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# Profile of Households in the Bouake Northeast District Using Long-Lasting Impregnated Mosquito Nets (LLins) in 2019

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**Abstract:** *Background:* Malaria remains a continuing health problem in sub-Saharan Africa and its complications are more serious among children less than 5 years and pregnant women. In Côte d'Ivoire, its incidence was rising in the general population from 155‰ in 2016 to 229‰ in 2019. Universal coverage of LLIN in endemic countries still remain essential to contain malaria scourge. LLINs have been distributed gratis in different countries, in which majority of the citizens benefited by protection conferred by their usage. The issue of impregnated mosquito net use has been addressed by many authors from different angles. Public health measures are generally focused on people who do not always adhere to them. Better profiling of those who do comply with these measures and the reasons for their compliance would probably make it possible to reach a large number of the reluctant groups. *Methods:* This was a cross-sectional study conducted from July 2018 to February 2019 in the Bouaké Nord-Est district. The study population was made up of heads of households in the Bouaké commune or their substitutes (wife(s)). We proceeded by cluster sampling. *Results:* Of the 930 heads of households surveyed, 78.7% were male (sex ratio=3.7). The median age of heads of household was 38, with extremes of 19 and 70. Our respondents were shopkeepers, had no formal education, and were cohabiting in 75.3%, 64% and 77.5% of cases respectively. In 72.6% and 48.6% of cases respectively, puddles and grass covered the area around the homes of those surveyed. Fever was the main sign of malaria, according to 98.3% of subjects. The condition affected all family members and could be fatal, according to 91.6% and 98.8% of heads of household surveyed respectively. All family members slept under the net in 44.4% of cases. In 98.2% of cases, the number of cases of fever in the household had fallen since the net had been used. The rainy season was the period when the net was most used, according to 96.5% of those surveyed. LLINs protected against mosquito bites and prevented malaria in 98.3% and 92.4% of cases respectively. *Conclusion:* Malaria will continue to be the talk of the town for a long time to come, especially in tropical zones. environmental sanitation, which is the responsibility of both communities and authorities, will reinforce the action of the LLIN.

**Keywords:** LLIN, Malaria, User, Côte d'Ivoire

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## 1. Introduction

Malaria remains a continuing health problem in sub-Saharan Africa and its complications are more serious among children less than 5 years and pregnant women [1, 2]. Even with advancements in control, treatment and preventive measures employed over time, malaria still threatens lives of millions of people in African countries [2, 3]. In Côte d'Ivoire, its incidence was rising in the general population from 155‰ in 2016 to 229‰ in 2019 [4]. According to WHO [2, 5], universal coverage of LLIN in endemic countries still remain essential to contain malaria scourge. Studies have proven that LLINs usage could still be a very useful tool in prevention of malaria among vulnerable groups [2, 5]. LLINs have been distributed gratis in different countries, in which majority of the citizens benefited by protection conferred by their usage. In Côte d'Ivoire, the free distribution of approximately 30,000,000 impregnated long-lasting mosquito nets (LLINs) on a routine basis during mass campaigns was carried out in 2010, 2014 and 2017 [6]. It is however saddening that possession of LLINs does not translate to usage [7, 8]. Many studies have been done with regards to factors affecting LLINs usage, in which several reasons for non-usage of LLINs have been identified [8]. Some of these include; itching, not being able to hang it up, as well as feeling hot while sleeping under the nets. These reasons dominated the complaints made by beneficiaries among others [2].

The issue of impregnated mosquito net use has been addressed by many authors from different angles. Public health measures are generally focused on people who do not always adhere to them. Better profiling of those who do comply with these measures and the reasons for their compliance would probably make it possible to reach many reluctant groups. The GBEKE health region, whose capital is Bouaké, comprises three health districts. With a population of 832710 according to the 2021 general population and housing census (RGPH), Bouaké is the second largest city in Côte d'Ivoire in demographic terms [9].

To improve the proportion of impregnated mosquito net use, we proposed to carry out this study with the aim of finding out the profile of households using long-acting insecticide-treated mosquito nets in the urban area of Bouaké.

