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Ownership and Utilization of Insecticide Treated Nets among Primary School Children Following Universal Distribution of Insecticide Treated Nets in Kasipul, Homa-Bay County, Kenya

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Abstract

Insecticide treated nets (ITNs) have become the preferred vector control tool for malaria. Studies indicate that even after universal net distribution, primary school children were significantly less likely to use ITNs compared to other age groups. The objective of this study was to examine the ownership and utilization of ITNs among primary school children living in Kasipul, one year after mass distribution of ITNs in Kasipul, Homa-Bay County. A cross-sectional study of 398 primary school pupils was conducted in Kasipul. Data on insecticide net use was collected using a questionnaire. The study established that only 51.0 % of the study population owned ITN, which is below the 80% target set by the Kenya Ministry of Health. Among 203 pupils who reported having ITN at home, 189 (93.1%) obtained them free from the government during 2014, mass distribution campaign. ITNs use among pupils in the area increased from 33% in 2015 to 75% in 2016. Age significantly influenced net ownership ($\chi 2=7.549$, df =3, p=0.054). The difference in ITNs ownership per school was significant ($\chi 2=37.191$, DF =8, p =0.000), indicating that net distribution was not done uniformly within Kasipul. The study concludes that a relatively high ITNs use in this survey, despite moderate coverage (51%) of nets and indicates an overall desire to deploy the nets by the pupils when they are available. Lack of educational campaigns accompanying universal net distributions was evident as 20.7% of net were not in regular use.

Keywords: Insecticide treated nets; Malaria; School Children; Homa-Bay.

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1. Introduction

Malaria is a re-emerging infectious disease contributing to more deaths in present day than in decades prior [1]. ITNs have become the preferred vector control tool for malaria. It is considered as the most efficacious of all the currently feasible interventions for *Plasmodium* infection control in Africa. This type of net is a new innovation based on the slow release of pyrethroid insecticides, which makes it wash resistant and does not require any retreatment to remain effective [2]. The net serve as physical barriers between humans and female *Anopheles* mosquito. They are known to have community-wide effects which extend protection range of the nets to include individuals not using the nets in a community [3]. Despite the knowledge that ITNs are effective in the prevention of malaria, ITN coverage and utilization remain low in most malaria endemic countries in Africa. Less than 10% utilization rate has been reported in most countries in sub-Saharan Africa [4]. Since the year 2002, many countries in Africa have scaled up the free provision of ITNs. However, coverage still falls far below the 80% coverage targets set by World Health Assembly resolution in a 2005 [5]. Proper deployment of nets and long-term retention of nets have posed substantial challenges to attaining this specific world health organisation target. In addition, low households ITNs possessions have been shown to compromise children access to insecticidal nets in Africa [6]. Previously use of ITN as a control tool routinely targeted children below five years of age and pregnant women mainly because of the high risk of malaria infection in this groups [5]. Controlling malaria by targeting children and pregnant women has failed to tame the tide of malaria in endemic countries. One possible reason for the persistence of *Plasmodium* infection in many African countries, is that ITNs are not being used by populations that are serving as reservoirs for infection and transmission [7]. Studies indicate that about 80% of human-to-mosquito *Plasmodium* transmission originates from infected human hosts older than five years of age [8]. Currently, there is increased effort to including school aged children in malaria control strategy mainly because they are rarely treated for asymptomatic infections, thus contributing significantly to the infectious reservoirs of malaria parasite [9]. The disease has been linked to reductions in sustained attention, cognition, and school achievement which can be an obstacle to future human resource development in Africa[10]. Despite the periodic distribution of ITNs in Kenya, studies indicate that ITN coverage shows highest coverage among children aged less than five years, dropping to lower levels of coverage among primary school children. As expected, this group constitutes the largest threat to the success universal coverage of ITN is likely to impact upon reduced community-levels of transmission, mainly because this age group have not developed a parasitic immunity that regulates the risk of blood stage infection [8]. Previous studies found that even after universal net distribution, primary school children were significantly less likely to use ITNs compared to other age groups [11], because some of the nets are diverted to be used for commercial activities in agriculture and fishing which reduce the overall number of nets per household[12]. Currently there is no health program in place that routinely monitors malaria control programmes such as ITNs coverage. Most countries in Africa rely on household based surveys such as Malaria Indicator Surveys, which is very expensive. However recent studies have demonstrated that school children based surveys can be a complementary, inexpensive way of evaluating ITNs ownership and utilization within a community [13]. Kasipul is among malaria high risk areas in Kenya [14], that benefited from the third round of universal distribution of ITNs in 2014[15]. This study examined ownership and utilization of insecticide treated nets in Kasipul, with a view to determine the extent of coverage and level of utilization among primary school children.

