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ORIGINAL PAPER

Factors Associated with Utilization of Insecticide-Treated Nets in Children Seeking Health Care at a Ugandan Hospital: Perspective of Child Caregivers

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Abstract In Uganda malaria causes more morbidity and mortality than any other disease and children below 5 years contribute the biggest percentage of malaria related mortality. Insecticide treated nets (ITNs) are currently one of the most cost effective option for reducing malaria-related morbidity and mortality, however the factors affecting their utilization in Uganda are still not well understood. This study examined the prevalence and factors associated with ITN utilization among children of age 0–12 years seeking health care from a Ugandan hospital using caregiver's reports. A cross sectional design was used to collect data using a semi-structured questionnaire from 418 participants. Binary logistic regression was employed to determine predictors of ITN utilization. Results show that the prevalence of ITN utilization among children seeking health care was 34.2%. ITN utilization was higher among children of age <5 years [37.0, 95% CI 31.81–42.21] as compared to children aged ≥5 years [22.9, 95% CI 13.77–32.01]. Source of mosquito net (OR = 13.53, 95% CI = 6.47–28.27), formal employment by head of household (OR = 6.00, 95% CI = 1.95–18.48), sharing a bed with parent (s) (OR = 2.61, 95% CI = 1.21–5.63) and number of children below 12 years in a household (OR = 0.80, 95% CI = 0.65–0.99), were significant predictors of utilization. ITN utilization among children was below the set national target. The predictors identified by this study reveal opportunities that can be taken advantage of by malaria control programs to achieve the desired rates of utilization and subsequently malaria prevention in children.

Keywords Children · Malaria prevention · Insecticide treated nets · Utilization · Caregivers

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Introduction

Malaria continues to be a major public health problem affecting at least 3.3 billion people worldwide and in Sub-Saharan Africa it is the leading cause of morbidity and mortality [1]. In Uganda, malaria accounts for up to 40% of all hospital outpatient visits, 25% of hospital admissions, 14% of hospital deaths, and children ≤5 years of age are one of the most affected segments of the population [2]. Children under 5 years of age contribute 25–30% of all malaria related annual mortality country-wide [3]. National surveys show that malaria is responsible for about 36% children absenteeism from school [4].

In order to overcome the high burden of malaria in children, governments and other healthcare organizations in Uganda and other malaria endemic countries have introduced Insecticide treated mosquito nets (ITNs) as the most viable options for reducing malaria-related morbidity and mortality especially in children [5]. ITNs are mosquito bed nets that repel, disables and/or kills mosquitoes when they come into contact with insecticide on the netting material. However, despite the cost-effectiveness of ITNs in malaria prevention in endemic areas [6], their utilization by children in Uganda is still very low. Recent reports show that 10% of children of age ≤5 years sleep under ITNs [4] and this is far short of the ideal 100% ITN utilization.

Low utilization of ITNs by children contributes significantly to the persistence of high malaria related morbidity and mortality rates in Uganda. Persistence of high rates of malaria related morbidity in developing countries has lifelong effects which range from poor school attendance by children, poverty and general poor child growth and development [7]. Because of the negative impact of malaria on children and their families, the promotion of ITN use has become a central element of national and international efforts against malaria. An example of these efforts was seen in the African Summit on Roll Back Malaria (RBM) held in Abuja, Nigeria in 2000, which set the target of having at least 60% ITN utilization by children of age ≤5 years by the year 2005 [8]. This target was subsequently revised to 80% by 2010 [6]. Unfortunately, Uganda has not achieved even half of the original target of 60% [9].

Failure to meet the set goals of ITN utilization is an indicator that there are challenges that need to be addressed before embarking on scaling up ITN use. Some of the challenges such as distribution and acceptance have been already documented in other African countries [10–12]. Recent school-based studies from African countries such as Tanzania show that only 38% of pupils use ITNs [13]. Literature also shows that factors such as age of child, parents marital status [14], religion [15] and annual seasonal weather changes [16] affect ITN utilization. None-utilization of ITN has also been attributed to absence of mosquitoes in the house, forgetting to mount the net [17], foul smell and fear of side effects from the chemicals used to treat the mosquito nets [13].