## 2. Methods

### 2.1. Type of Study, Study Setting and Sampling

This was a cross-sectional study conducted from July 2018 to February 2019 in the Bouaké Nord-Est district. This district included eight urban health areas, namely the maternal and child protection (PMI) center of Sokoura, the urban health center (CSU) of Sokoura, the urban health center (CSU) of Belleville, the urban and community health center (CSU-COM) of Kotiakoffikro, Akwaba Catalunya Maternal and Child Hospital (HMIAC) of Attienkro, The Touré Private Maternity Hospital, the non-governmental

organisation Aime Ton Prochain, the Infirmary 3rd Battalion. This district covers 10 districts and 30 sub-districts, with a population of 46310 households. The population is cosmopolitan, with Baule natives and non-natives from other Côte d'Ivoire ethnic groups, as well as migrants from neighboring countries such as Mali, Burkina Faso and Guinea, to name but a few. The ordinary household is made up of a head of household, his or her spouse(s) and their unmarried children, possibly with other family members or unrelated persons. The household can be reduced to one person living alone or with children. In the case of a polygamous household, when one of the wives is in a different concession, she constitutes a head of household.

The study population was made up of heads of households in the Bouaké commune or their substitutes (wife(s)), selected on the basis of the following criteria:- who were at least 18 years old at the time of our visit; - who reported daily use of impregnated mosquito nets in their household; - who gave their free and informed consent; - who had been resident in Bouaké for at least six months prior to the start of the survey.

We proceeded by cluster sampling.

Sample size:

We had no precise information on the rate of use of LLINs in the Gbêkê region. We therefore chose a value of 50%. To determine the sample size, we applied the following formula:

$$N = (z^2 pq / i^2) \times g$$

N=sample size

p=estimated rate of use of LLINs

p=50%=0,5

q= 1-p=1-0,5=0,5

z=1.96 for a risk of error  $\alpha$  of 0.5

i = statistical precision set at 0.05

g = cluster effect =2

So  $N = ((1.96)^2 \times (0.5 \times 0.5) / (0.05)^2) \times 2 = 770$

Taking into account non-respondents estimated at 20% of the sample obtained, we added 154 people for a size of 924, i.e. 30 clusters of 31 households.

### 2.2. Data Collection and Data Analysis

The interview consisted of an individual interview with each head of household or his or her substitute, using an anonymous, identical, structured and standardized questionnaire.

Survey parameters

The survey form included questions on:

Socio-demographic characteristics of the subject to be surveyed

Respondents' knowledge of malaria

LLIN use practices

Reasons for using LLINs

Quantitative variables were expressed as mean with standard deviation or median with extreme values. Qualitative variables were expressed as proportions. Data

were analyzed using SPSS software.

### 2.3. Ethical Considerations

All research was conducted in accordance with the 2013 Declaration of Helsinki. Verbal consent was sought and obtained from each head of household surveyed. Respondents' anonymity was respected by assigning a unique code to each survey file corresponding to an interviewed subject. The research was conducted after obtaining survey authorization from the health authorities of the Gbêkê region.

## 3. Results

### *Socio-demographic characteristics (Table 1)*

Of the heads of households surveyed, 78.7% were male (sex ratio=3.7). The median age of heads of household was 38, with extremes of 19 and 70. Our respondents were shopkeepers, had no formal education, and were cohabiting in 75.3%, 64% and 77.5% of cases respectively.

**Table 1.** Socio-demographic characteristics.

	Total	Percentage
Gender		
Male	732	78,7
Female	198	21,3
Age (years old)		
19-29	154	16,6
30-39	378	40,6
40-49	329	35,4
50-59	55	5,9
60-70	14	1,5
Occupation		
Acting Civil Servant	81	8,7
Retired Civil Servant	14	1,5
Active Private Company	34	3,7
Retired Private Company	30	3,2
Shopkeepers	700	75,3
Employed	71	7,6
Education Level		
None	595	64
Primary	182	19,6
Secondary	115	12,4
High	38	4,1
Marital Status		
Married	84	9
Cohabitation	721	77,5
Single /Bachelor	89	9,6
Widower/Divorced	36	3,9
Number of Rooms		
1	39	4,2
2	599	64,4
3	256	27,5
More than Three Rooms	36	3,9
Number of People/Household		
1 to 5	505	54,3
6 to 10	333	35,8
sup to 10	92	9,9
Number of Children under 5 years		
None	301	34,6
At least one	570	65,4
Puddles of water around the house		
Yes	675	72,6
no	255	27,4

	Total	Percentage
Wheeds around the house		
Yes	452	48,6
no	478	51,4

The 930 heads of household surveyed lived mainly in a two-room house in 64.3% of cases.

