Analysis of Insecticide-Treated Net Use by Pregnant Women: Implications for Donor Organizations

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Background: The World Health Organization (WHO) recommends the use of insecticide-treated nets (ITNs) for the prevention of malaria and reduction of mortality and morbidity from mosquito-borne diseases. Although many countries, including the Democratic Republic of Congo, have adopted this recommendation and distributed bed nets to their inhabitants, the percentage of the population using ITNs remains low.

Methods: This study was conducted with 400 mothers with at least one child under 5 years of age in health zones in the Bandundu province. Face-to-face interviews were conducted using structured pre-coded questionnaires. Chi-square tests and logistic regressions were calculated using the SPSS Version 21.0 software.

Results: Among the studied variables, education status (p = 0.013), marital status (p = 0.004), ANC utilization (p = 0.13), suffering from malaria during pregnancy (p = 0.019), and knowledge of the seriousness of malaria (p = 0.013) were significant determinants of the use of ITNs in logistic regression analyses.

Conclusion: The results of this study indicate that the regular use of ITNs by women during pregnancy is associated with marital status, attending ANC services, and awareness of the serious nature of malaria. Therefore, education about the risk factors among populations is needed.

Key Words: Malaria, Pregnant women, Insecticide-treated nets, Democratic Republic of Congo, KOICA

INTRODUCTION

Malaria remains a major public health problem across the globe, although significant progress has been made in the past decade. In 2010, the number of malaria cases was estimated to be 216 million, with approximately 660,000 deaths; 86% of these cases involved children under 5 years old. Regions in Africa suffer more from malaria than other regions; 81% suffered from malaria episodes and 91% of deaths resulted from malaria in Africa [1].

Among the 44 African countries, the Democratic Republic of the Congo (DRC) reported that more than 40% of all deaths were attributed to malaria, accounting for the second highest malaria mortality rate in the region (WHO, 2012). In 2012, the country recorded 9.1 million suspected cases of malaria, which represents 37.7% of new outpatient cases recorded in health facilities, and 21,601 deaths, or 32.6%

of hospital deaths [2].

To reduce the burden of malaria, rapid and appropriate diagnosis and treatment, as well as prevention, are important. The WHO Global Malaria Program's recommendation describes a shift in guidance toward malaria prevention using insecticide-treated mosquito nets (ITNs) and recommends the distribution of ITNs to achieve full coverage of the population at risk for malaria [3]. The Ministry of Public Health of the DRC adopted the WHO recommendation and created a policy focused on six strategies: prevention and accurate diagnosis of malaria cases; control and outbreak management; monitoring, evaluation and operational research; response to epidemics; communication to promote behavior change; and follow-up and evaluation of operational research to fight against the disease [2,4-6]. The policy promoted, especially among children and pregnant woman, sleeping under ITNs in every house for the prevention of malaria. Since ITNs are considered the most important malaria preventive measure, especially in high-risk malaria-endemic areas, this is the primary intervention carried out by the NMCP in the DRC [2]. Malaria is a global public health issue, especially for pregnant women, as it may be dangerous to both the mother and fetus [7-9]. Therefore, utilization of ITNs can reduce the complications related to malaria during pregnancy.

Using ITNs has advantages in preventing malaria. Indeed, expanding the use of ITNs leads to the reduction of malaria transmission and the entomological index, the density of the mosquito population, the rate of female parity and the sporozoite index [10-13]. Studies in African countries where malaria is endemic have reported reductions on the order of 20 to 63% in morbidity and mortality among children under the age of 5 [14,15].

To ensure sufficient coverage of ITN ownership, the National Program of Fight against Malaria (PNLP) of the DRC has adopted three distribution strategies: distribution through a mass campaign, prenatal consultation for pregnant women and the growth of monitoring consultation for children under five years of age [2]. The PNLP set objectives that every household should have at least one ITN. Eighty percent of the general population has access to ITNs. More specifically, pregnant women and children under five should have greater access to ITNs.

Although these objectives were adopted in 2001, the percentage of those using ITNs remains low in the DRC. A countrywide evaluation in 2010 found intermediate ITN coverage of 38.1% for children under five years old and 42.6% for pregnant women (MICS 2010). Because of their particular vulnerability to malaria, these two target groups require particular attention.