A qualitative study conducted in Burkina Faso found that ITNs were initially used to avoid mosquito bites or when participants felt disturbed, saw or heard the mosquitoes, but when not bothered by the mosquitoes, ITNs were not used [18]. The other factors reported by studies in other African countries show that socioeconomic status of the family [19] and assumptions that nets do not prevent malaria and not suitable for sleep, affect ITN utilization [20].

It is not clear whether the factors reported in other African countries also apply to Ugandan children considering the numerous differences in cultures and practices. Very few studies have examined the factors affecting ITN utilization among children in Uganda. One qualitative study done in Western Uganda, found that the common reasons given for not using ITNs were heat discomfort during sleep and the high cost of ITNs [21].

However, despite the lack of adequate evidence about factors affecting utilization of ITNs, governments and other health agencies have continued to implement strategies for increasing ITN utilization. For instance in Uganda the strategies used include free distribution of Long-lasting Insecticidal nets (LLINs) through mass campaigns, antenatal clinics, immunization clinics, Non-Governmental Organizations (NGOs) and sales at subsidized prices by private vendors [22]. LLINs are factory-treated mosquito nets made with netting material that has insecticide incorporated within or bound around the fibers [23]. A mosquito net that is classified as LLINs is able to retain its effective biological activity without re-treatment for at least 20 standard washes under laboratory conditions and can be used for up to 3 years [23]. This study presents findings about the current prevalence and factors associated with utilization of ITNs in children using reports of their caregivers.

Methods

Study Setting

The study was conducted at the assessment center of Mulago National Referral Hospital (MNRH). MNRH is Uganda's largest public hospital and is located in Kampala, the national capital. The assessment center at MNRH is the largest out-patients department in the hospital and receives walk in patients and referred patients from health facilities from all parts of Uganda. The assessment center is the entry point for all children, both out-patients and emergence cases. According to MNRH hospital report of 2008, the assessment center received 73,764 patients and 41,237 of these were children aged 0–12 years. At the assessment center, out-patients are treated and sent back home while the very sick children are sent to the pediatric acute care unit for admission. This study focused on children between ages of 0 and 12 years seeking health care at the assessment center.

Study Participants and Procedures

A cross sectional design was employed to guide data collection in this study. The study was approved by the

institutional review board (Research and ethics committee) of Makerere University College of Health Sciences and MNRH. Approval to treat mothers <18 years of age as emancipated minors was also granted by the research and ethics committee. The study recruited caregivers of children seeking health care at the assessment center during a 2 month period. In this study caregivers are defined as that person who stays with and provides day-to-day care for the sick child. In order to be included in the study, the child's caregiver had to meet the following inclusion criteria; be the primary caregiver to a child of age 0–12 years; and willing to provide informed consent. Caregivers of children who were returning to the hospital for follow up care or visits were not included in the study to avoid re-admission in the study. Systematic random sampling method was used to obtain the required sample of 418 participants.

The questionnaires were administered by 3 research assistants (registered nurses) with experience in data collection. On data collection days, informed consent was obtained from every third child caregiver. In addition to informed consent, assent was obtained from children aged 8–12 years. And to ensure confidentiality, only a unique study number was recorded on the questionnaire. The study questionnaires were administered to the caregivers in private rooms as they were waiting for their medication or other healthcare services. Caregivers with a child who required urgent treatment and admissions were followed to the admitting ward (acute care unit) and the questionnaire was administered after the child condition had stabilized. Every completed questionnaire was checked for completeness immediately before the leaving the caregiver.

Measures

The questionnaire used for data collection was developed by the researchers and was written in English and translated into Luganda (local language) by an experienced translator and then back translated by a different linguistic expert to ensure consistency. The English and Luganda versions were pre-tested on 20 participants (10 each) prior to the study at another hospital outside of Kampala. ITN utilization was measured by asking whether the child slept under an ITN on the night preceding the interview. ITNs were considered to be any mosquito net that was either permanently treated (LLIN) or was pre-treated or had an insecticide treatment in the last 12 months. Data about caregivers' socio-demographic characteristics; the child's socio-demographic characteristics; caregivers' knowledge about malaria and ITNs, preferred malaria control method, problems encountered when using ITN, sleeping arrangements, type of house, size of house and source of mosquito net, was collected.

