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Analysis of the impact of the Covid-19 pandemic on the implementation of activities of the malaria control program, from January 2020 to June 2021 in the Haut-Katanga province in the DRC

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Summary

Malaria is a leading cause of childhood morbidity and mortality in many developing countries, including ours, where young children and pregnant women are the most affected groups. The objective is to analyze the harmful impact of Covid-19 on the implementation of malaria control activities in Haut Katanga from January 2020 to June 2021.

Methods

This is a cross-sectional descriptive study carried out in the HGR (Hakika and Kenya). The population studied is represented by patients who consulted for malaria and were treated in the two health facilities. The collected data were encoded in Excel 2013 then exported to Epi Info 7 version 7.2.26 software for analysis.

Results

The preventive component shows that more LLINs were distributed in the first half of 2020 in Kenya and the first half of 2021 in Hakika, and fewer in the first half of 2021 in Kenya and the first half of 2020 in Hakika; a low percentage of positive RDTs in H1 2020 in Hakika (15.8%) and Kenya (21.8%) than in the first half of 2021 in Hakika (8.5%) and Kenya (14.9%); as well as the percentage of children aged 6 to 59 months who had a malaria infection was lower in the first half of 2021 in Kenya (22.4%) and in the first half of 2020 in Hakika (16.5%).

Conclusion

Our study shows that the occurrence of the Covid-19 pandemic negatively hinders the implementation of malaria control activities in the Haut Katanga province.

Keywords : Covid – 19, malaria, impact, activities, Lubumbashi, DRC

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1.INTRODUCTION

Malaria is one of the most serious public health problems in the world. It is one of the main causes ofdeath anddiseases in many developing countries, where young children and pregnant women are the most affected groups(1).

Globally, the number of malaria cases in 2019 is estimated at 229 million in 87 endemic countries and the number of deaths at 409,000, of which 67% concern children under 5 years old.(2). Also in the same year, 29 countries accounted for 95% of the total number of malaria cases, including theNigeriawith 27% of cases andDemocratic Republic of Congowith 12% of cases. Nearly 95% of deaths were recorded in 31 countries, including Nigeria for 23% and the Democratic Republic of Congo for 11% of deaths (2).

In Africa, malaria represents 94% of cases, or 215 million estimated cases, its incidence increased from 363 to 225 cases, over the period 2000 – 2019. Over the same period, the number of deaths decreased by 44% (680,000 in 2000) to 384,000 in 2019) and mortality decreased by 67%, from 121 to 40(3). In the DRC, malaria is endemic over 97% of the country's territory, where it is the leading cause of infant morbidity and mortality. The 2019 annual report of the PNLP reports 21,934,127 cases of malaria, i.e. 19,877,113 cases of simple malaria and 2,057,014 cases of severe malaria (9%); 11,172,764 children under 5 suffered from malaria in 2019, including 1,051,385 cases of severe malaria. There were also 13,072 deaths linked to malaria during this year, including 9,855 occurring in children under 5 years old, or 75%.(4). Since 2016, the country, like other endemic countries, has experienced an increase in cases despite the significant efforts made. In 2018, 18,208,440 cases of malaria were recorded, representing a proportional morbidity of 44% compared to 12,186,639 cases of malaria recorded in 2015, representing a proportional morbidity of 38.7% (5). As for malaria-related deaths, a significant reduction was noted during this same period, going from 39,054 deaths in 2015 to 18,030 deaths in 2018(6). Multiple prevention, case management and epidemiological surveillance constitute the main intervention strategies against malaria in the country.

The malaria situation in the Haut Katanga province is the same as everywhere else in the country, and this situation has been negatively influenced by the appearance of the Covid-19 pandemic since March 2020, jeopardizing the implementation of interventions to combat malaria in Haut Katanga (7). The prevalence of malaria in Haut Katanga in 2020 is estimated at 13%, unlike the two previous years when it was 11% in 2018 and 2019 (8).

Since the outbreak of coronavirus disease at the end of December 2019(9), many countries have taken containment measures, closing borders and canceling sporting and cultural events in order to reduce the circulation of the Covid-19 virus. These decisions hadeconomic, social and environmental consequencesand raise uncertainties and fears about the global economy and about the education, health and fundamental rights of populations.(ten). Covid-19 has disrupted the pace of life, creating

a new order in the world of work, even hindering the operation of several health service production structures. This has made the response to malaria much more difficult around the world(11).

The Covid-19 pandemic has relegated the fight against malaria to the background, the containment and social distancing measures taken to fight against Covid-19 have slowed down malaria prevention campaigns and in the same context "the congestion in health services, fear of contracting the coronavirus, or even the stigma surrounding the virus have contributed to the decline in the treatment of malaria cases"(12).

