not been administered [11]. Another way to measure the adherence is by testing the levels of medications in children's blood during a follow-up period [11].

To reduce malaria incidence in children under five within an endemic community, a high proportion of adherence to SMC is indispensable. The adherence demonstrated by this study is associated with mainly to the good knowledge of SMC, the knowledge of SMC's purpose, the larger household size, the place of residence, the satisfaction of caregivers with previous SMC, the source of knowledge of caregivers about SMC.

The study revealed that the respondents demonstrated a better awareness of malaria and SMC. This result is not different from what Mazigo et al. and Ingabire et al. reported on the knowledge of SMC [12]. Having good knowledge is a basic predisposition for committing to adhere to all three doses of AQ-SP.

There is a tremendous need to intervene in the communication channels related to the SMC. The caregivers who reported that there had been introduced to SMC through their friend are likely to not adhere to the 3-day protocol. In contrast, those introduced through professional sources are likely to adhere. This factor may be explained by a lot of rumors that go from one to another about all the mass drug administration (MDA). Some people do not trust any free medication. In some remote areas, people still trusting only traditional medicine. This knowledge gap may explain the lack of importance of those who reported they forgot to give medicine to children.

There was a difference in household size observed in this study. Households composed of more than 5 people are more likely to adhere to SMC; this may be due to the increased number of people (sisters, brothers) to take care of children, the primary caregivers.

The perceptible factor assessed in this study is the satisfaction level with SMC. The majority of caregivers reported that they are satisfied with SMC.

However, the study found that the tendency to adherence varied significantly with caregivers' level of satisfaction, the more they are satisfied more they adhered to SMC. In Mali Diawara et al. found that parents' opinions about SMC were very positive, with 99.9% of parents reporting that they felt the strategy was good or very good, and 99% of them were in favor of continuing the intervention. SMC's strong support and favorable opinion are major assets for continuation and scale-up [13]

The reasons for non-adherence in this study were the child's refusal to swallow the drug, vomiting, illness after the first dose, and the mother's forgetting about the medication. In Niger, Ding et al., 2020b found that children refusing to take the drug; suboptimal health worker instructions; small children spitting out medication, even if it is dissolved; vomiting within 30 minutes of dosing; caregiver saving medicines for the treatment of another family member with acute malaria later on; caregivers sharing/giving medication to older children who were not eligible for SMC; fathers not allowing the medicine to be taken; and fatigue of giving medication, mainly when the child is not sick were the main reason for non-adherence cited by study participants were the main reasons of non-adherence to SMC [14]

Ultimately, an integrated approach to funders, policymakers, health workers, applied health social scientists, drug distributors, community members, and all stakeholders will be appropriate for achieving the National Malaria Control Program's goal in the Upper East region of Ghana.

Limitations of the study

Study results were based on the opinions and experiences of a representative Builsa North District subdistricts, not for all the Upper East Region of Ghana. Therefore, the results can be generalized only to the sampled population in the district and not to the whole regional or national level.

The present study adopted a quantitative approach only. A mixed approach (both quantitative and qualitative) would help define the deep reasons behind the non-adherence influencing factors.

Strength of the study

The strengths of this study include the fact that the study was carried out by a research team that was not involved in the implementation of the SMC.

There is a possibility for selection and observer bias as with any observational study. Study participants were selected at random to eliminate these biases.

The potential of recall bias could not be omitted; to minimize them, the survey was conducted in the four sub-districts about one week after the first round of SMC 2020.

Conclusion

The present study found the level of SMC adherence in Builsa North District, Upper East Ghana.

The main reason for non-adherence is the child's refusal to take the drug, the child vomiting, the occurrence of a disease, the caregiver's forgetting about medication.

Caregivers with good knowledge, those who have obtained extensive information about SMC from health care providers, those who have only one child, those who live in Town are likely to adhere to SMC.

