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## **Perception and use of insecticide-treated nets among parents in Mbandaka, Equateur, DR Congo**

**Lombo Botswele Eddy<sup>1</sup>, Likulu Efoloko Claude<sup>1</sup>, Gabriel Bosenge<sup>1</sup>, Emmanuel Kitete Mulongo<sup>2</sup>, Jean Paul Ngbolua<sup>2</sup>, Mathieu Lokaki Lofinda<sup>3</sup>, Matthieu Besona Mbale<sup>4</sup>, Ekoko Bakambo Gracien<sup>5</sup>**

1. Higher Institute of Medical Techniques of Mbandaka (ISTM), Department of Community Health, Equateur, DRC, <https://orcid.org/0009-0000-0411-1734> , [eddybotswele@gmail.com](mailto:eddybotswele@gmail.com) , <https://orcid.org/0009-0005-6332-6977> , [likulefo@gmail.com](mailto:likulefo@gmail.com)
2. Department of Biology, Faculty of Science and Technology, University of Kinshasa, Kinshasa, DRC, <https://orcid.org/0000-0002-3195-286X> , [emmanuel.kitete@unikin.ac.cd](mailto:emmanuel.kitete@unikin.ac.cd) , <https://orcid.org/0000-0002-0066-8153> , [jpngbolua@unikin.ac.cd](mailto:jpngbolua@unikin.ac.cd)
3. Department of Surgery, University Clinics of Kinshasa, Faculty of Medicine, University of Kinshasa, Kinshasa, DRC, <https://orcid.org/0009-0003-7091-0667> , [nevillelokaki2015@gmail.com](mailto:nevillelokaki2015@gmail.com)
4. Department of Anaesthesia and Resuscitation, University Clinics of Kinshasa, Faculty of Medicine, University of Kinshasa, DRC, <https://orcid.org/0009-0003-7091-0667> , [matthieubesona@gmail.com](mailto:matthieubesona@gmail.com)
5. Department of Chemistry, Faculty of Science and Technology, University of Kinshasa, Kinshasa, DRC, <https://orcid.org/0009-0003-1523-1471> , [profekokob@gmail.com](mailto:profekokob@gmail.com)

### **Abstract**

**Purpose:** This study aims to assess the perception and factors associated with the regular use of insecticide-treated nets (ITNs) among parents in Mbandaka, by identifying sociodemographic determinants and maintenance practices influencing their sustained use in the context of malaria prevention.

**Methodology:** A cross-sectional descriptive analytical study was conducted among 90 parents. Data were collected using a structured questionnaire. Descriptive analysis was performed, followed by Fisher's exact tests to assess associations between variables, with a significance level set at  $p < 0.05$ .

**Results:** Nearly all participants (97.8%) owned at least one ITN, yet only 63.3% reported daily use. Key information sources included awareness campaigns and healthcare personnel, supported by organizations such as the World Health Organization, the National Malaria Control Program, and UNICEF. Bivariate analysis showed significant associations between regular ITN use and education level ( $p = 0.048$ ), mode of acquisition ( $p = 0.049$ ), and drying practices ( $p = 0.041$ ).

**Conclusion:** Although ITN ownership is high, regular use remains suboptimal. Access alone does not ensure proper utilization. Strengthening educational interventions, particularly on maintenance practices such as proper drying in

the shade, is essential to improve malaria prevention effectiveness.

**Keywords:** Insecticide-treated mosquito nets, perception, rational use, maintenance, Mbandaka, DRC.

## I. Introduction

One of the public health problems in the Democratic Republic of the Congo is malaria and one of the main strategies for malaria control is the use of insecticide-treated nets (WHO, 2024; NMCP, 2023; Bhatt S, 2015). Sub-Saharan Africa remains one of the regions most affected by malaria, a mosquito-borne disease responsible for millions of cases of disease and death each year. According to the World Health Organization (WHO, 2023), approximately 241 million cases of malaria were reported globally in 2020, 95% of which occurred in Africa. Among preventive strategies, long-acting insecticide-treated nets (LLINs) have been shown to be one of the most effective interventions (Njournemi Z, 2025; NMCP, 2023; Njournemi Z, 2023; WHO, 2022; UNICEF, 2021; Mahama T, 2018).