The Global Technical Strategy for Malaria 2016-2030 aims to reduce human suffering caused by malaria(13)and at the country level, the National Strategic Plan of the PNLP 2020 – 2023, is part of the logic of reducing morbidity by 40% and mortality linked to malaria by 50%, particularly among pregnant women, new born, children. children and adolescents(14). Given this state of affairs, it is plausible to analyze the impact of Covid-19 on the implementation of malaria control activities. The spread of Covid-19 around the world constitutes a real health shock to the extent that, since its appearance, it has significantly affected morbidity and mortality rates as well as the capacities of national health systems, even in countries advanced, to function correctly. take care of patients(15). World day againstmalaria, celebrated on April 25, this year 2021 took place in a context of health crisis(16).

In 2020, 59 millions residents were waiting to receive their mosquito nets ; overnight, it became complicated to move forward. It was necessary to completely review the campaign's organizational strategy, to move from distributions at fixed sites to door-to-door distributions, in order to avoid crowds which could be vectors of transmission of Covid-19. »(17).The report produced by the Global Fund in April 2021, entitled "Impact of Covid-19 on health services and systems related to HIV, tuberculosis and malaria". This report, resulting from a study carried out among 502 health establishments in 31 countries, including 24 in Africa and 7 in Asia, notes that performance regarding these three diseases has seen a marked decline.(18). Facilities surveyed in Africa saw a 17% drop in malaria diagnoses and a 15% drop in malaria treatment services(18).

Some provinces of the country experienced difficulties in 2020 in the implementation of massive campaigns for the free distribution of mosquito nets impregnated with long-lasting insecticide, the case of the provinces of Maindombe and Haut Katanga., which pushed the experts to modify their strategy by opting for door-to-door distribution.

This situation has also been observed in other African countries such as Niger and Cameroon, hampering efforts to control the malaria epidemic(19).

A first case in the DRC was identified on March 10 inKinshasaby theNational Institute of Biomedical Research. And on March 22, two suspected cases were announced among passengers on a flightCongo Airwaysto arrive atLubumbashiof Kinshasa, contaminated people can smell thefever, therecough, and andifficulty breathingwhich can evolve, in the most serious cases, towardsacute

respiratory distressdeadly(20). Our objectives are : Identify antimalaria interventions not implemented or delayed in the context of Covid-19 in Haut Katanga from January 2020 to June 2021; Analyze the evolution of impact indicators for the fight against malaria in the context of the Covid-19 pandemic in Haut Katanga from January 2020 to June 2021; Compare the effect of this pandemic on the deaths of children under 5 years old.

2.POPULATIONAND STUDY METHODS

2.1. Study framework

The study will be carried out in the Kenya and Ruashi Urban Health Zones, through their respective General Reference Hospitals (Kenya and Hakika), in the city of Lubumbashi in the Haut Katanga province. The two reference health facilities selected are public utility structures, subject to the supervision of the Ministry of Public Health, Hygiene and Prevention. They are located in Kenya commune for HGR Kenya and Ruashi commune for HGR Hakika.

2.3. Data source, period and type of study

We used the patient consultation registers, the SNIS report of these two HGR, the different patient files for the period from January 2020 to the 1st Semester 2021, the DHIS-2 databases of their respective Health Zones, as well as the DHIS-2 database of the SP-PNLP/HK and that of the health information office of the HK DPS. The study is descriptive, cross-sectional, with retrospective collection of patients who consulted for malaria in the two targeted HGRs.

2.4. Population studied and sampling

The population studied is made up of patients who consulted for malaria and treated in the two health establishments during the period from January 1, 2020 to June 30, 2021, from which we obtained our sample. The files to be included in our study were selected by cluster sampling. We used as support the monthly activity reports of the HGR and the registers or consultation forms of patients who were diagnosed as having had malaria (simple or severe) during the study period.

2.5. Target population

It consists of medical records of sick children under 5 years of age and over, pregnant women who suffered from malaria and who consulted during the period concerned.

2.6. Criteria for selection

- **Inclusion criteria :**

All data from the files of patients diagnosed with malaria and treated in the two aforementioned structures from January 2020 to June 2021.

- **Non-inclusion criteria**

All data of other diagnosed cases except malaria during the period January 2020 to June 2021 in the two selected HGRs.