2. Materials and methods

2.1 Study area

The study was conducted in Kasipul in Homa-Bay County (34.75 to 34.95°E, 0.41 to 0.52°S). Kasipul lies within the Lake Victoria basin, which has high malaria prevalence of 40% [14], among the residents. It has an area of 365.5 sq. Kms and a population of 129,854. Eighteen thousand children are enrolled in sixty-seven primary schools within Kasipul [16]. This region benefited from free distribution of ITN in 2014 [15].

2.2 Study design and protocol

School-based cross-sectional study involving nine randomly selected primary schools within Kasipul, Homa-Bay County was undertaken to establish the ownership and utilization of ITNs among primary school children. The minimum sample size was determined using the formula $n = t^2p(1-p)/m^2$ [17]. Where **n** = required sample size, **t** = confidence level at 95% (standard value of 1.96), **p** = estimated prevalence of malaria in the study area**, m** = margin of error of 5% (standard value of 0.05). Using area malaria prevalence of 40.0 [14] precision 0.05 (5%) and confidence level at 95% (standard value of 1.96), the minimum sample size for this study was 369 subjects. The sample size was increased to 450 children to account for eventualities such as failure to sign informed consent form and absenteeism. Number of observations per school was calculated by dividing the sample size by the number of participating schools;

$= \frac{\textbf{Sample size}}{\textbf{Number Schools}}$ = school sample size = $\frac{450}{9}$ = 50 children

Sample size per class = $\frac{\mathbf{50}}{\mathbf{5}}$ = 10 pupils per class.

All primary school children in class 4 to 8 who agreed to participate and their parents or guardians signed informed consent form and were physically present in school on the days when data collection was done were enrolled in this study. Pupils who were absent from school on data collection days, and those whose parents or guardians refused to sign informed consent form, were excluded from this survey. Participating children were selected using simple random sampling technique. Questionnaires were used to collect data on insecticidal net ownership, usage and characteristics of participants in terms of gender, age and level of education. The data collected using questionnaires were recorded and analysed using Statistical Package for Social Sciences (SPSS) version 22.0 computer software. Descriptive statistics were used to summarise the data and the association between variable were tested using Chi-Square at 5% level of significance.

2.3 Ethical consideration and clearance

Ethical approval to carry out the study was obtained from the Kenyatta University Ethical Review Committee. Permission to conduct this study was also obtained from the National council of science, technology and innovation (NACOSTI). Authorization from Head teachers of the schools concerned and consent from the parents of participating children was also obtained. Participation of the pupils was voluntary and those who

decided to withdraw during the study were permitted to do so.

3. Results

3.1 ITN ownership by demographic characteristics of study participants

Table 3.1 indicates that 203 pupils representing 51.0 % of the study population owned ITNs. However, with respect to sex 104 (54.2 %) females possessed ITNs compared to 99 (48.1%) males. ITNs ownership was similar for both sexes ($\chi 2$=1.484, df =1, p =0. 223), although there was an age influence (χ^2=7.549, df =3, p=0.054). Difference in ITNs ownership per school was significant in Kasipul ($\chi 2$=37.191, df =8, p =0.000).

