Factors contributing to prevent malaria in children aged 3 to 59 months after first cycle of seasonal malaria chemoprevention in Tenkodogo Health District of Burkina Faso, July 2020: A prospective cohort study

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Abstract

Background

The incidence of malaria in children under 5 years in Burkina Faso was 163‰ with a case fatality of 1.5% in 2018. Despite the implementation of several strategies, malaria incidence increases in Tenkodogo Health District after taking seasonal malaria chemo prevention (SMC). In order to better struggle this situation and take corrective measures, a study was undertaken.

Methods

We conducted a prospective cohort study from 10 June to 5 September 2020 at Tenkodogo Health District. The study population consisted of children aged 03 to 59 months. We conducted a cluster sample and selected 847 eligible children. We conducted a survey with mothers using a questionnaire and a literature review. We used Epi-info 7 for calculating averages, proportions and carried out multivariate logistic regression.

Results

The overall level of SMC adherence was 90.02%. During the 4-week follow-up, malaria incidence was 99.76 cases per 1000 children, increasing from 15.43 to 34.44 cases per 1000 children from the first to the fourth week after the first cycle of SMC. Advice from community health workers was a protective factor against malaria in children (RR = 0.43; CI 95% [0,24–0,75]

Conclusion

A gradual increase in malaria incidence after the first passage of SMC was objectified. Also, the advice given by the community health workers was a protective factor against malaria after first cycle of SMC. Measures to strengthen the quality of advice by community health workers are needed to reduce this incidence of malaria in children after SMC in Tenkodogo health district.

What is already know on this topic

Seasonal malaria chemoprevention protects children aged 3 to 59 months against malaria for 4 weeks after taking three daily doses of Sulfadoxine pyrimethamine+ Amodiaquin

What this study adds

Despite the chemoprevention of seasonal malaria which protects children aged 3 to 59 months against malaria during the first four weeks after taking the three daily doses of Sulfadoxine pyrimethamine +

Amodiaquin, our results show a progressive increase in the occurrence of malaria in children after two weeks of taking malaria chemoprevention.

Background

Malaria remains one of the main challenges facing health policies and systems, although significant progress has been made [1]. The world health organization (WHO) African region bears a disproportionate share of the malaria burden, accounting for 94% of malaria cases and deaths in 2019 [1]. In Burkina Faso the incidence is higher in children with 1,631 cases per 1000 inhabitants compared to 591 for the general population in 2018 [2]. In the same year, malaria was the main reason for consultation in basic health facilities (41.3%), the main reason for hospitalization (21.4%) and death (16.4%) in medical centres and hospitals [2] .

Several actions have been implemented in recent years by the national malaria control programme to reduce the burden of malaria. These include intermittent preventive treatment (IPT) with sulfadoxine-pyrimethamine in pregnant women during antenatal consultations, periodic national campaign for the universal distribution of long-lasting insectide-treated mosquito nets (LLINs) every three years, indoor spraying in some pilot districts, the seasonal malaria chemoprevention (SMC) campaign since 2014 initially localized to a few districts and then generalized to all districts in 2019, community malaria management and malaria awareness and communication activities[3]. Among these strategies, seasonal malaria chemoprevention (SMC) for children aged 3 to 59 months is one of the most important, effective, inexpensive and safe strategies[4]. It is defined as "the intermittent administration of a complete course of treatment with an antimalarial drug during the high transmission season of malaria to avoid the disease. The goal of SMC is to maintain therapeutic concentrations of antimalarial drug in the blood during the period when the risk of contracting malaria is higher." She is expected to administer at least four cycles of sulfadoxin pyrimethamin plus Amodiaquin (SP + AQ) treatment at one-month interval to children aged 3 to 59 months in areas of high seasonal malaria transmission.

Started in Burkina Faso in 2014 with 07 districts, SMC covered 65 districts in 2018 and all 70 districts of the country in 2019. It consists of four separate passages of 4 weeks during the high transmission season of malaria from July to October each year. The first dose of SP-AQ during each pass is administered in a supervised manner by Community Distributors (CDs). The second and third doses are given to parents for home administration for the last two days at the same hour.

The major finding from routine malaria data in Burkina Faso in recent years shows a "significant" decrease in the number of malaria cases among children under 5 years of age within two weeks after a SMC passage and then a "rebound" for the two weeks before the next pass. Few studies have looked at malaria incidence a few weeks after the SMC campaign and their associated factors.

This study was conducted to determine malaria incidence in children who received SMC and to identify factors associated with malaria in children aged 03 to 59 months within 28 days of first SMC passage in Tenkodogo Health District in Burkina Faso in 2020.