Analysis

Data analysis was conducted using the Stata 9 statistical software. Prevalence of ITN utilization was determined by dividing the number of children who slept under an ITN the night preceding the interview by the total number of children in the sample. Odds ratios were used as a measure of association and 95% confidence intervals (CI) were computed. Statistical significance was assessed using a Chi-square test or Fisher's exact test and P values of ≤ 0.05 were considered significant. Variables with P values ≤ 0.1 at bivariate analysis were used in multivariate analysis to determine predictors of ITN utilization. A binary logistic regression model was performed using a back word stepwise method for selection of variables. Interaction was assessed using the Chunk test while confounding variables were determined using a 10% difference in Odds ratio.

Results

Socio-Demographic Characteristics of the Participants

As shown in Table 1, the sample was comprised of 418 caregivers most of whom were female biological parents to the child (93%) and the children were mostly male (56%). The mean age of the caregivers was 27 ± 7.5 years and majority of the children were under 5 years of age (80%) and half of the caregivers were not employed and had secondary level education.

Characteristics of Households of Children Seeking Health Care at MNRH

All caregivers stated that they had at least one mosquito net (any type) in their household. As shown by results summarized in Table 2, the sick children were from families which had mostly 2–5 people and 80% of the household of the caregivers had 1–3 children below the age of 12 years. The houses where the caregivers and the child lived were mostly comprised of 2 rooms (74%) and headed by the father of the sick child. Most of the heads of household had secondary school education (49%) and were employed in the informal sector (56%). Most children (65%) shared a bed with their caregivers in a house described as a permanent structure (85%). The other household heads were a brother, sister, uncle, aunt, cousin or grandparent to the sick child.

Prevalence of ITN Utilization in Children Seeking Health Care

The caregivers' reports show that 75.8% of the children slept under some kind of mosquito net (any type) the night

Table 1 Socio-demographic characteristics of caregivers and their children

Variable	Frequency ($N = 418$)	Percentage (%)
Gender of child		
Male	235	56.2
Female	183	43.8
Age group of the child		
Under 5 years	335	80.1
5 years and above	83	19.8
Relationship with caregiver		
Biological parent	388	92.8
Others (siblings, grandparent, aunt/niece/cousin)	30	7.8
Gender of caregiver		
Male	29	6.9
Female	389	93.1
Education level of caregiver		
None	25	6.0
Primary	166	39.7
Secondary	208	49.8
Post-secondary or tertiary	19	4.5
Religion of caregiver		
Catholic	143	34.2
Muslim	118	28.2
Protestant	97	23.2
Pentecostal	46	11.0
Seventh day-adventists	14	3.4
Employment of caregiver		
Not employed	211	50.5
Informal employment	152	36.4
Formal employment	55	13.1

Table 2 Characteristics of the households where caregiver and children live

Variable	Frequency ($N = 418$)	Percentage (%)
Family size (M = 5.0, SD = 2.3)		
2–5 people	294	70.3
6 and above number of people	124	27.7
Number of children <12 years (M = 2.4, SD = 1.3)		
1–3 children	335	80.1
4 and above	083	19.9
Size of the house (M = 2, SD = 1.3)		
1–2 rooms	308	73.7
3 and above number of rooms	110	26.3
Type of house		
Permanent	356	85.2
Semi-permanent	62	14.8
Head of household		
Father	277	66.3
Mother	79	16.5
Grandparent	36	8.6
Others	26	6.2
Sex of head of household		
Male	286	68.3
Female	132	31.7
Education level of household head		
None	52	12.4
Primary	120	28.7
Secondary	206	49.3
Post-secondary or Tertiary	40	9.6
Employment of household head		
Not employed	54	32.8
Informal employment	318	56.3
Formal employment	46	10.9
Sleeping arrangement		
Child sleeps alone	81	19.4
Child shares a bed with parent(s)	273	65.3
Child shares a bed with other caregivers	64	15.3

before the interview. However, as indicated in Table 3 the prevalence of ITN utilization among children was 34.2% (95% CI 29.0–38.81) because 65.8% of the children did not sleep under a treated mosquito net the night before the interview. The prevalence of ITN utilization was higher among children less than 5 years (37, 95% CI 31.82–42.21), children whose caretakers were employed with the formal sector (56.3, 95%CI 31.11–81.44) and had tertiary level of education (52.6%, 95% CI 29.50–75.77).