2.7. Sample size estimation

To determine the sample size, we used the SCHWARTZ formula :

$$n=\frac{Z^2.(1-\&/2)\ x\ p(1-p)}{e^2}$$

Or :

n = is the sample size;

Z= is the confidence level. It is a coefficient that measures the precision of a risk

&=0.05 to be wrong, we have & for a confidence level of 95%, which is equal to 1.96;

e is the absolute margin of error on the estimate of the expected proportion e=0.05.

p = proportion of people who have had malaria;

q=1-p proportion of people who have not had malaria;

e^2= degree of precision 0.05 squared, or 0.0025

&/2 = 0.05/2 = 0.025

To get p we referred to data from the Provincial Coordination – PNLP/HK for the year 2020, where the prevalence is equal to 13%, or 0.13.

p = 13% = 0.13, so by inserting the different values into the formula, we obtain:

n = (1.96)2.(1-0.0025)(0.13(1 – 0.13) /(0.05)2, n = (3.8416)(0.9975)(0, 13)(0.87) / 0.0025

= 0.4333987 / 0.0025 = 173.36 = 173 this represents the minimum sample size

If we take into account the margin of error of 10%, 17 we will have 173 + 17 = 190 which represents our height. Given that our n is 190, which represents the size of the sample, we must find the number of files which correspond to this small n out of the 1496, i.e. 144 for Hakika and 1352 for the files of patients from Kenya which represent the large N, i.e. the population from which we must draw our sample size estimated at 190. To do this, we must carry out the proportional allocation, granting 75% of the 144 HGR Hakika files and 25% out of the 1352 HGR files. This gives us the following values :

For HGR Hakika : 144 x 75 / 100 = 108 files

And for HGR Kenya : 1352 x 25 / 100 = 338 records

Given our n which is equal to 190 ; we will have :

For HGR Hakika 108 x 100 / 190 = 56.84 = 57

For HGR Kenya 338 x 100 / 190 = 177.89 = 178

The sampling interval is determined as follows:

No survey = total number. Population survey units; number of survey units in the sample

For Hakika = 144 / 57 = 2.5 => 3, and for Kenya 1352 / 178 = 7.56 => 8

Thus, by applying these investigation steps at the level of HGR Hakika, we have chosen a number between 1 and 3 and by randomly taking file number 2 out of all 57 files, we will have 19 files (taking into account the previous survey unit added at the survey stage) to go through, while at the HGR

Kenya level we choose a number between 1 and 8, and by randomly choosing file number 1 we will have 23 files to go through (in following the same procedure as above) in proportional allocation by cluster sampling.

2.8. Technique of collection, processing and analysis of data

We used the consultation registers of patients from two health facilities, the available medical files of patients consulted and hospitalized in said structures, for whom the diagnosis of malaria had been made during the period from January 1, 2020 to June 30, 2021; we also used different SNIS reports on these two HGRs. The data collected will be encoded in Excel 2013 then exported to Epi Info 7 version 7.2.26 software.

2.9. Statistical analyzes

We used a descriptive analysis of the variables, which allowed us to calculate the Pearson Chi-square test. When the p-value is greater than 0.05 the test would be judged non-significant and therefore there would be no statistically significant links between the parameters studied and when this p-value is less than 0.05 the test would be judged significant.