Methods

Study setting.

The study was implemented in the health district of Tenkodogo which follows the territorial jurisdiction of the province of Boulgou. It covers three (03) communes including one (01) urban commune (Tenkodogo with 06 sectors and 92 villages) and two rural communes (Bagré: 8 villages and Bissiga: 23 villages). There are fifty-five (55) farming hamlets. Tenkodogo is the capital of Boulgou Province and the Centre-East Region. It has an area of 1990 Km^2. It is bordered by the health districts of Koupela to the north, Fada to the northeast, Ouargaye to the east, Bittou to the south, Garango to the west; and Zabré and Manga districts in the southwest. The population of the health district in 2020 is estimated at 261,732 inhabitants, according to a projection of the general census of population and housing (RGPH) of the year 2006. In 2018, children under the age of 15 accounted for almost half of the population (47.84%) and women of reproductive age (23.75%). The population density is estimated in 2019 at 124 inhabitants per km^2. The fertility rates, crude birth rate and death rate are 203‰, 47.5‰, and 15.3‰ respectively. (Statistical Yearbook 2018) The average household size is 6 people according to the same census. It is a relatively young population with significant migratory movements internationally and in the sub-region.

Study design and sampling technique

We conducted a prospective cohort study.

Study period: The study period was from June 10th to September 05th 2020.

The sample size was calculated from the following formula using the OPEN EPI software. Sample size (n) = [DEFF*Np(1-p)]/ [(d2/Z21-α/2*(N-1) + p*(1-p)] with Z = 1.96 for p = 0.05 or 95% CI, P = the relative status of SPC compliance is not known in Burkina Faso, so we will default to 50%. We retained the accuracy level d at 0.05. The cluster effect was 2 because clusters were formed in both rural and urban areas and children included through a two-level sampling (village and household). n = 762. In anticipation of possible lost follow-up or non-respondents, a 10% increase in size [762/(1-0.1)] was achieved; giving us a total of 847 children aged 3–59 months to investigate.

For sampling, the health district of Tenkodogo was randomly selected from the list of 70 districts in Burkina Faso. The districts were arranged alphabetically and then assigned a serial number from 1 to 70 was assigned to each. Excel software was used to generate a random number between 1 and 70. The number generated corresponded to the chosen district. A cluster sampling was conducted. Areas and villages were considered clusters and listed alphabetically with the size of their target population. After dividing the total population of children aged 3 to 59 months in Tenkodogo Health District (44,599) by 30 (cluster), we obtained a sampling pitch of 1487. Using Excel we randomly generated between 1 and 1487 (= ALEA. COME IN. TERMINALS (1; 1487)] and the number obtained corresponded to the rank of the first

cluster. Number 35 has been drawn. We applied this rank to the first cluster and then used the sampling step for the selection of complementary clusters (see table in appendix).

Within each cluster, concessions were chosen randomly using the pen method. Indeed, a pen was thrown at the village level and the tip of the pen indicated the direction to follow to enter the first concession. The other concessions were visited from the left after the first concession until the desired number of children in the cluster were obtained.

Within a concession all the children of the chosen concession meeting the inclusion criteria were selected. The mother/caregiver with multiple children responded for each child. The children targeted by our investigation and absent during the passage of the investigators were not retained;

Study population and inclusion criteria

The study population consisted of children aged 03 to 59 months in the Tenkodogo Health District and their parents/guardians of children (father, mother, concession manager, babysitter). The inclusion criteria for children were: age between 3–59 months, having received SP + AQ during the CPS in 2020 and whose parent or legal guardian has given informed consent to participate in the study and have resided in the study area for one month and desire to do so for at least one month. Inclusion criteria for parents or guardians of children included: being the child's guardian (father, mother, guardian) and having signed an informed consent.

Data collection: variables, tools and techniques

Sociodemographic characteristics of children 03 to 59 months of age and their mothers/caregivers, SMC adherence in children 3 to 59 months of age, malaria incidence in children 03 to 59 months of age in the 28 days after taking SP + QA at the first pass were collected. A child was found to be observant when this one took Sulfadoxine + Pyrimethamine on Day 1, amodiaquine on Day 2 and Day 3 at the same time and he took an alternative dose in case of rejection/vomiting.

Data collection techniques consisted of interviews, literature review and direct observation. Several data collection tools have been developed, namely the questionnaire, the observation grid and the content analysis grid. Simple malaria was defined by the presence of fever (uncorrected axillary temperature greater than or equal to 37.5°C) or a history of hot body in the last 72 hours And the detection of plasmodium on microscopic examination by thick drop/blood smear or the positivity of the rapid diagnostic test (RDT) And the absence of signs of severity or general signs of danger.