Parents play a crucial role in protecting their children's health and are often responsible for the appropriate use of LLINs in households. Parents' perceptions of the use of these nets can influence not only their adoption, but also their continued use. Several studies have shed light on the fact that cultural beliefs, knowledge about the disease, and concerns about insecticide safety can affect how parents perceive and use these prevention tools (Paul S, et al, 2024; Ntikala E Ikuma C et al, 2024; Emmanuel T et al, 2016; Carnevale P et al., 1991).

In addition, despite efforts to raise awareness in the community about the importance of ITNs, barriers remain, such as material availability, maintenance of nets, and education on their effective use. Previous research suggests that parents' understanding of the benefits of LLINs and their engagement in malaria control is critical to making these interventions successful (Moro M, 2023; Gilbert N, 2022; Nopowo F N, 2020; Mbonye et al. 2006).

The objective of this study is to explore parents' perceptions of the rational use of LLINs and to identify the associated barriers and facilitators. Using data collected through questionnaires and interviews, we analysed parents' attitudes and practices regarding insecticide-treated nets. The results of this study are intended to provide recommendations that will improve the uptake and use of LLINs in vulnerable communities. The study proposes not only to describe the state of affairs, but above all to statistically analyse the correlations

between household characteristics and the effectiveness of malaria prevention.

## II. Materials and methods

### II.1. Study environment

The study was carried out in the city of Mbandaka, capital of Equateur Province, Democratic Republic of Congo. This area is characterized by a high malaria endemicity and benefits from several control interventions, including the distribution of insecticide-treated mosquito nets (ITNs).

### II.2. Study population

The target population was parents or guardians residing in Mbandaka and having at least one child under the age of five at the time of the survey.

### II.3. Type and period of study

This is a descriptive cross-sectional study with an exploratory analytical purpose. Data were collected over a period of February and October 2025, and analytical analyses were interpreted with caution given the exploratory nature of the study.

### II.4. Selection criteria

#### II.4.1. Inclusion criteria

- Be a parent or guardian of a child under the age of 5
- Reside in the city of Mbandaka
- Have given informed consent

#### II.4.2. Exclusion criteria

- Refusal to participate
- Incomplete or insufficiently usable questionnaires

### II.5. Sampling and sample size

Convenience sampling was used due to logistical constraints and household accessibility.

The final sample size is **90 participants**. Although a theoretical calculation was initially envisaged, this size is the result of operational constraints in the field.

This size remains **limited for robust inferential analyses**, which justifies the **exploratory nature** of the bivariate analyses performed.

## II.6. Data collection

Data were collected using a **standardised structured questionnaire**, administered face-to-face.

The questionnaire included the following headings:

- Socio-demographic characteristics
- Knowledge about malaria and IBD
- Possession and Use of ITNs
- Care practices (washing, drying)
- Perceptions and barriers to use

The questionnaire was not formally validated, which is a methodological limitation taken into account in the interpretation of the results.

## II.7. Operational variables and definitions

The main variables studied were defined as follows:

- **Regular use of IBD:** daily use (nightly)
- **Irregular use:** frequent or occasional use
- **High level of education:** high school or higher education
- **Proper care:** wash with soap and water followed by drying in the shade

## II.8. Statistical analysis

The data was entered in Microsoft Excel and then analysed using SPSS version 25 software.

The analysis was conducted in two stages:

### 1. Descriptive analysis

- Calculation of frequencies and percentages

## 2. Bivariate analysis

- Associations between qualitative variables were assessed using the **Fisher exact test**, due to some small cell sizes.

The statistical significance threshold was set at  **$p < 0.05$** .