3.RESULTS

3.1. Flowchart

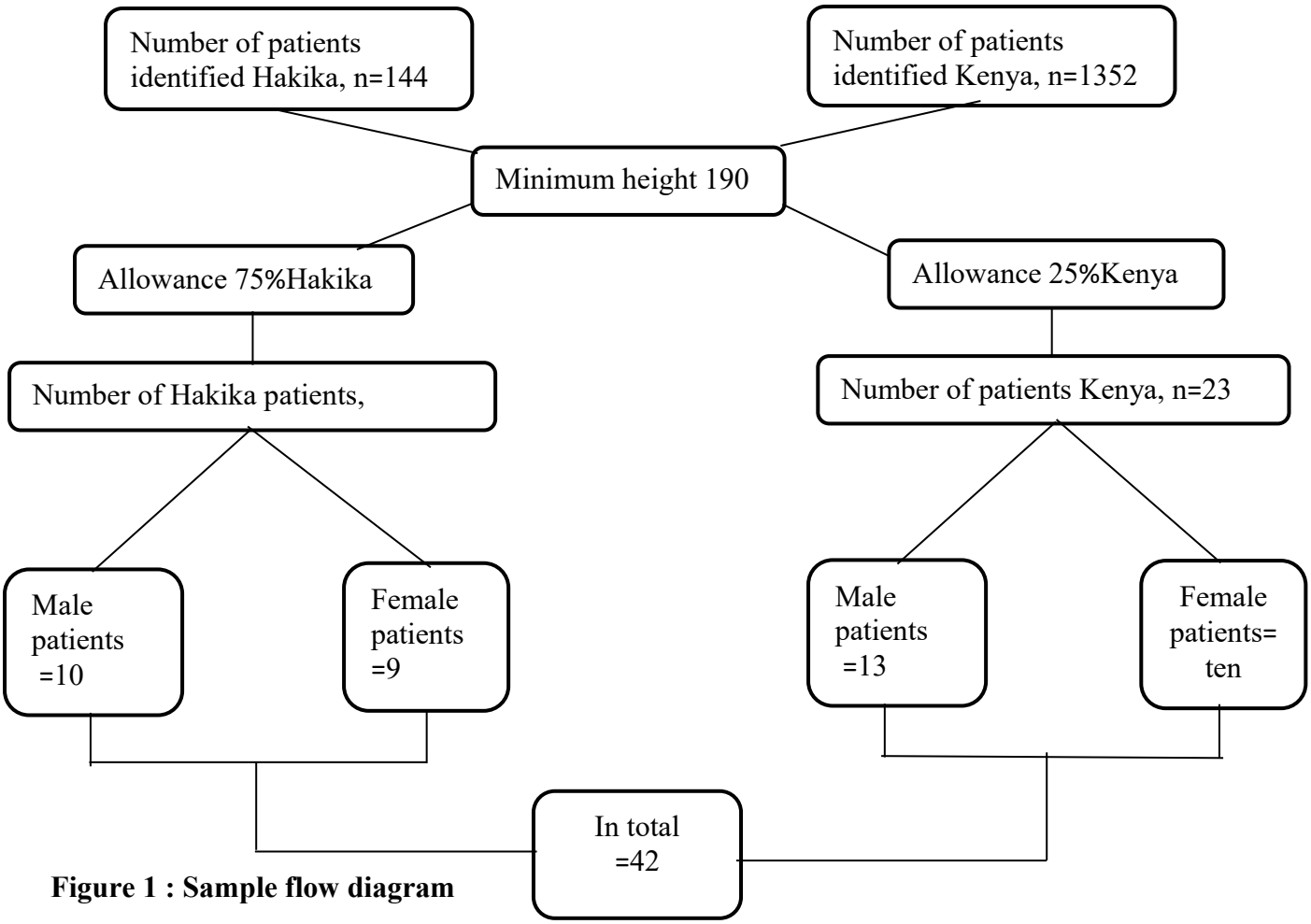

Figure 1 : Sample flow diagram

3.2. Identification of antimalaria interventions not implemented in the context of Covid-19 in General Referral Hospitals in Hakika and Kenya from 2020 to the first half of 2021

Only two vector control activities, notably the distribution of mosquito nets impregnated with long-lasting insecticide to children under 5 years old during preschool consultation sessions and to pregnant women, the latter also benefited from taking Sulfadoxine-pyrimethamine in as part of intermittent preventive treatment. To protect their pregnancy against malaria during prenatal consultation sessions.

Fewer LLINs were distributed in the first half of 2020, unlike the first half of 2021 in the Hakika and Kenya General Referral Hospitals.

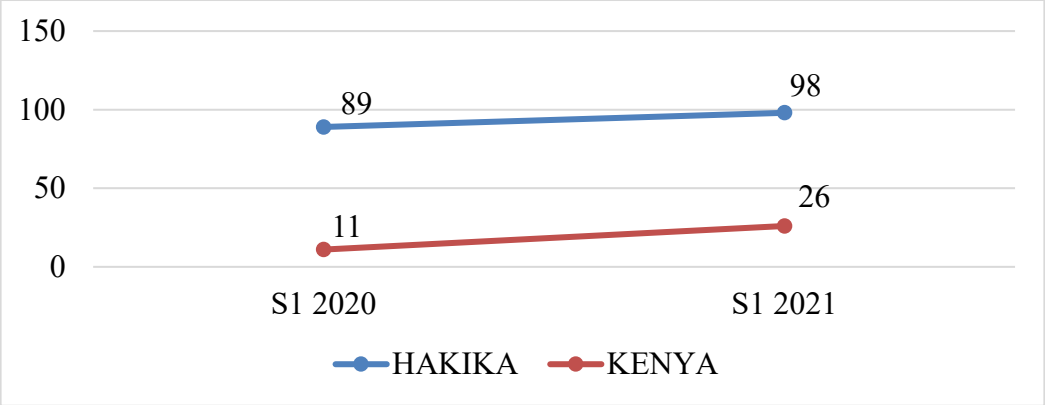

Figure 2 : LLIN distributed to the CPN

More LLINs were distributed in the first half of 2020 in Kenya and the first half of 2021 in Hakika, and fewer in the first half of 2021 in Kenya and the first half of 2020 in Hakika.