Table 3.1: ITN ownership by demographic characteristics of study participants

Characteristic	N	ITNs ownership		χ^2(df)	p-value
		Yes	No		
Sex					
Male	206	99(48.1%)	107(51.9%)	0.715	**0.223**
Female	192	104(54.2%)	88 (45.8%)	0.769	
Total	**398**	**203(51.0%)**	**195(49.0%)**	**1.484(1)**	
Age group (years)					
9-11	**94**	53(56.4%)	41(43.6%)	1.0879	**0.054**
12-14	**237**	125(52.7%)	112(47.3%)	0.2863	
15- 17	**65**	25(38.5%)	40(61.5%)	4.0925	
Above 17	**2**		2(100.0%)	2.0821	
Total	**398**	**203 (51.0%)**	**195 (49.0%)**	**7.549 (3)**	
Education level					
STD 4	69	34 (49.3%)	35 (50.7%)	0.0826	**0.661**
STD5	69	40(58.0%)	29(42.0%)	1.3399	
STD 6	91	43(47.3%)	48(52.7%)	0.5127	
STD 7	83	40 (48.2%)	43(51.8%)	0.2627	
STD 8	86	46 (53.5%)	40(46.5%)	0.2122	
Total	**398**	**203 (51.0%)**	**195 (49.0%)**	**2.410 (4)**	
School					
Kalando	**42**	11 (26.2%)	31 (73.8%)	10.349	0.000
Kokwanyo	**45**	33 (73.3%)	12 (26.7%)	8.9776	
Agawo	**44**	26 (59.1%)	18 (40.9%)	1.1512	
Umai	**49**	17 (34.7%)	32 (65.3%)	5.2167	
Andin'go	**39**	23 (59.0%)	16 (41.0%)	0.9911	
Nyawango	**99**	28 (57.1%)	21 (42.9%)	0.7387	
Omiro	**44**	15 (34.1%)	29 (65.9%)	5.0372	
Got	**43**	21 (48.8%)	22 (51.2%)	0.0808	
Manga	**43**	29 (67.4%)	14 (32.6%)	4.6488	
	398	**203 (51.0%)**	**195 (49.0%)**	**37.191(8)**	

Slightly more female pupils owned nets compared to males, although the difference was not significant (χ^2=1.484, df =1, p=0. 223).

3.2 Type and source of nets used by pupils in Kasipul

Analysis of data on overall net possession with a focus on type of net and source revealed that out of 250 respondents who had mosquito bed nets, 203 (81.2 %) had ITNs, while 47 (18.8%) owned other types of bed nets. Among 203 pupils who reported to have ITNs at home, 189 (93.1%) obtained them free from the

government, while 14 (6.9%) bought the nets (Table 3.2). There was evidence of a significant association between type and source of net used by pupils (χ^2= 4.875, df = 1, p = 0.027). This finding indicates that ITNs free distribution campaign was highly successful and majority of the nets distributed to residents of Kasipul by the Government were being used to protect them against malaria, particularly school children.

Table 3.2: Type and source of nets used by pupils in Kasipul

Type of net	Number	Source		χ2(df)	p-value
		Free	Bought		
ITN	203	189(93.1%)	14(6.9%)	0.9164	**0.027**
Others	47	39(83.0%)	8(17.0%)	3.9582	
Total	**250**	**228(91.2%)**	**22(8.8%)**	**4.875(1)**	

Majority of the pupils used ITNs given free by the government. Difference in source and type of net used was statistically significant (χ^2= 4.875, df = 1, p = 0.027).

3.3 Frequency of ITN use

One hundred and sixty-one (161) representing 79.3% of pupils with ITNs slept under it on the eve of the survey, while the remaining forty-two representing 20.7 % failed to deploy the insecticidal nets (Table 3.3). The survey reported more females using insecticidal nets on the eve of the study compared to males. However, there was no significant difference in insecticidal net use between the sexes (χ2 = 2.452, df =1, p-value = 0.117). Out of those pupils who indicated that they deployed insecticidal nets on the eve of the survey, 152 (74.9%) hanged their nets daily on the bed while 51 (25.1%) did not. This study established that, daily bed net use was not influenced by sex of the child (χ^2= 1.786, df = 1, p = 0.181), neither was it age dependent (χ^2= 3.844, df = 2, p = 0.146).

Table 3.3: Frequency of ITN use amoing pupils in Kasipul

	Frequency of ITN use among pupils in Kasipul				
Demographic Characteristic	**n**	**YES**	**NO**	**χ^2 (df)**	**p-value**
Use of ITNs the previous night by sex					
Male	99	74 (74.7%)	25 (25.3%)	1.2561	**0.117**
Female	104	87 (83.7)	17 (16.3)	1.1957	
Total	**203**	**161(79.3%)**	**42 (20.7%)**	**2.452(1)**	
Use of ITNs on the eve of the survey by age group					
9-11	52	43 (82.7%)	9 (17.3%)	0.36246	**0.573**
12-14	126	97 (77.0%)	29 (23.0%)	0.41552	
15-17	25	21 (84.0 %)	4 (16 %)	0.33508	
Total	**203**	**161(79.3%)**	**42 (20.7%)**	**1.113 (2)**	
Daily use of ITN by Sex					
Males	99	70 (70.7%)	29 (29.3%)	0.9151	**0.181**
Females	104	82 (78.8%)	22 (21.2%)	0.871	
Total	**203**	**152 (74.9%)**	**51(25.1%)**	**1.786(1)**	
Daily use of ITNs by age group					
9-11	52	44 (84.6%)	8 (15.4%)	2.6216	**0.146**
12-14	126	89 (70.6%)	37 (29.4%)	1.2052	
15-17	25	19 (76.0%)	6 (24.0%)	0.0168	
Total	**203**	**152 (74.9%)**	**51(25.1%)**	**3.844(2)**	

Both males and female school children of all the three age sets used the nets similarly.