The results of this study indicate that the caregivers in the district of Builsa North have a very good knowledge of the cause of malaria, its consequences on children, and its preventive methods. It also shows that more than half of caregivers in the district are aware of Seasonal Malaria Chemoprevention.

There has been considerable progress in Ghana's implementation of SMC at the district level. However, some factors regarding SMC, like child refusal to take medicine, still have a bad effect on adherence rate to unsupervised doses. If specific strategies are not implemented to control them, they could spread and undermine all attempts made so far to achieve the reduction of the burden of malaria in children under five may be spread.

List of Abbreviations

AQ – SP	Amodiaquine + Sulfadoxine-Pyrimethamin
CHPS	Community-Based Health Planning and Services
CHWs	Community Health Workers
GHS	Ghana Health Services
MLR	Multivariable Logistics Regressions
RA	Research Assistants
SMC	Seasonal Malaria Chemoprevention
UER	Upper East Region
UWR	Upper West Region
WHO	World Health Organization

Declaration:

Ethical Consideration

Ethical approval for the protocol of this survey was obtained from Ghana Health Service Ethical Committee [GHS-ERC 034/02/20]. In August 2020, community meetings were held with caregivers and local community representatives to explain the study's purpose, after which communities were offered the choice to participate in the survey. Signed consent before the interview was also obtained from all the caregivers interviewed during the study.

The study had been carried out during the COVID-19 pandemic, so participating in this study presented a minimal risk of COVID-19 transmission. To ensure the study participants' and research assistants' protection, the study adopted safety measures such as PPEs (Personal Preventive Equipment) by study participants and the interviewers. The study ensured that the interviews maintain a social distance of at least 6 feet (about two arm lengths).