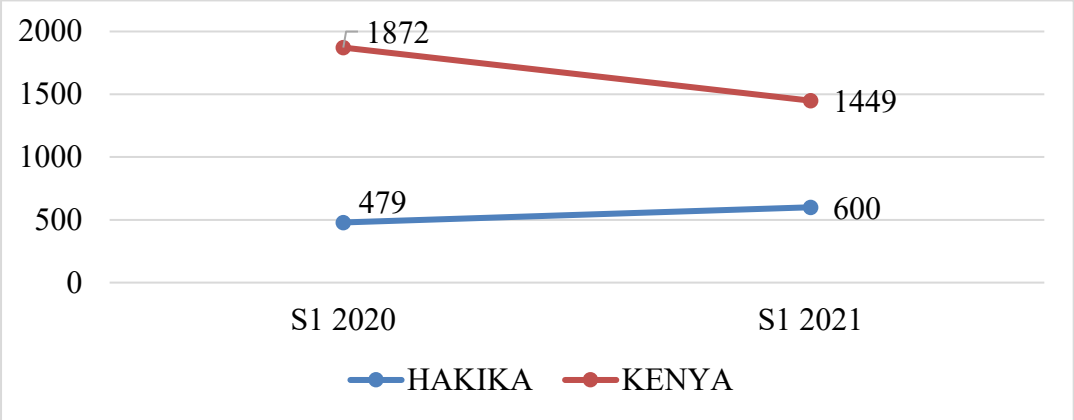

Figure 3 : LLINs distributed to SPC

We observe low achievement of IPT in the General Referral Hospitals of Hakika and Kenya in the first half of 2020 and the first half of 2021.

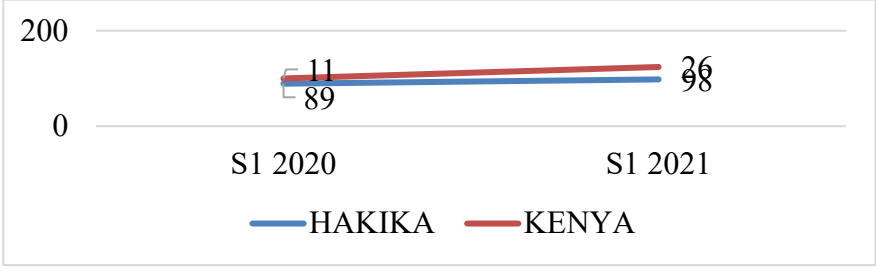

Figure 4 : TPI at HGR Hakika and Kenya

Regarding case management, patients suffering from malaria are properly managed in accordance with the national policy of the National Malaria Control Program. Other activities such as indoor spraying, malaria chemoprevention, intermittent preventive treatment in infants and entomological surveillance were not reported in these two targeted structures.

3.3. Evolution of impact indicators in the fight against malaria in the context of Covid – 19 at the HGR Hakika and Kenya

3.3.1. Percentage of deaths attributed to malaria

It is lower in H1 2020 and higher in H1 2021 in the two HGRs, i.e. from 3.3% in H1 2020 to 3.7% in H1 2021 in Kenya and from 19.2% in H1 2020 to 31.2 % in H1 20201 in Hakika.

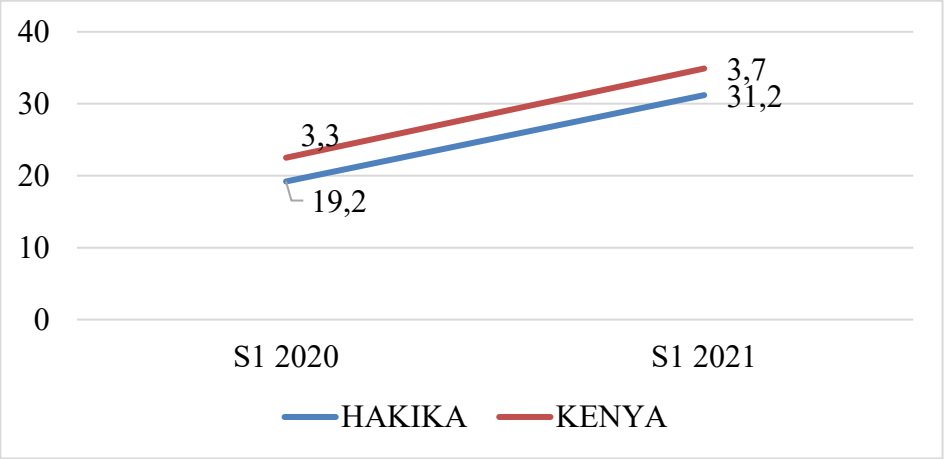

Figure 5 : Percentage of deaths attributed to malaria

3.3.3. Number of simple and severe malaria cases among target groups

Table I : Number of malaria cases by HGR

Malaria	HGR Hakika		HGR Kenya	
	Effective	Percentage	Effective	Percentage
Simple	8	42.1	11	47.8
Severe	11	57.9	12	52.2
Total	19	100	23	100

Cases of severe malaria were more recorded 52.8% in Kenya and 57.9% in Hakika than those of simple malaria 42.1% in Hakika and 47.8% in Kenya in the two hospital structures during the period. epidemic studied.