3.4 Reasons why pupils avoided insecticidal nets on the eve of the survey

Among those pupils who possessed ITNs but reported not using them the night before the survey, the main reasons given included: too hot (28.6%) and forgetting to hang the net (45.2%). Other reasons given were no mosquitoes (7.1%), and that the nets were dirty (9.5%) (Figure3.1).

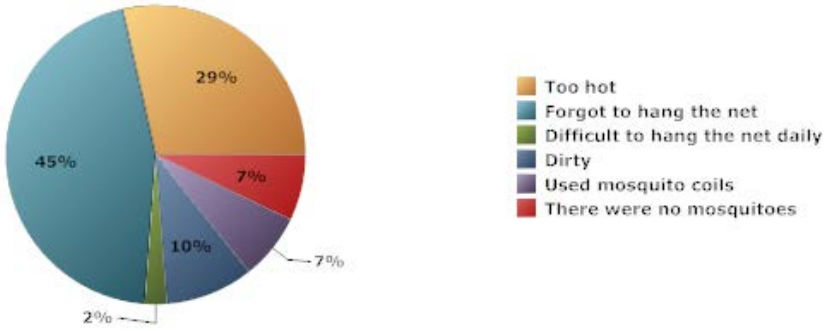

Figure 3.1: Reasons why pupils avoided insecticidal nets on the eve of the survey

3.5 Duration of ITNs use by pupils

Further assessments of net usage among pupils in Kasipul, revealed that 67.7% of the male pupils and 64.4 % of female pupils had been using ITNs for more than four months (Table 3.4). Though not significant, 12-14 years age set had the highest proportion (72.0%) of pupils who had been using ITNs for more than four months (χ^2= 7.098, df = 4, p = 0.131).

Table 3.4: Duration of ITNs use by pupils

Demographic Characteristic	**1 week to 1 months n (%)**	**2 to 3 months n (%)**	**More than 4 months n (%)**	**χ^2 (df)**	**P-value**
Overall	42(20.7%)	27(13.3%)	134 (66.0%)		
Sex					
Males	22 (22.2%)	10 (10.1%)	67 (67.7%)	1.788(2)	0.409
Females	20 (19.2%)	17 (16.3%)	67 (64.4%)		
Age (years)					
9-11	12 (22.6%)	9 (17.0%)	32 (60.4 %)	7.098(4)	0.131
12-14	21 (16.8%)	14 (11.2 %)	90 (72.0 %)		
15-18	9 (36.0 %)	4 (16.0 %)	12 (48.0 %)		

Most of the pupils (72.0%) who had been using ITN for more than four months were in 12-14 years age set. Difference in duration of ITN use in terms of age set was not statistically significant (χ^2= 7.098, df =4, p = 0.131).

3.6 Overall usage of ITNs by households in Kasipul

In 51.0 % of the households, all family members possessed and protected themselves using ITNs, while in 29.4 % children lacked nets and only parents were protected from mosquito bites. None of the household members slept under ITN in 18.1 % of the households (Figure 3.2).