Caregivers' Knowledge about ITNs

All caregivers reported that they have ever heard of ITNs. Results presented in Table 4 shows that most caregivers knew the cause (96%) and route of transmission of malaria (95%). Sleeping under a mosquito net was the most preferred method of preventing malaria in children (78%) and ITNs were perceived to be effective in controlling malaria (99%). The most common problems reported about ITNs were; being too hot (23%) and causing difficult breathing during sleep (14%). Most caregivers bought their children's mosquito nets from private vendors (57%) while the others got ITNs as a donation (43%) from NGOs. The mosquito nets were washed 4 or more times (71%) in the last 1 year and were not treated or re-treated after washing (86%). The reason given for not treating or re-treating the mosquito nets were; not knowing that the net needed to be re-treated (46%); chemicals for re-treating the net are not available (33%); and forgetfulness and lack of time (22%).

Table 3 Prevalence of ITN utilization among children seeking health care

Variable	Total	Utilized ITN	Percentage (%)	95% CI
Overall ITN utilization	418	143	34.2	29.60–38.81
Age group of the child				
Under 5 years	335	124	37.0	31.82–42.21
5 years and above	83	19	22.9	13.77–32.01
Gender of child				
Male	235	79	33.6	27.55–39.69
Female	183	64	35.0	28.02–41.92
Child's relationship with caregiver				
Parent	388	136	35.1	30.28–39.82
Other	30	7	23.3	7.89–38.77
Age of caregiver				
16–27 years	249	86	34.5	28.60–40.47
28–54 years	169	57	33.7	26.56–40.90
Employment of caregiver				
Not employed	211	76	36.1	29.51–42.52
Informal employment	191	58	30.2	23.83–36.91
Formal employment	16	9	56.3	311.1–81.44
Education level of caregiver				
None	25	5	20.0	3.95–36.05
Primary	166	51	30.7	23.66–37.78
Secondary	208	77	37.0	30.42–43.62
Post-Secondary or Tertiary	19	10	52.6	29.50–75.77

Factors Associated with ITN Utilization Among Children Seeking Health Care

Bivariate analysis were conducted to determine factors associated with ITN utilization and the findings summarized in Table 5 show that children under 5 years were more likely to use ITNs as compared to older children (OR = 1.99, CI 1.13–3.46). The other factors associated with ITN utilization were; age of caregiver (OR = 0.97, CI 0.94-0.99); tertiary level education of caregiver (OR = 4.44, CI 1.97–16.82); formal employment for head of household (OR = 2.83, CI 1.24–6.44); number of children below 12 years (OR = 0.77, CI 0.66–0.91); sharing a bed with a caregiver (OR = 2.43, CI 1.35–4.37); getting a mosquito net donation from hospital or Non-Governmental Organization (OR = 10.07, CI 5.24–19.36); and getting information about ITNs from Non-Governmental Organization health workers (OR = 0.54, CI 0.31–0.93).

Predictors of ITN Utilization in Children Seeking Health Care

Variables which had *P* values of ≤ 0.1 at bivariate analysis (Table 5) were further analyzed using logistic regression to determine predictors of ITN utilization. The results presented in Table 6 shows that source of mosquito nets (OR = 13.53, CI 6.47–28.27), having a household head who is employed in the formal sector (OR = 6.00, CI 1.95–18.48), sharing a bed with a caregiver (OR = 2.61, CI 1.21–5.63) and number of children below 12 years in a household (OR = 0.80, CI 0.65–0.99), are significant predictors of ITN utilization among children seeking health care.