3.3.4. Number of malaria cases confirmed by laboratory diagnosis (Microscopic/RDT) in the two HGR

Confirmed cases of malaria were more numerous in the first half of 2021 and fewer reported in the first half of 2020 in both HGRs.

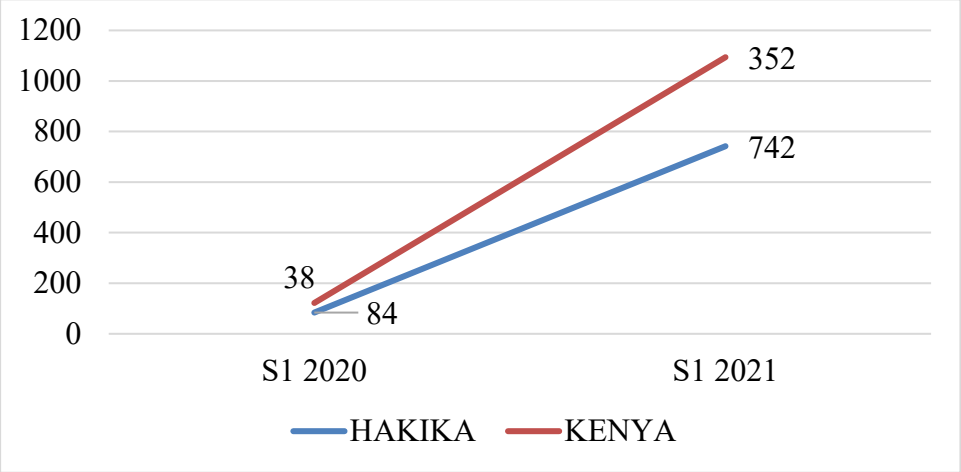

Figure 6 : Number of confirmed malaria cases

3.3.5. Number of TDRs carried out in the two HGRs in H1 2020 and H1 2021

Table II : TDRs carried out in H1 2020 in 2 HGR

TDR H1 2020	HGR Hakika		HGR Kenya	
	Effective	Percentage	Effective	Percentage
Positive	84	15.8	742	21.8
Negative	446	84.2	2663	78.2
Total	530	100	3405	100

Regarding Table II, we noted in H1 2020, a low percentage of positive RDTs, i.e. 15.8% in HGR Hakika and 21.8% in HGR Kenya and a high proportion of negative RDTs, i.e. 84.2% in Hakika and 78.2% in Kenya.

Table III : TDRs carried out in H1 2021 in the 2 HGR

TDR H1 2021	HGR Hakika		HGR Kenya	
	Effective	Percentage	Effective	Percentage
Positive	38	8.5	352	14.9
Negative	408	91.5	2015	85.1
Total	446	100	2367	100

Reading the table above, we see that in H1 2020, a low achievement of positive TDRs, i.e. 8.5% in Hakika and 14.9% in Kenya and a high percentage of negative TDRs, i.e. 91.5 % in Hakika and 85.4% in Kenya.

Table IV : Management of malaria in the 2 HGR according to national policy

Malaria treatment	HGR Hakika		HGR Kenya	
	Effective	Percentage	Effective	Percentage
ACT	8	42.1	11	47.8
Quinine	11	57.9	12	52.2
Total	19	100	23	100

It appears from this table that all cases of simple malaria (42.1% Hakika and 47.7% Kenya) were able to benefit from artemisinin-based treatment (ACT), while those who suffered from severe malaria (57.9% Hakika and 52.8% Kenya) received quinine (infusion and tablet), in accordance with the national malaria control policy.

3.3.5. Screening test positivity rate malaria (TDR/GE)

This rate decreased in H1 2021 in the two hospital facilities compared to H1 2020 data from two HGRs, i.e. from 17.6% in H1 2020 to 14.3% in H1 2021 for Kenya and from 15.8% in H1 2021. H1 2020 at 6.5% in H1 2021 for Hakika.