The Korean International Cooperation Agency (KOICA) supports a global health project in 2 health zones, Kenge and Boko, in the Bandundu province of the DRC. The project aims to reduce the mortality rate of malaria in pregnant women and children under five years of age and to increase the proportion of births attended by skilled health personnel as well as the percentage of those attending CPN and CPS services at project sites. To achieve this goal, the project manager conducted a survey to assess the health status, behavior and knowledge of site inhabitants before moving forward. Malaria is one of the major causes of death at the project sites. This study aimed to identify the factors related to ITN utilization among women of reproductive age. The identification of these factors will contribute to the development of interventions to improve ITN use in order to reduce further the morbidity and mortality associated with malaria.

Fig. 1. Map of the study area.

MATERIALS AND METHODS

1. Study sites

A cross-sectional study was conducted in the area of maternal and child health care and was supported by the KOICA. The study district is located in the southwest corner of the DRC, about 200 km from Kinshasa.

2. Sampling technique

Seven health zone areas were randomly created in 2 health zones in the Bandundu province. At the level of each health zone, 3 villages were selected randomly from a list of villages. At the village level, households were selected randomly by systematic sampling.

The minimum required sample size was 376 women with children under 5 years old. This sample size was calculated by considering the national average (42.6%) of pregnant women who use ITNs (MICS, 2010), with a 5% margin of error. The data were collected from 400 households. These households were selected proportionally to the demographic weight of each health area. The interview was conducted with mothers using structured pre-coded, pre-tested questionnaires.

3. Data analysis

The dependent variable was a question about the regular use of ITNs during the last pregnancy. Associations between the dependent variable and the independent variables were tested using Chi-square tests.

To identify determinants of insecticide-treated net use by pregnant women, logistic regression was used. To build the multi-variable model, only variables from the bivariate analyses with a p-value less than 0.25, as given by [16], were used. The entry method of logistic regression was used. Variables were introduced systematically, according to the scheme-demographic factors related to ITN, health and environmental factors. Data were entered using the EPI DATA software version 3.0. Data analyses were performed using the SPSS Version 21.0 software and analyses were performed considering a significance level of 5%.

4. Ethics

The study protocol received ethical clearance from the Institutional Review Board (IRB) of Gangneung-Wonju National University, South Korea, in 2012. A clear written consent was obtained from each respondent.

Table 1. General characteristic of the study population

Variables	ITN User n (%)	ITN Non-user n (%)	Total n (%)	p-value
Utilization of the ITN	313 (78.2)	87 (21.8)	400 (100)	
Age (n = 352)				
Less than 25 yrs	88 (77.9)	25 (22.1)	113 (32.1)	0.869
25-29 yrs	69 (75.0)	23 (25.0)	92 (26.1)	
More than 30 yrs	114 (77.6)	33 (22.4)	147 (41.8)	
Religion				
Christianity	190 (80.5)	46 (19.5)	236 (59.0)	0.189
Other	123 (75.0)	41 (25.0)	164 (41.0)	
Education status				
Uneducated	122 (84.1)	23 (15.9)	145 (36.3)	0.095
Primary	57 (76.0)	18 (24.0)	75 (18.0)	
Secondary and above	134 (74.4)	46 (25.6)	180 (45.0)	
Marital status				
Married	290 (80.3)	71 (19.7)	361 (90.3)	0.002
Other	59 (23.0)	16 (41.0)	39 (9.8)	
Family size				
Up to 5 members	120 (78.4)	33 (21.6)	153 (38.3)	0.961
6-7 members	97 (78.9)	26 (21.1)	123 (30.8)	
8+ members	28 (22.6)	28 (22.6)	124 (31.0)	
Geographical accessibility to the health facility				
<30 min	194 (80.5)	47 (19.5)	241 (60.3)	0.180
>30 min	119 (74.8)	40 (25.2)	159 (39.8)	

RESULTS

The general characteristics of the study population are presented in Table 1. The total sample size is 400, and the ITN utilization rate is 313 (78.2%). Most of the respondents are older than 30 (147 [41.8%]). Participants under 25 and those over 30 utilized ITNs at a rate of nearly 80%. The majority of the respondents (236 [59.0%]) identify as Christian; among these individuals, 190 (80%) are using ITNs. Forty-five percent of respondents completed at least a secondary level of education. Similarly, 361 (90.3%) are married, with the remaining 39 (9.8%) unmarried, divorced, separated, widowed and other. Family size is divided into 3 categories, up to 5 members, 6-7 members and 8 members or more. These three categories were similarly distributed at 153 (38.3%), 123 (30.8%) and 124 (31.0%), respectively. Two hundred forty-one (60.3%) respondents live in an area that is geographically accessible to the health facility.