Discussion

The prevalence of ITN utilization among children seeking health care was 34.2% and this is still below the desired target. However the prevalence of utilization in this study is higher than the 12% reported from a longitudinal study conducted 4 years ago [24].The increasing prevalence of ITN utilization found in this study could be attributed to the increasing number of community programs providing ITNs to people in Uganda.

The signs of slow, but increasing rates of mosquito net utilization paint a picture which conveys both good and bad news. The good news is that the practice of sleeping under some kind of mosquito net has become a common practice in most households and provides an opportune entry point for scaling up ITN utilization. The bad news is that most households with children are still using untreated nets and these have a lower protective effect against mosquito bites and malaria. ITNs have a significantly higher protective

Table 4 Caregivers' knowledge about ITNs

Variable	Frequency ($N = 418$)	Percentage %
Cause of malaria		
Knows	402	96.2
Does not know	16	3.8
Malaria transmission		
Knows	398	95.2
Does not know	20	4.8
Perceived effectiveness of ITNs		
Effective	413	98.8
Not effective	5	1.2
Preferred malaria prevention method for child		
Sleeping under a mosquito net	324	77.6
Clearing bushes around homes	28	6.7
Closing windows and doors early in the evening	27	6.4
Keeping water drainages clean	21	5.0
Use of sprays, coils or burnings	16	3.8
Use of mesh screens in the windows	2	0.5
Perceived problems encountered by children when sleeping under ITNs (Multiple responses)		
No problems	247	59.1
Net too hot to sleep in	95	22.7
Difficulty in breathing when sleeping under an ITN	59	14.1
Difficulty getting out of bed at night	3	0.7
Other problems	14	3.4
Source of information about mosquito nets or ITNs (multiple responses)		
Government health facility	273	65.3
Radio/Television	264	63.2
NGO	62	14.8
Posters/News papers	11	2.6
Relatives, friends and local leaders	65	15.6
Source of mosquito nets		
Donated by hospital or NGOs	180	43.1
Bought from pharmacy, shops, hawkers or supermarket	238	56.9
Number of times mosquito net was washed in last 1 year		
One time	27	9.6
Two times	32	11.4
Tree times	23	8.2
Four times and above	198	70.8
Treated or re-treated the mosquito net after washing		
Yes	44	13.6
No	279	86.4

efficacy when compared to untreated mosquito nets because of the additional chemical barrier which further reduces the human-vector contact [25, 26].

In this study ITN utilization was reported to be higher among children under 5 years of age when compared to children aged 5 years and above. Findings from other studies conducted in Uganda have also reported trends of decreasing ITN utilization as the age of the child increases [6, 24]. The slow increase in ITN utilization could be explained by the associated factors found by this study such as number of children in a household below 12 years of age, source of mosquito nets, sharing a bed with caregiver and formal employment of the head of household. The associated factors found by this study point to two important aspects central to ITN utilization and these are affordability or cost (economics) and ITN related knowledge or health related knowledge in general. The two aspects need to be examined critically because they seem

Table 5 Factors associated with ITN utilization in children seeking health care

Variable	Frequency ($N = 418$)	Utilized ITN	OR	95% CI	P value
Age group of the child					
5 years and above	83	19	1.00		
Under 5 years	335	124	1.99	1.13–3.46	0.016
Age of caregiver	418	143	0.97	0.94–0.99	0.027
Caregiver's level of education					
None	25	5	1.00		
Primary	166	51	1.77	0.63–4.99	0.277
Secondary	208	77	2.35	0.85–6.52	0.100
Tertiary	19	10	4.44	1.97–16.82	0.028
Education (head of household)					
None	52	9	1.00		
Primary	120	44	2.77	1.23–6.21	0.014
Secondary	206	69	2.41	1.11–5.22	0.026
Tertiary	40	21	5.28	2.04–13.45	0.001
Employment (head of household)					
Not employed	54	16	1.00		
Employed with informal sector	318	102	1.12	0.60–2.11	0.720
Employed with formal sector	046	25	2.38	1.24–6.44	0.013
Number of children <12 years	418	143	0.77	0.66–0.91	0.003
Sleeping arrangements					
Child sleeps alone	81	17	1.00		
Child shares bed with Parent(s)	273	108	2.43	1.35–4.37	0.003
Child shares bed with other caregivers	64	18	1.45	0.68–3.11	0.340
Source of mosquito net					
Bought from private vendor	252	81	1.00		
Donated by Hospital or NGO	75	62	10.07	5.24–19.36	<0.001
Source of information about ITN (NGO health worker)					
Yes	273	96	1.00	0.31–0.93	0.025
No	145	47	0.54		