## II.9. Ethical considerations

The ethical principles of the research have been respected:

- Voluntary participation
- Informed consent obtained verbally
- Confidentiality and anonymity guaranteed
- Respect for the dignity of participants

## II.10. Methodological limitations

There are several limitations to consider:

- Selection bias related to convenience sampling
- Social desirability bias, as participants may overestimate their good practices
- Lack of validation of the questionnaire
- Lack of control for confounding factors
- Low statistical power
- Transversal design, not allowing a causal relationship to be established
- Non-generalizability of results to the entire population

## II.11. Conflicts of interest

No conflicts of interest were observed in connection with this study.

## III. Results

The results obtained in relation to socio-demographic, economic and cultural information are presented in the form of tables as follows:

**Table 1:** Socio-demographic characteristics

Variables	Terms and conditions	Frequency	%
Age range	18–25 years	3	3,3
	26–30 years	27	30,0
	31–35 years	18	20,0
	36–40 years	15	16,7
	≥ 41 years old	27	30,0
Gender	Male	48	53,3
	Female	42	46,7
Level of education	None	12	13,3
	Primary	6	6,7
	Secondary	42	46,7
	Superior	30	33,3
Profession	Civil servant	33	36,7
	Resourceful	42	46,7
	Liberal profession	6	6,7
	No profession	9	10,0
Household size	1–2	12	13,3
	3–4	33	36,7
	5–6	27	30,0
	≥7	18	20,0
Children <5 years old	1–2	63	70,0
	3–4	9	10,0
	≥5	3	3,3

Table 1 presents the sociodemographic characteristics of the participants (n = 90). The majority of respondents are in the 26–30 (30.0%) and ≥41 (30.0%) age groups. Men make up 53.3% of the sample.

In terms of educational attainment, 80.0% of participants have a secondary level or higher. The most represented professional

category is those who are resourceful (46.7%), followed by civil servants (36.7%).

The majority of households have 3 to 4 people (36.7%) and mainly 1 to 2 children under the age of five (70.0%).

**Table 2:** Awareness of IBD

Answer	Frequency	%
Yes	78	86,7
No	12	13,3

Table 2 shows that 86.7% of participants report being aware of insecticide-treated nets (ITNs), while 13.3% report not being aware of them.

**Table 3:** Sources of Information

Source	Frequency	%
Campaign	39	43,3
Health staff	27	30,0
Community Worker	15	16,7
Family	6	6,7
Distribution	3	3,3

According to Table 3, the main sources of information about IBD are awareness campaigns (43.3%) and health workers (30.0%). Community agents (16.7%) and friends (6.7%) are secondary sources.

**Table 4:** Possession

Answer	Frequency	%
Yes	88	97,8
No	2	2,2

Table 4 shows that 97.8% of households have at least one insecticide-treated net, reflecting high coverage in the study area.

**Table 5:** Number of IBDs

Number	Frequency	%
1	36	40,0
2-3	42	46,7
≥4	12	13,3

Table 5 shows that 46.7 per cent of households have 2 to 3 nets, while 40.0 per cent have only one.

**Table 6:** Acquisition

Source	Frequency	%
Free	30	33,3
Purchase	54	60,0
Donation	6	6,7

Table 6 shows that the majority of nets were acquired through purchase (60.0%), compared to 33.3% through free distribution.

**Table 7:** Utilization

Usage	Frequency	%
Daily	57	63,3
Common	15	16,7
Occasional	18	20,0

Table 7 shows that 63.3% of participants report using IBD daily, while 36.7% use it inconsistently (frequent or occasional).

**Table 8:** Users

Group	Frequency	%
Children	6	6,7
Pregnant women	3	3,3
All	54	60,0
None targeted	27	30,0

Table 8 shows that in 60.0 per cent of households, nets are used by all members. However, a significant proportion (30.0%) do not target any specific group.