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Authors' contribution

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Consent for Publication

Not applicable for that section

Availability of data and materials

Not applicable for that section

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Figures

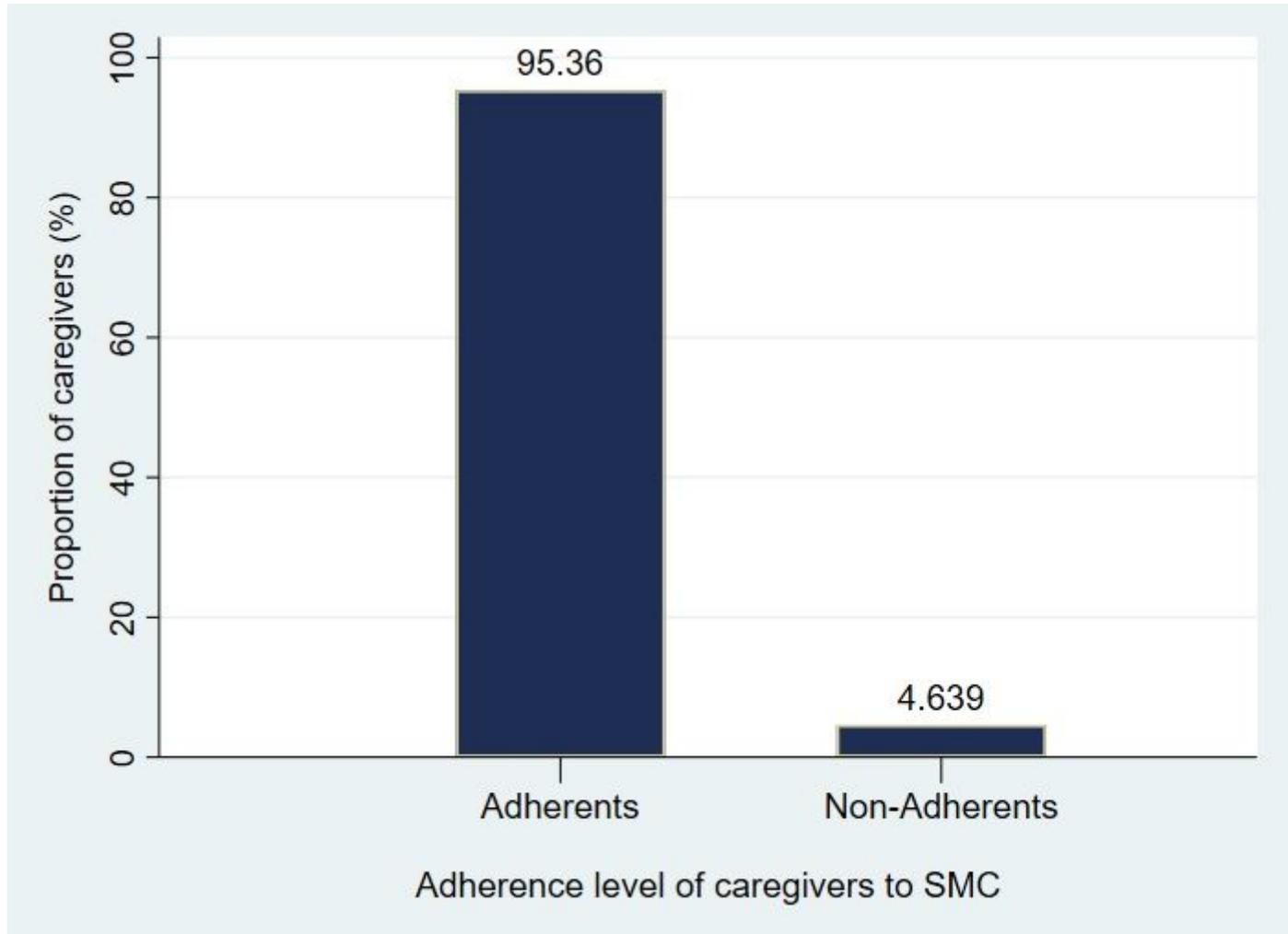


Figure 1

Adherence level of caregivers to SMC during the first in Builsa North District 2020