The median number of people in the household was 5, with extremes of 1 and 35. 65.4% of households had at least one child under the age of five. In 72.6% and 48.6% of cases respectively, puddles and grass covered the area around the homes of those surveyed.

### *Knowledge of malaria (Table 2)*

Mosquito bites were cited as the cause of malaria by 97.5% of the heads of households surveyed. These subjects affirmed that mosquitoes thrive in unhealthy environments and bite more during the night in 95.9% and 92% of cases respectively.

Fever was the main sign of malaria, according to 98.3% of subjects. The condition affected all family members and could be fatal, according to 91.6% and 98.8% of heads of household surveyed respectively.

**Table 2.** Knowledge about malaria.

	Total	Percentage
Causes of Malaria		
Mosquitos bites	907	97,5
Not know	23	2,5
Wheeds around the house		
Yes	452	48,6
no	478	51,4
Mosquito breeding environment		
Unhealthy environments	892	95,9
Stagnant water	204	21,9
Does not know	17	1,8
When mosquitoes bite most		
Night	856	92
The whole day	32	3,4
Afternoon	18	1,9
Morning	17	1,8
Does not know	7	0,7
Symptoms of Malaria		
Fever	914	98,3
Headache	443	47,6
Pain	346	37,2
Vomiting	297	31,9
Diarhea	159	17,1
Dark urine	64	6,9
Anorexia	46	4,9
Convulsion	22	2,4
Cough	10	1,1
Ictere	6	0,7
Does not know	6	0,6
People who can contract malaria		
The entire family	852	91,6
Does not know	78	8,4
Malaria is a deadly disease		
Yes	919	98,8
Does not know	11	1,2

### *About the LLINs (Table 3)*

The households surveyed had obtained the LLIN during mass distribution campaigns in 96.7% of cases. All family

members slept under the net in 44.4% of cases. In 98.2% of cases, the number of cases of fever in the household had fallen since the net had been used. The rainy season was the period when the net was most used, according to 96.5% of those surveyed. LLINs protected against mosquito bites and prevented malaria in 98.3% and 92.4% of cases respectively. The surveys revealed that the shape and color of the net were of little importance to 50.6% and 77.8% of respondents. No other means of combating malaria, apart from the LLIN, was used in 48.6% of cases. However, insecticide sprays and sanitation were used in 40.1% and 6.8% of cases respectively.

**Table 3.** About LLINs.

	Total	Percentage
Getting LLINs		
Through mass distributions of milda	899	96,7
During Prenatale Consultation	15	1,6
Whole Visiting a hospital	7	0,8
During a purchase	7	0,7
Gift given by another person	2	0,2
People who sleep under LLINs		
Children under 5 years old	202	21,7
Males	133	14,3
Females	118	12,7
The entire Family	413	44,4
Does not know	64	6,9
Impact of LLINs in households on the number of fever cases		
Demanding	913	98,2
Do not recall	17	1,8
Insistance Period		
Rainy Season	898	96,5
Dry Season	32	3,5
Reasons of using LLINs		
Protects against Mosquitos bites	914	98,3
Prevents Malaria	859	92,4
Closeness created by it	54	5,8
Advice of a health Care provider	3	0,3
Importance of the Shape of LLINs		
Yes	459	49,4
No	471	50,6
Importance of the color of LLINs		
Yes	203	21,8
No	724	77,8
No idea	3	0,3
Other means of fighting used		
Environmental sanitation	63	6,8
Insecticides spray	373	40,1
Anti- malaria Medecine	42	4,5
None	452	48,6

## 4. Discussion

### *Socio-Demographic Characteristics*

Our study population was predominantly male, with a sex ratio of 3.70. This result can be explained by the fact that we conducted a study of heads of household. Traditionally in Africa, men are the heads of household. Klu D and al [10] in their study in Ghana in 2019 also found a male predominance among household heads (65.2%). However, Talipouo A and al [11] in their study in Cameroon in 2019 found a high proportion of women (64.3%) among the heads of household surveyed. Our respondents were young with a median age of 38. This

youthfulness was in line with the youthfulness of populations in Africa. Klu D and al [10] found that the most represented age group was 30-49. The lack of education among the heads of households surveyed does not represent a brake on the use of LLINs in our study. This may be the result of the population's support for this public health measure. Conversely, this low level of education could hinder net use techniques, as demonstrated in the studies by Mora-ruiz and al [12] in Mexico in 2014 and Hambisa and Al [13] in Kenya in 2018.