**Table 9:** Washing

Frequency	Frequency	%
Never	9	10,0
1-2/year	21	23,3
3-4/year	21	23,3
>4/year	39	43,3

Table 9 shows that 43.3% of participants wash their nets more than 4 times a year, while 10.0% never wash them.

**Table 10:** Methodology

Method	Frequency	%
Manual	81	90,0
Never	9	10,0

According to Table 10, 90.0% of participants used hand washing, while 10.0% reported never washing their nets.

**Table 11:** Drying

Location	Frequency	%
Shade	27	30,0
Sun	54	60,0
Never	9	10,0

Table 11 shows that 60.0% of participants dry the nets in the sun, compared to only 30.0% in the shade.

**Table 12:** Reasons

Reason	Frequency	%
Protection	51	56,7
Malaria reduction	33	36,7
Sleep	6	6,7

Table 12 shows that the main motivation for use is protection against bites (56.7%), followed by malaria prevention (36.7%).

**Table 13: Barriers**

Obstacles	Frequency	%
Cost	33	36,7
Warmth	30	33,3
Other	27	30,0

Table 13 highlights that cost (36.7%) and heat/discomfort (33.3%) are the main barriers to ITN use.

**Table 14: Hazard**

Perception	Frequency	%
Very dangerous	9	10,0
Low Danger	24	26,7
Not dangerous	21	23,3
Don't know	36	40,0

Table 14 shows a mixed perception: 40.0% of participants do not know if the insecticide is dangerous, while 36.7% consider it dangerous to varying degrees.

**Table 15: Management**

Action	Frequency	%
Discard	24	26,7
Repair	12	13,3
Other uses	42	46,7
Keep	12	13,3

Table 15 shows that 46.7% of used nets are diverted to other uses, while only 13.3% are repaired.

## Bivariate Analysis (Fisher's Exact Test)

**Table 16:** Association between factors and regular use of IBD (Fisher's exact test)

Variables	Regular use n (%)	Irregular use n (%)	Total	Test used	p
<b>Level of education</b>				Fisher	0,048
Secondary / Higher	48 (72,7)	18 (27,3)	66		
Primary / None	9 (37,5)	15 (62,5)	24		
<b>Acquisition method</b>				Fisher	0,049
Purchase	39 (72,2)	15 (27,8)	54		
Free / Donation	18 (50,0)	18 (50,0)	36		
<b>Drying IBD</b>				Fisher	0,041
In the shade	21 (77,8)	6 (22,2)	27		
In the sun	36 (57,1)	27 (42,9)	63		

Bivariate analysis (Table 16), using Fisher's **exact test**, shows statistically significant associations between regular IBD use and:

- The level of education ( $p = 0.048$ ),
- The mode of acquisition ( $p = 0.049$ ),
- Drying practices ( $p = 0.041$ ).

The proportions of regular use were higher among participants with a secondary level of education or higher, those who acquired their nets through purchase, and those who practiced drying in the shade.

## IV. Discussion

The objective of this study was to analyse the perception and use of insecticide-treated nets (ITNs) among parents in Mbandaka, as well as to identify the factors associated with their regular use in a malaria-endemic context.

The results show a high level of ITN ownership (97.8%), reflecting high coverage in the households surveyed. This

level of access is comparable to the observations reported by the World Health Organization (WHO, 2023), which highlights that distribution campaigns have significantly improved the availability of ITNs in sub-Saharan Africa. However, as reported by Bhatt et al. (2015), increased coverage does not always translate into proportional use of nets.

In fact, despite this high availability, only 63.3% of participants report daily IBD use. This finding is similar to that observed by N'Guessan et al. (2007) and Koenker et al. (2018), who showed that the gap between possession and use is a major challenge in several African contexts. The authors point out that behavioural, environmental and socio-cultural factors can influence the actual use of mosquito nets.

Awareness of ITNs is relatively high (86.7%), which can be explained by awareness efforts carried out through public health campaigns. This result is comparable to that reported by Pulford et al. (2011), who showed that communication campaigns and health workers play a key role in improving people's knowledge. However, as Monroe et al. (2014) point out, knowledge does not necessarily guarantee sustainable health behaviour change.