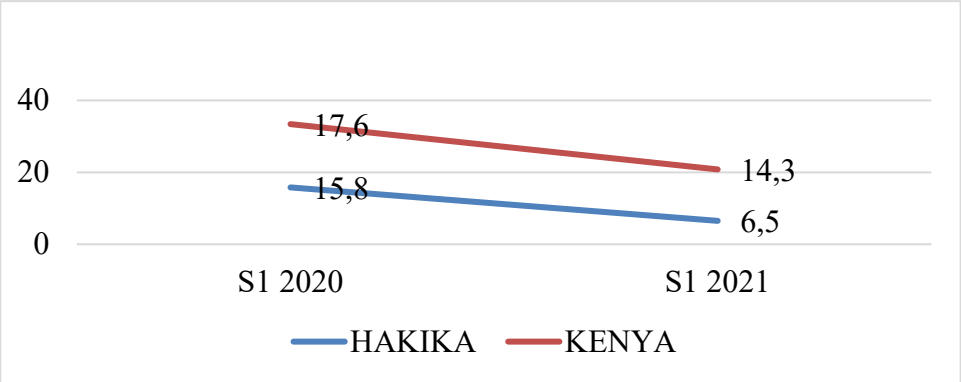

Figure 7 : Malaria test positivity rate

3.4. Effect of the Covid-19 pandemic

3.4.1. New curative consultations for children aged 0 to 59 months in the two hospital units from January 2020 to June 2021

Table V : Evolution of new HGR Hakika curative consultations

HAKIKA	New curative consultations		
	H1 2020	H1 2021	Deviations
Expected	785	809	+24
Completed	156	106	-50

HGR Hakika only achieved 19.9% in H1 2020 and 13.1% in H1 2021 of curative consultations over the entire study period; speaking of curative consultations, the frequency of exposure is lower among those carried out than among those expected; OR 0.659 (95% CI [0.291; 1.945], p-value > 0.05), this result is not statistically significant.

Table VI: Evolution of new curative consultations HGR Kenya

KENYA	New curative consultations		
	H1 2020	H1 2021	Deviations
Expected	244	251	+7
Completed	511	216	-295

The frequency of exposure is lower in the realized than in the expected; OR 0.410 (95% CI [0.324; 0.521], p-value < 0.05), this result is statistically significant.

3.4.2. Number of pregnant women who received SP1 and SP3 in 2020 and 2021 during prenatal consultations in the two HGR

Table VII : Evolution of IPT in pregnant women HGR Hakika

HAKIKA	Number of pregnant women who received SP1 and SP3		
	H1 2020	H1 2021	Deviations
Expected	785	809	+24
Completed	89	98	+9

Reading this table, we see that there is no relationship between IPT and exposure to Covid-19 ; OR 1.068 (95% CI [0.788; 1.447], p-value > 0.05), this result is not statistically significant.

Table VIII : Evolution of IPT among pregnant women HGR Kenya

KENYA	Number of pregnant women who received SP1 and SP3		
	H1 2020	H1 2021	Deviations
Expected	244	251	+7

Completed	12	26	+14

Regarding the TPI, the frequency of exposure is higher in the realized case than in the planned case ; OR 2.106 (95% CI [1.039; 4.268], p-value < 0.05), this result is statistically significant.

4.DISCUSSION

4.1. Study's limitations

Our study was carried out using data from the files of patients consulted and treated for malaria in the general referral hospitals of Hakika and Kenya. She encountered some difficulties, despite the research certificate which was given to us on time by the coordination of the school of public health, the strike of health professionals put us in a very complicated situation and this did not make the easy task. The lack of previous publications related to our research topic was also one of the limitations of this study.

4.2. Identification of unimplemented malaria interventions in the context of Covid – 19 in HGR Hakika and Kenya from 2020 to the first half of 2021

Activities to distribute mosquito nets impregnated with long-lasting insecticide were implemented during prenatal consultations and preschool consultations, as well as intermittent preventive treatments to pregnant women to protect them against malaria. However, we observed a lower distribution of LLINs during antenatal consultations at HGR Kenya than at HGR Hakika, as we recorded a total for the two semesters H1 2020 and H1 2021 of 187 LLINs in Hakika compared to 37 LLINs in Kenya, at the same time. During preschool consultations, HGR Kenya far exceeded the number of LLINs systematically distributed to children under five years old, i.e. 3,321 LLINs in Kenya, compared to 1,079 LLINs in Hakika for the same period.

4.3. Evolution of impact indicators for the fight against malaria in the context of Covid – 19 at HGR Hakika and Kenya.

The all-cause mortality rate among children decreased both in the HGR by 0.4‰ in the HGR Kenya (from 3.2‰ in the first half of 2020 to 2.8‰ in the HGR 2021) and by 12 .6‰ in the HGR Hakika (i.e. from 20.9‰ in the first half of 2020 to 8.3‰ in the first half of 2021).