The questionnaire was administered face-to-face and consisted of the interviewer recording the respondent's answers on a paper form. Collection was conducted by intermediate field epidemiology training program residents of cohort one of Burkina Faso who were divided into pairs. The initial collection began the day after the SMC ended. A second collection took place two weeks after the initial collection. After the initial collection, the follow-up of the children in the cohort was provided by the community health workers of each village. The follow-up was done on day7, day14, day21, day28. Thus,

for children declared sick, residents were immediately informed by telephone by the community health workers. The residents also confirmed the diagnosis of paludism through the necessary media (health record, primary health care facility consultation register, verbal autopsy) and confirmation of the first manager of the health center. The control and supervision of the collection of community health workers was done by the first managers of the health center and the FETP residents. Firsts manager of the health centers supervised and monitored the actions of community health workers once a week. They confirmed the diagnosis of paludism of sick children. Very sick children were cared for at the health center by the first managers and the other members of the health center.

Data analysis

A data entry mask was developed with Epi-info software version 7.2.3.1 by FETP residents. The data was entered into this software and a quality control followed by a cleaning of the database was carried out. It consisted of finding and deleting duplicate records and missing data and correcting outliers.

Analysis of quantitative data was performed using Epi info software version 7.2.3.1. Descriptive statistics of the sample variables in table and/or figure form were carried out, and then the proportions and crude relative risks of malaria were presented according to the different factors studied.

The comparison between qualitative variables was made using Pearson's Chi2 test or Fisher's exact test if more than 20% of the expected values are ≤ 5. The materiality level was set at 0.05. Results were presented with a 95% confidence interval. Also, we use logistic regression model to analyze confusing independent variables for the outcome. The dependent variable was malaria after SMC. This variable was a dichotomic qualitative variable coded 1 if the child had malaria after SMC and 0 if not.

Ethical considerations

The study protocol has been approved by the Burkina Faso national Research Ethics Committee. At the same time, before the field phase, an authorization to collect data was issued by the Secretary General of the Ministry of Health and sent to the Regional Director of Health of the Central East who forwarded it to the Chief Medical Officer of the Tenkodogo Health District. Participation in the study was conditional on the respondent obtaining free and informed consent using an informed consent form.

The confidentiality of the information collected and their anonymity by all stakeholders in this study was respected.

Results

Socio-demographic characteristics of the children surveyed and mothers/caregivers

In our study 50.59% of children were male and 85.87% were over 12 months of age. 65.8% of mothers and/or caregivers had no level of education and 97.39% had a long-lasting insectide-treated mosquito

net. Also, 57.96% of Children were in households with cohabitation of animals and 48.1% of children were in house with the presence of larval breeding sites. (Table I).

SMC adherence in children aged 3 to 59 months in Tenkodogo Health District at first cycle 2020

Adherence was 90.02% (n = 758) and the first dose of SMC was supervised in 83.50% of cases (n = 703).

Malaria incidence among children aged 3–59 months in Tenkodogo Health District after the first passage 2020

During follow-up, 15.20% of children (n = 128) became ill, of whom 84 had confirmed malaria, i.e. a malaria incidence of **99.76 cases per 1000 children.** However, 11.71% (n = 15) of sick children had suspected malaria (RDT not performed).

Malaria incidence increased from 15.43 to 34.44 cases per 1000 from the first week to the fourth week after SMC (Fig. 2).

Associated factors with malaria in children 03 to 59 months of age after taking SMC drugs at first pass 2020

Children of mothers who received advice from community health workers during SMC administration were less likely to develop malaria compared to children who did not receive advice from community health workers. In multivariate analysis, children whose mothers had received advice from the community health workers during administration had a 57% decrease in the risk of developing malaria compared to children whose mothers had not received counselling (table III).

Discussion

Overall adherence to seasonal malaria prevention chemo in the first cycle in our study was 90.02%. This proportion seems to be good according to the standards of Burkina Faso's national malaria control program, which attests to the target of 90%. This good compliance is explained by the strong support of the population for the strategy that has been implemented since 2017 in this health district and whose beneficial effects are observed by the populations. Our results are slightly higher than those found by Salissou in Niger, which found a level of adherence to treatment of 89.2% among children who received SMC[5].