Table 2 presents the characteristics related to reproductive health and their associations with ITN utilization. One hundred twenty-seven (31.8%) suffer from malaria during their pregnancy; among them 90 (70.9%) use ITNs. Three hundred seventy-three (93.3%) have knowledge of malaria, but only 77.7% use ITNs. Two hundred twenty-four (56%) thought that malaria is very serious. One hundred thirty-five (34.6%) respondents own three mosquito nets at home; among them, 83.7% are ITN users. Three hundred eighty-seven participants (96.8%) own ITNs; among these individuals, 79.6% use their ITNs.

Bivariate analyses are conducted for each of the 12 independent variables with each of the seven following variables: education, marital status, ITN ownership, ANC utilization, having malaria during pregnancy, knowledge of the severity of the malaria and total number of mosquito nets at home. These seven variables were all significantly associated with ITN utilization. Table 3 shows the results of bivariate and multivariate analyses, which identify the factors associated with ITN utilization. Multivariate analysis is done using only the seven variables significantly associated with ITN use; among them only four variables are significant: education status (AOR, 2.18; CI, 1.17-4.03), marital status (AOR, 3.09; CI, 1.43-6.63), malaria during pregnancy (AOR, 0.52; CI, 0.30-0.89) and knowledge of the severity of malaria (AOR, 0.48; CI, 0.27-0.85).

Table 2. Associations between reproductive characteristics and INT users

Variables	ITN User n (%)	ITN Non-user n (%)	Total n (%)	p-value
Malaria during pregnancy				
Yes	90 (70.9)	37 (29.1)	127 (31.8)	0.015
No	223 (81.7)	50 (18.3)	273 (68.3)	
ANC utilization				
Yes	295 (94.2)	76 (87.4)	371 (92.8)	0.028
No	18 (5.8)	11 (12.6)	29 (7.3)	
Knowledge of causes of malaria				
Yes	290 (77.7)	83 (22.3)	373 (93.3)	0.36
No	23 (85.2)	4 (14.8)	27 (6.8)	
Knowledge of the severity of malaria				
Not serious	33 (70.2)	14 (29.8)	47 (11.8)	0.016
Moderate and serious	93 (72.1)	36 (27.9)	129 (32.3)	
Very serious	183 (83.5)	37 (16.5)	224 (56.0)	
No. of mosquito nets at home				
0-1	16 (57.1)	12 (42.9)	28 (7.2)	0.016
2	95 (76.6)	29 (23.4)	124 (31.8)	
3	113 (83.7)	22 (16.3)	135 (34.6)	
4 or more	83 (80.6)	20 (19.4)	103 (26.4)	
ITN ownership				
Yes	308 (79.6)	79 (20.4)	387 (96.8)	0.000
No	5 (38.5)	8 (61.5)	13 (3.3)	

Table 3. Factors related to utilization of ITNs

Variables	Crude OR (95% CI)	p-value	Adjusted OR (95% CI)	p-value
Age (n = 352)				
Less than 25 yrs	1.01 (0.55-1.83)	0.950		
25-29 yrs	0.86 (0.47-1.5)	0.651		
More than 30 yrs	1			
Religion				
Christianity	1.37 (0.85-2.22)	0.190		
Other	1			
Education status				
Uneducated	1.82 (1.04-3.71)	0.035	**2.18 (1.17-4.03)**	**0.013**
Primary	1.08 (0.58-2.03)	0.794	1.15 (0.57-2.31)	0.68
Secondary and above	1		1	
Marital status				
Married	2.84 (1.42-5.65)	0.003	**3.09 (1.43-6.63)**	**0.004**
Other	1			
Family size				
Up to 5 members	1.06 (0.59-1.87)	0.840		
6-7 members	1.08 (0.59-1.99)	0.784		
8+ members				
Geographical accessibility to the health facility				
<30 min	1.38 (0.85-2.24)	0.181		
>30 min				
ITN ownership				
Yes	6.23 (1.98-19.59)	0.002	3.86 (0.53-27.96)	0.18
No	1		1	
ANC utilization				
Yes	2.37 (1.07-5.23)	0.32	2.04 (0.80-5.19)	0.13
No	1		1	
Malaria during pregnancy				
Yes	0.59 (0.33-0.89)	0.015	**0.52 (0.30-0.89)**	**0.019**
No	1		1	
Knowledge of causes of malaria				
Yes	0.60 (0.20-1.80)	0.370		
No	1			
Knowledge of the severity of malaria				
Not serious	0.46 (0.22-0.95)	0.037	0.49 (0.22-1.07)	0.76
Moderate and serious	0.51 (0.30-0.86)	0.012	**0.48 (0.27-0.85)**	**0.013**
Very serious	1		1	
No. of mosquito nets at home				
0-1	0.32 (0.32-0.78)	0.013	0.36 (0.13-1.00)	0.051
2	0.78 (0.41-1.49)	0.47	0.62 (0.31-1.24)	0.182
3	1.23 (0.63-2.41)	0.53	1.05 (0.52-2.12)	0.881
4 or more	1		1	