Table 6 Predictors of ITN utilization among children seeking health care

Variable	aOR	95% CI	P values
Source of mosquito net			
Bought	1.00		
Donated	13.53	6.47–28.27	<0.001
Employment of head of household			
Not employed	1.00		
Informal employment	1.75	0.7–4.37	0.231
Formal employment	6.00	1.95–18.48	0.002
Sleeping arrangement			
Child sleeps alone	1.00		
Child shared bed with parents	2.61	1.21–5.63	0.014
Child shared bed with other caregiver	2.65	0.94–7.52	0.066
Number of children	0.80	0.65–0.99	0.040

to suggest that partnerships between malaria prevention programs, hospitals and other community organizations is a good approach to promoting utilization of ITNs.

The aspects of socio-economic status such as type of employment and numbers of children below the age of 12 years are important barriers to utilization of ITNs. These factors pose the biggest challenge because they require a multi-sector approach to be addressed. A study done in western Uganda supports the point that cost is one of the major reasons why people generally do not use mosquito nets to prevent malaria [21]. Socioeconomic reasons could also be responsible for the family sleeping arrangements such as sleeping with caregiver which have been found to be associated with ITN utilization in children. Social economic factors are very important because families which cannot afford to regularly replace ITNs could decide to use ITNs for a period longer than the recommended lifespan. And prolonged use and multiple

washings could lead to loss of net physical integrity and development of holes in the ITN. Other studies have already shown that mosquito nets used by young and older children tend to have more holes than those used by infants [27]. In the Current study it was not possible to collect objective data about the condition of the ITNs, which could have assisted in defining intactness of the ITNS. Intact nets have been defined as those with less than 20 holes each of less than 2 cm in diameter [28]. Research shows that intact nets whether treated or not treated provide protection against mosquitoes when compared to no bed net at all [25]. Therefore presence of holes in ITNs reduces their effectiveness. It should also be noted that to many people sleeping under the same ITN with limited size may lead to improper protection from mosquitoes because as individuals sleeping together turn and move in bed during sleep this may release the net from holding points on the lower side of the bed.

Such releases create spaces where mosquitoes can enter to bite the people sleeping in the improperly covered bed. Therefore arrangements where the child sleeps in the same bed with the parents or caregiver may lead to increased utilization of ITNs, but the outcome in terms of protection from Malaria is likely to be less effective. A study conducted in Burkina Faso has also already shown that parents who usually sleep with their young children are less likely to sleep under ITNs during all season of the year [16].

Study Limitations

It is important to note that although the current study used widely accepted methods to determine utilization, its results still have to be interpreted with caution since using caregivers report to assess ITN utilization might overestimate the prevalence of ITN utilization in children. Additionally, assessing ITN utilization using behavior of the previous night before the interview is another challenge because the caregivers are likely to hang up their children's mosquito nets when the child fall sick which may not be a daily routine.

Conclusion

This study has showed that the prevalence of ITN utilization is still low among children with in the age group of 1 month to 12 years and has identified factors such as source of mosquito nets, formal employment for head of household, sleeping arrangement, and number of children below 12 years in a household- as key factors influencing utilization of ITNs by children. These factors reveal the opportunities that can be explored to scale up ITN utilization. We recommend that efforts to enhance ITN utilization should consider partnership and collaboration with community organizations such as employers of parents and family members of children, local hospitals and other community based organizations as essential approaches to scaling up ITN utilization in children. Activities aimed at promoting ITN utilization should also be integrated in other health care services such as family planning and child health clinics. This integrated and multi-sectorial approach addresses the factors associated with ITN utilization found in this and other studies.

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Conflict of interests The authors declare that they have no competing interests.

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