Also, the rebound of malaria was observed after SMC with a gradual increase in malaria incidence from the first to the fourth week after SMC. This finding is similar with data from the epidemiological surveillance service at the level of the Burkina Faso malaria control program, which shows a gradual increase in malaria cases after the first week of each SMC cycle until the next cycle. However, this situation is contrary to that studied in vitro by researchers before the implementation of SMC through the studies of Cisse B and Dicko A, which did not find a significant rebound in the clinical incidence of malaria in the year following the administration of SMC during initial studies in Senegal, Ghana, and

Mali[6–8] Also, controlled studies have demonstrated protective efficacy against clinical malaria between 31% and 93% [9] Also, after an evaluation of the implementation of seasonal malaria chemoprevention, it appears that the administration of SMC reduces the risk of malaria measured by RDT during SMC campaigns in Burkina Faso from 2010 to 2017 (10). This rebound of malaria after two weeks of administration of SMC in our situation could be explained by the reduced duration of the effectiveness of SMC in vivo contrary to what is observed in vitro where we find a therapeutic efficacy of 4 weeks after the administration of preventive treatment.

Finally, the advice given by community health workers was a protective factor against the occurrence of malaria after SMC in children. This could be explained by the fact that the advice provided by the community health workers is beneficial and allows mothers of children to follow good practices in order to have better malaria protection outcomes for children during the period of high malaria transmission. In addition, community health workers live in the same context as mothers and act as intermediaries with health workers. If the advice given by community health workers is successful, it means that their advice is in line with scientific knowledge and has a positive impact in malaria prevention, hence the need for good training of these actors in behaviour change communication before the start of SMC. This advice certainly has a positive impact on SMC compliance. However, the factors related to adherence are diverse and varied. Fatou Diawara et al. in Mali noted that forgetfulness was the main reason for non-adherence to treatment on days two and three [10]

Conclusion

The study on factors associated with the occurrence of malaria after taking SMC allowed us to objectify a gradual increase in malaria incidence after the first passage of SMC and the advice given by community health workers to mothers of children was associated with the occurrence of malaria. However, other studies may better assess the factors associated with the occurrence of malaria.

Declarations

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Competing Interest

The authors do not declare any conflict of interest.

Authors' contributions

All authors of this article have made substantial contributions to the design, analysis and/or interpretation of the data. In addition, they participated in the preliminary re-edaction of the article as well as in its critical revision and in the approval of the final version to be published.

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Tables

Table I: Sociodemographic characteristics of children aged 03 to 59 months and their mothers or caregivers (n=842)

Variables	n	Proportion %
Characteristics of children		
Sex		
Male	426	50,59
Female	416	49,41
Age		
12-59 months	723	85,87
3-11 months	119	14,13
Place of residence		
Urban	616	73,16
Rural	226	26,84
Sleeping under ITLN		
Yes	769	91,13
Not	73	8,87
Characteristics of mothers/caregivers		
Profession		
Farmer	353	41,92
Housewife	309	36,70
Merchant	87	10,33
Student	28	3,33
Official	14	1,66
Other	50	5,94
Educational attainment		
None	554	65,80
Secondary	140	16,63
Primary	104	12,35
literate	38	4,54
Upper	6	0,71
Having ITN		

Yes	820	97,39
Not	22	2,61
Characteristics of living environment		
Cohabitation with animals	488	57,96
Presence of larval breeding sites in the house	405	48,1
Presence of latrine	395	46,91
Presence of house protection grilles	10	1,2

Table III: Factors associated with malaria occurrence after first cycle of SMC in Tenkodogo District in 2020: Univariate et multivariate analysis

Variables	Univariate		Multivariate	
	cRR [CI; 95%]	*p-value*	aRR [CI; 95%]	*p-value*
Adherence to treatment				
Yes	0.62 [0.32 – 1.21]	0.16	0.68 [0.34; 1.34]	0.27
No	1		1	
Sex				
Male	1.02 [0.65 – 1.61]	0.9	0.63 [0.29; 1.36]	0.24
Female	1		1	
Age				
3-11 months	0.61 [0.28 – 1.30]	0.2	0.62 [0.29; 1.34]	0.23
12-59 months	1		1	
Place of residence				
Urban	1.17 [0.71 – 1.92]	0.52		
Rural	1			
Sleeping under ITLN				
Yes	1.044 [0.4 – 2.36]	0.47		
No	1			
Occurrence of side effects				
Yes	0.93 [0.48 -1.82]	0.84		
No	1			
Nutritional status				
Malnutri	0.81 [0.1- 6.41]	0.84		
Normonutri	1			
Educational attainment				
Uneducated	1.13 [0.68 -1.87]	0.62		
Educated	1			