DISCUSSION

Among the seven variables taken into account in the final model of the multivariate analysis, four were significantly associated with the regular use of ITNs: education, marital status, malaria during pregnancy and knowledge of the severity of malaria. Previous studies have also found similar factors associated with ITN use. In a study conducted in the Congo, marital status and education were associated with ITN use [17], in Uganda, marital status and ANC visits were related to ITN use [18], and in Kenya, marital status and education were associated with ITN use [9].

The proportion of pregnant women who reported regularly sleeping under ITNs during their last pregnancy was

78.2%. This proportion is close to that reported for pregnant women in the Bandundu province (76.1%) as assessed by a Multiple Indicator Cluster Survey (MICS) performed in 2010. Uneducated individuals are at a greater risk for malaria, as they use ITNs at a lower rate than do those with secondary or higher levels of education, which is concordant with the results of a study in southern Ethiopia [19]. Regarding marital status, the results in the present study demonstrate that ITN use by married pregnant women is significantly higher than that of other women (OR = 3.09, 95% CI = 1.43-6.63, p = 0.004). Seck et al. also found similar results in Senegal (OR = 3.22, 95% CI = 1.6-6.6, p < 0.001) and concluded that marital status strongly influences the use of preventive measures, notably the use of ITNs [20].

The awareness level that malaria remains a serious disease was significantly associated with regular use of ITNs during participants' last pregnancy (OR = 0.48, 95% CI = 0.27-0.85, p = 0.013). Many similar studies have shown positive associations between the use of ITNs and adequate knowledge of different aspects of malaria among pregnant women. Similar results were found by Baume et al. in Ghana, reporting an association between knowledge of causal agents and transmission mode and ITN use (OR = 1.38, 95% CI = 1.03-1.86, p < 0.05) [16]. In addition, similar results have been found by Graves et al. in Ethiopia (p < 0.05) [21] and Seck et al. in Senegal [20]. These authors confirmed a significant link between ITN use and knowledge of the modes of transmission, prevention and clinical indices of malaria (OR = 0.5, 95% CI = 0.3-0.9, p = 0.042). These results can be explained through participation in interpersonal communication sessions organized for pregnant women during antenatal care.

The two variables, ITN ownership and ANC utilization, are not significant in this study, although Singh et al. [22] found that net ownership was significantly associated with ITN use [23] and ANC utilization was significantly associated with ITN use in Obol's 2014 study.

Among the seven variables taken into account in the final model of the multivariate analysis, four were significantly associated with the regular use of ITNs, education status (AOR, 2.18; CI, 1.17-4.03), marital status (AOR, 3.09; CI, 1.43-6.63), malaria during pregnancy (AOR, 0.52; CI, 0.30-0.89) and knowledge of the severity of malaria (AOR, 0.48; CI, 0.27-0.85). The PNLP should organize a social awareness campaign integrated with health facilities offering preventive care in order to inform the population about behavior change in the fight against malaria. In addition, sustaining a high usage rate of ITNs (>80%) requires improvements in geographic accessibility, access to information with respect to supply and demand, and quality prevention services with the effective involvement of all sectors (state, private and NGO, community relay, community radios, etc.) along the chain of supply to distribution, as well as with follow-up on the effective use of ITNs in the community. Based on these results, government and donor organizations need to provide ITNs, as well as education, to enhance the utilization of ITNs.

The consequences of malaria are particularly harmful for both the pregnant mother and her growing fetus. Therefore, for a safe pregnancy and a healthy baby, utilization of ITN is important.

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