The percentage of deaths attributed to malaria remained high at HGR Hakika (31.2% in H1 2021 compared to 19.2% in H1 2020). The number of severe malaria cases was higher in HGR Hakika (57.9%) than in HGR Kenya (52.8%). The number of malaria cases confirmed by laboratory diagnosis was higher in HGR Hakika (742 cases) than in HGR Kenya (352 cases) in the first half of 2021. We observed that in H1 2020, a low percentage of positive RDTs , i.e. 15.8% in HGR Hakika and 21.8% in HGR Kenya, than in H1 2020, a low achievement of positive TDRs, i.e. 8.5% in Hakika and 14.9% in Kenya. ; this situation

seems to be corroborated with the global fund report which notes that the number of tests and treatments of suspected cases of malaria had decreased slightly, by 4.3% and 0.5% respectively(37).
We also observed a decline in the malaria positivity rate, from 17.6% in H1 2020 to 14.3% in H1 2021 for Kenya and from 15.8% in H1 2020 to 6.5% in H1 2021 for Hakika, this situation seems to be supported by the investigation. conducted by the global fund in seven malaria endemic countries and which states that the number of malaria diagnoses has fallen by 56%(38).
The percentage of children aged 6 to 59 months having had a malaria infection was high in the first half of 2020 (26.8%), lower in the first half of 2021 (22.4%) in Kenya ; while at HGR Hakika, down in H1 2020 (16.5%) and up in H1 2021 (21.4%).

4.4. Effect of the Covid-19 pandemic

Taking into account 191 children vaccinated in H1 2020 out of the 679 children expected in H1 2020 and 180 children vaccinated in H1 2021 out of the 700 expected in H1 2021, we see that HGR Hakika experienced a decrease in Penta 3 coverage, i.e. 28.1 % in H1 2020 and 25.7% in H1 2021. This decline could be explained by the fueling of debates on conspiracy theories around the Covid-19 pandemic in the community. That of Kenya achieved vaccination coverage of 84.3% in H1 2020 on the 211 children expected in H1 2020 and 78.4% in H1 2021 on 218 children expected in H1 2021. In curative consultations for children under five years, Hakika had only achieved 19.9% in H1 2020 and 13.1% in H1 2021; This supports the argument in the global fund's survey report recognizing that counseling services for children under five have declined by 74%.(38), and even medical consultations for children under five fell by 23% in Africa during the pandemic(39).We observed a low level of implementation of intermittent preventive treatment at HGR Hakika with 11.3% in H1 2020 and 12.1% in H1 2021; as well as to HGR Kenya, for 5% and 10.3% during the study period.

CONCLUSION

We observed that children under 5 years old were less affected than those over 5 years old in the two General Reference Hospitals; LLIN distribution was low during CPNs at HGR Kenya and HGR Hakika; a low percentage of positive RDTs in the first half of 2020 at HGR Hakika and HGR Kenya, compared to the first half of 2021, as well as the percentage of children aged 6 to 59 months who had malaria infection was high in the first half of 2020, more weak in the first half of 2021 in Kenya; while at HGR Hakika, down in the first half of 2020 and up in the first half of 2021; we also noted a low level of implementation of intermittent preventive treatment at HGR Hakika in the first half of 2020 and the first half of 2021; as well as at HGR Kenya during the study period.

Abbreviations: PID: Intra-domestic spraying, **CCC**: Communication for social behavior change, **CPN**: Prenatal consultation, **PC**: Provincial coordination, **CPS**: Seasonal Prevention Chemotherapy, **DPS**: Provincial Health Division, **DTC**: Diphtheria Tetanus Pertussis, **ESP**: School of Public Health, **FOSA**: Health training, **GE**: Tick drop, **HGR**: General Reference Hospital, **INRB**: National Institute of Biomedical Research, **CL**: Larval control, **IBD**: Mosquito net impregnated with insecticide, **MILDA**: Mosquito net impregnated with long-lasting insecticide,**WHO**: World Health Organization, **NMCP**: National Malaria Control Program, **SARS-CoV-2**: Severe acute respiratory syndrome Coronavirus 2,**SNIS**: National Health Information System, **M.S.**: Sulfadoxine Pyrimethamine, **TDR**: Rapid Diagnostic Test, **TPI**: Intermittent preventive treatment, **UNILU**: University of Lubumbashi, **HIV**: Human immunodeficiency virus, **ZS**: Health Zone.

Author contributions

Study design and tools: ANK, FNM, analysis and interpretation: KKG, ANK, FNM, PMC, EMS, manuscript: all. All the authors have read it.

Ethics approval and consent to participate

Ethical approval was obtained. All participants provided written informed consent before participating.

Competing interests: The authors declare that they have no competing interests.

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