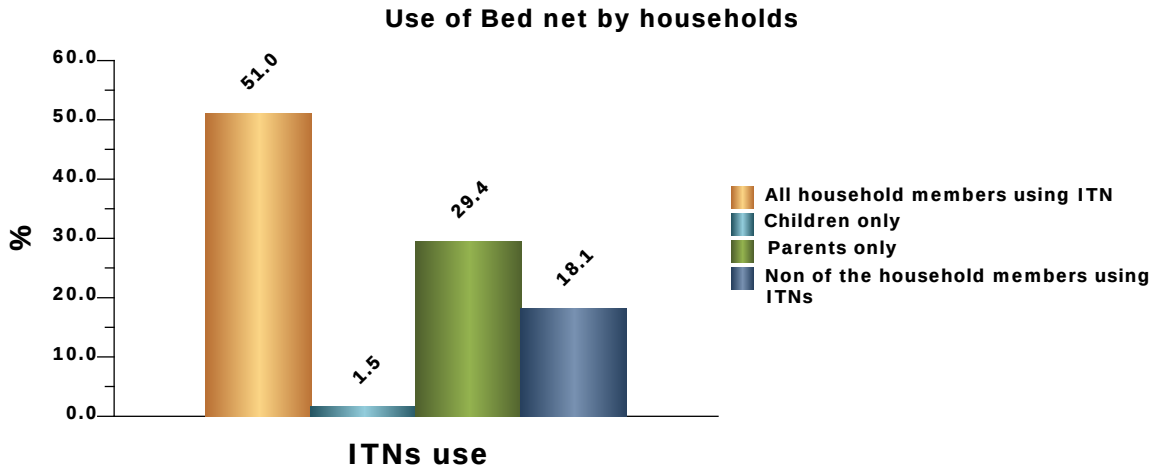

Figure 3.2: Overall usage of ITNs per household in Kasipul

4. Discussion

The data from 398 respondents indicated that 203 (51%) pupils possessed at least an ITN. The majority (90.16%) of the nets were blue-square type, reportedly obtained free from the government agencies. At least 79% of pupils with mosquito bed nets used them, on the eve of the survey and about 75% used them daily. 20.7% of pupils owning ITNs did not sleep under them the night before the interview. Some of the reasons for not using the nets were, forgetting to hang them, no mosquitoes in the house and hot weather conditions among others. A similar survey indicated an irregular bed net use, only 72.3% of all the nets possessed were in regular use in western Kenya[18]. However the reported overall use of ITNs among school children in this study was high (75%) compared to previous reports of 33 % bed net usage among pupils [19]. Over 60% of the children sampled reported using ITNs daily for the last four months. In recent years, primary schools in Africa have focused on education in disease prevention, including bed net use [11]. This deliberate education program may have contributed to the high prevalence of nets use among children in Kasipul. Highest daily ITNs utilization rate (84.6 %) was recorded in children aged between 9-11 years, compared to 70.6 % recorded in 12-14years age group, similar to studies in Gambia [20].

Despite about 80% of the pupils using nets daily, overall household utilization of the ITNs was 51%, which is

far below the universal bed net programme target, which was expected to increase household ITNs use by 80% in Kenya [21]. The findings are comparable to similar studies in western Kenya which reported that only 53% of households protect themselves using free insecticidal nets in Emuhaya district[22]. The current study revealed that, in about 30% of the households' only parents used ITNs; while in fewer cases the children were given preference of using nets, similar to earlier studies in Burkina Faso [20]. Among nine schools sampled Kokwanyo primary school had the highest overall pupil net possession of 73.3% compared to the least in Kalando primary. This indicates that universal bed net distribution campaign was not uniformly done in Kasipul. From the study results, both boys and girls owned nets similarly, similar to previous reports in Nigeria [23].

5. Conclusion

The study has revealed that universal coverage of ITNs was inadequate in Kasipul, making it difficult for all household members to use ITNs. Relatively high ITNs use reported in this survey despite low coverage (51%) of nets indicates an overall desire to deploy the nets by the pupils when they are available. The main obstacle to increased use of ITNs among pupils in Kasipul is the low coverage experienced at household level. Lack of educational campaigns accompanying universal net distributions was evident as 20.7% of net were not in regular use. The difference in ITNs ownership per school was significant, indicating that net distribution was not conducted uniformly in Kasipul and this requires future improvement.

6. Recommendation

The current study revealed that, in about 30% of the households' only parents used ITNs; while in fewer cases the children were given preference of using nets.

There is a need to intensify health education on the benefits of ITNs to create an understanding of the connection between malaria and mosquitoes, since the study revealed that 20.7% of pupils owning ITNs did not sleep under them the night before the interview. Due to logistical constraints, no effort was made to follow-up absent children, thus introducing potential selection bias, future surveys should strive to include pupils absent from school. More research on the physical integrity of the net in Kasipul is also required. For example: what is the rate of progression from good to poor condition.

Acknowledgments

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7. Abbreviations

ITN: Insecticide treated nets; MOH: Ministry of health.

Competing interests

The authors declare that they have no competing interests.

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