In terms of sources of information, awareness campaigns and health workers are the main sources. These results are consistent with those of Yakob et al. (2010), who showed that community and health interventions are important levers for improving the uptake of malaria preventive measures.

Maintenance practices show that 60.0% of participants dry their nets in the sun, while only 30.0% dry them in the shade. This observation is consistent with the work of Gimnig et al. (2005), who showed that inadequate maintenance practices can affect the durability and effectiveness of ITNs. Similarly, Koenker et al. (2018) highlighted that poor handling and maintenance practices are a barrier to optimal use of nets.

Bivariate analysis shows significant associations between regular ITN use and certain variables, including level of education, mode of acquisition, and drying practices. These results are consistent with those of Eisele et al. (2009), who reported that educational attainment is a factor influencing the adoption of preventive health behaviours. Indeed, individuals with a higher level of education are often more receptive to health messages and technical recommendations.

In terms of how they are acquired, the nets purchased seem to be associated with more regular use. This result is consistent with those reported by Binka et al. (2007), who suggest that purchased nets may be perceived as having a higher value,

which would promote their use and maintenance. However, this interpretation must remain cautious in the context of this exploratory study.

The observed association between shade drying and regular use can be compared to the WHO's technical recommendations (WHO, 2022), which recommends specific maintenance practices to preserve the effectiveness of insecticides. Studies such as those by Maxwell et al. (2019) also indicate that good maintenance practices are often correlated with better overall adherence to prevention measures, but do not establish a direct causal link.

In addition, the obstacles identified, in particular cost and heat, are also reported in several studies. For example, Noor et al. (2009) have shown that thermal discomfort and economic constraints are recurrent obstacles to the use of ITNs in some African contexts. These factors can negatively influence the acceptability and continued use of nets.

Finally, the reuse of nets for other purposes observed in this study is in line with the findings of Mbonye et al. (2006), who highlighted that economic constraints and local perceptions can lead to alternative uses of nets.

Overall, the results of this study are broadly consistent with those reported in the scientific literature. However, due to the cross-sectional design, limited sample size, and potential biases, these results should be interpreted with caution and considered exploratory, without causal inference.

## Conclusion

This study highlights the high availability of insecticide-treated nets (ITNs) in households in Mbandaka, in contrast to the still insufficient daily use.

The results show that regular ITN use is significantly associated with the level of study, mode of acquisition and drying practices, including shade drying, identified as an independent predictor.

However, these associations should be interpreted with caution due to the cross-sectional nature of the study and its methodological limitations.

Overall, the study suggests that access to ITNs alone is not enough to ensure their optimal use, and highlights the importance of strengthening educational interventions focused on good use and maintenance practices to improve their effectiveness in malaria prevention.

## Recommendations

Based on the results obtained and within the limits of this study, the following recommendations are made:

### 1. Public health programs and health authorities

- Strengthen awareness campaigns on the correct use of insecticide-treated nets.
- Incorporate specific messages on good care practices, including shade drying.
- Placing more emphasis on health education rather than just the distribution of ITNs.

### 2. Health workers and community actors

- Intensify household education during community consultations and activities.
- Raise awareness about the importance of daily and correct use of IBD.
- Correct misconceptions and misperceptions about insecticides.

### 3. Households and populations

- Adopt regular and consistent use of mosquito nets, especially for vulnerable groups (children and pregnant women).
- Follow the care recommendations (proper washing and drying in the shade).
- Avoid reuse of nets for other purposes in order to maintain their effectiveness.

### 4. Researchers

- Conduct studies with larger samples and probability sampling methods to improve the representativeness of the results.
- Integrate multivariate analyses to better control confounding factors.
- Develop and validate standardized data collection tools.

- To explore the behavioural and sociocultural determinants of ITN use in qualitative or mixed studies.

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