Difficulties in administering medications				
Yes	1.05 [0.52 – 2.12]	0.87		
No	1			
Living environment				
Acceptable	1	0.55		
Not acceptable	1.14 (0.73 - 1.8)			
Advice given to the mother during administration				
Yes	0.43 [0.24 – 0.75]	0.003	0.41 [0.22; 0.77]	0.006***
No	1		1	
Supervised dose 1				
Yes	0.82 [0.46 – 1.46]	0.25	1.22 [0.63; 2.35]	0.61
No	1		1	

Figures

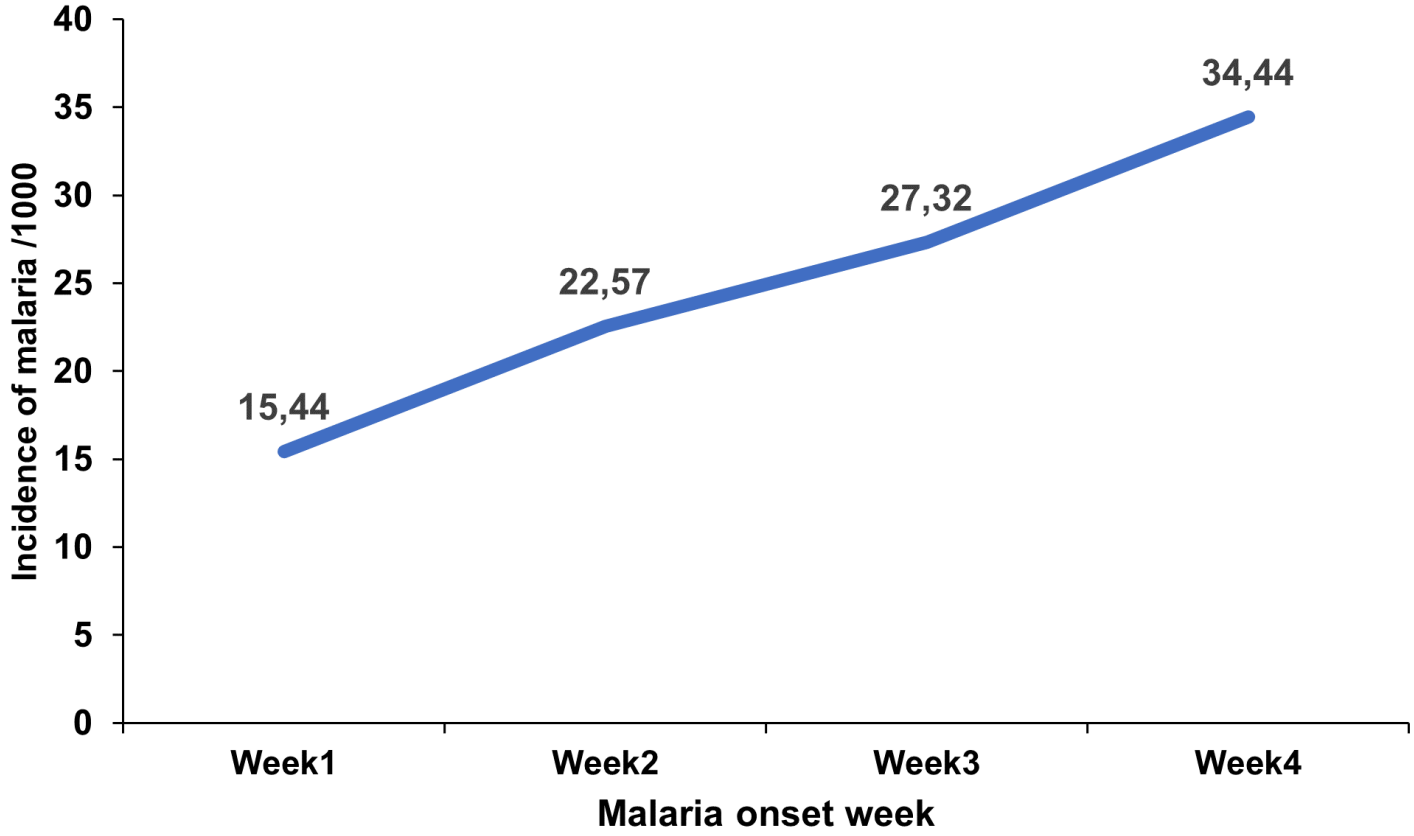

Figure 1

Malaria incidence by week children aged 03 to 59 months after first cycle of SMC in Tenkodogo, July 2020