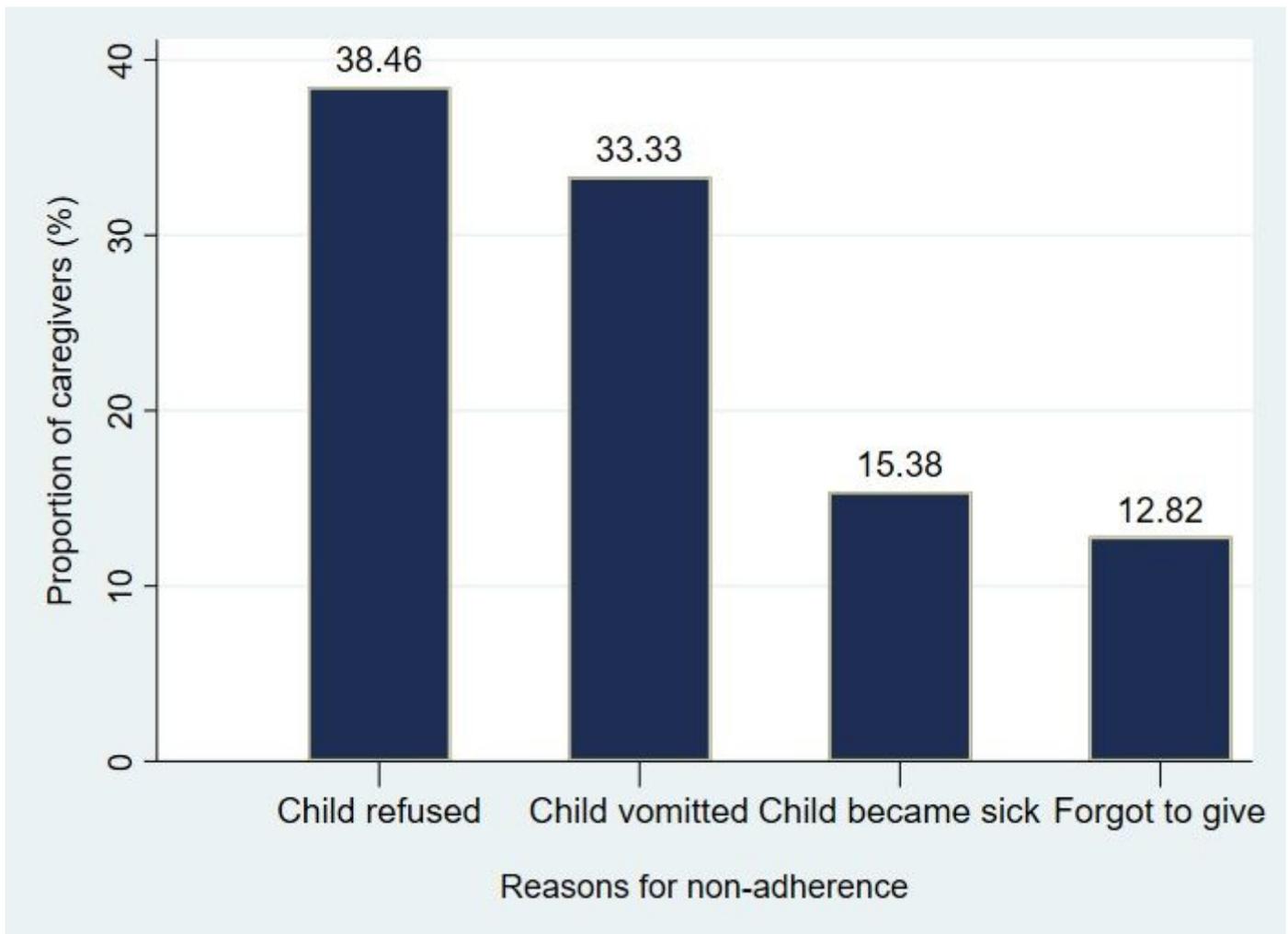
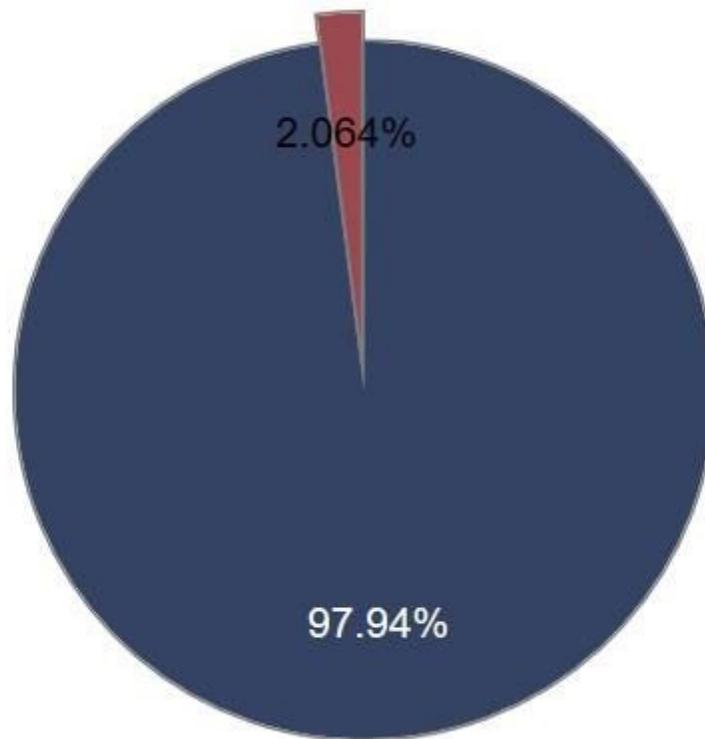