Most of the heads of households surveyed had between 1 and 5 people per household (54.3%). Hambisa and al in 2018 found that households with fewer than 4 people per household were better at using ITNs than those with more [13].

Environmental conditions play a key role in the malaria transmission cycle. The habitat of our respondents was marked by the presence of puddles and grass. These elements constitute potential larval breeding grounds. The presence of at least one of them in a residential area could encourage the proliferation of mosquitoes, the vectors of malaria. Belay M and al in 2008 in Ethiopia made the same observation, with puddles present around houses in 94.5% of cases [14]. The presence of these potential breeding grounds may be due to the non-existence and/or malfunctioning of sanitation structures. This poor management can be attributed to both local authorities and local populations. These populations should invest more in improving their living environment. Such an investment by the local population would reinforce the sanitation actions already undertaken by the municipal authorities.

### *Knowledge of malaria.*

They knew that malaria was caused in most cases by mosquito bites (97.5%). They also knew that the mosquitoes responsible for malaria are mainly active in the evening and at night. The presence of these vectors is favored by an unhealthy environment. This good level of knowledge could be the result of the many malaria awareness campaigns and LLIN distribution campaigns run by the PNLP [15]. This good knowledge is found in ETHIOPIA in the studies by Hambisa and al [13] in 2018 and Tasew and al [16] in 2017 in Ethiopia, where respectively 67% and 87.3% of respondents knew that malaria was caused by a mosquito bite.

In our study, the majority of people cited fever as the main sign of malaria, in 98.8% of cases. This result was in line with the study carried out by Hambisa MT in 2018 in Ethiopia, which stipulated that malaria was the main cause of fever in 91% of households surveyed [13].

The lethal characteristic of malaria was reported by 98.8% of household heads surveyed. This fact was noted by Hambisa MT, where the fatal nature of malaria was reported by 67% of the heads of households surveyed [13]. The disease could affect any member of the household. This awareness of the seriousness of malaria could explain the use of LLINs by the households surveyed.

### *About LLIN*

National mass distribution campaigns for LLINs had enabled households to acquire them. As reported by WANZIRA H et al, in Uganda in 2018, 85% of the

population had LLINs [17].

Mosquito net use was highest in the rainy season (96.5%). This is the season when there are the most puddles, especially as there are rarely enough drains. One of the consequences is the proliferation of mosquitoes. TIGRAY *et al* [18] in their 2010 study in Nigeria showed that 44% of respondents used mosquito nets during the rainy season. As for mosquito abundance, Tasew A [16] noted that it peaked during the rainy season. Malaria being a disease of all sections of society, heads of households reported that their entire household slept under the net. This reduced the incidence of fever (98.2%). These results clearly demonstrate the effectiveness of LLIN use in the households surveyed, hence the importance of using LLINs on a daily basis and in all seasons [15]. Free LLIN distribution campaigns tend to relegate the use of other means of malaria prevention to the background. In our study, LLINs were the only means used in 48.6% of cases. Other measures used were insecticide sprays (40.1%) and environmental sanitation (6.8%). MORA RUIZ, in his 2014 study, noted that 38% of the people surveyed associated insecticide sprays with the use of LLINs [12].

Protection against mosquito bites and malaria prevention, with 98.3% and 92.4% of cases respectively, were the main reasons for use. These optimistic responses are the result of the various and regular messages conveyed by health professionals and the media. Our results were comparable to those of Tasew A *et al*, who observed that 99.2% knew the importance of LLINs in preventing malaria and 97.6% recognized that they protected them against mosquito bites [16].

## 5. Conclusion

Malaria will continue to be the talk of the town for a long time to come, especially in tropical zones. Our study has revealed that malaria is fairly well known among populations using LLINs, who do not have a high level of school education. The use of LLINs has reduced the incidence of this disease. However, environmental sanitation, which is the responsibility of both communities and authorities, will reinforce the action of the LLIN.

## Conflict of Interest

The authors declare no conflict of interest.

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