Figure 2

Reasons for non-adherence to unsupervised daily treatment doses of SMC

Proportion of awareness about SMC among caregivers



Legend: ■ Never heard about SMC ■ Ever heard about SMC

Figure 3

Levels of awareness of Seasonal Malaria Chemoprevention

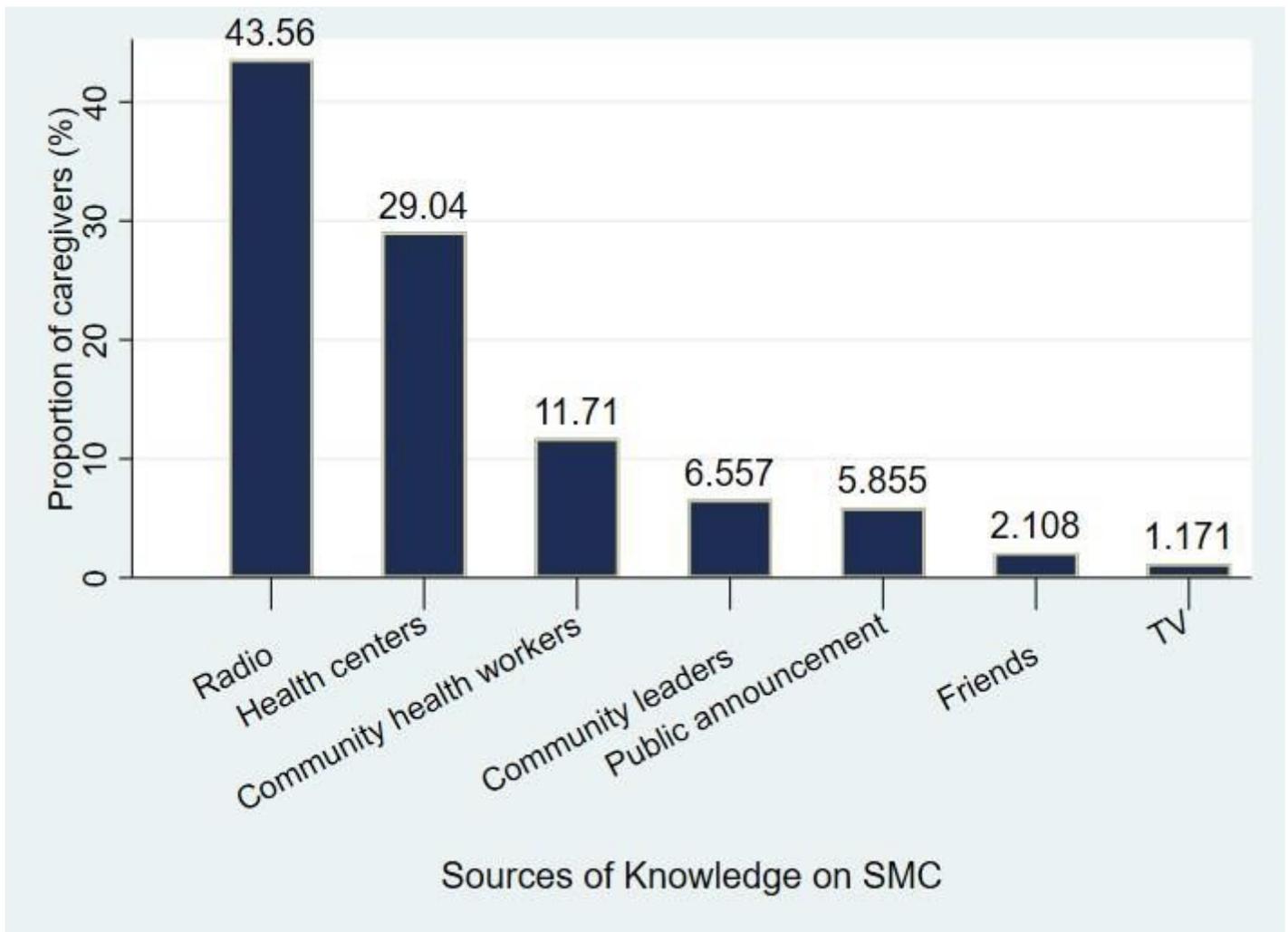


Figure 4

Source of Knowledge on SMC