Utilisation of insecticide treated nets among pregnant women in Gulu: a post conflict district in northern Uganda

*Obol JH[1,4], Ononge S[2], Orach CG[3]

1. Department of Public Health, Faculty of Medicine, Gulu University, P.O Box 166, Gulu, Uganda
2. Department of Obstetrics and Gynaecology, Makerere University, P.O Box 7072, Kampala, Uganda
3. Department of Community Health and Behavioural Sciences, Makerere University, P.O Box 7072, Kampala, Uganda
4. Clinical Epidemiology Unit, Makerere University, P.O. Box 7072, Kampala, Uganda

Abstract

Background: Malaria during pregnancy causes severe anaemia, placental malaria or death to the mother while the fetus may be aborted or stillborn.

Objective: To establish the prevalence and factors associated with Insecticide Treated Net (ITN) utilisation among pregnant women in a post conflict Internally Displaced Persons (IDP) camps of Gulu district.

Methods: We conducted cross-sectional study in 20 IDP camps in which 769 pregnant women were interviewed for ITN utilisation the night before the survey. The 20 IDP camps were selected using simple random sampling technique as clusters. Households that had pregnant women were then consecutively selected. Data were entered in EpiData 3.1 and analyzed using STATA11.

Results: 35% of pregnant women (95% CI 31% - 38%) had utilised ITNs. Factors that promoted ITN utilisation includes: antenatal visit (AOR 1.90, p-value 0.000); ITN awareness (AOR 1.57, p-value 0.011), and willingness to purchase ITN (AOR 2.12, p-value 0.000). Factors which hinder ITN utilisation were: hours taken to reach health centre (AOR 0.64, p-value 0.050) and being single/widow/divorced (AOR 0.22, p-value 0.000).

Conclusion: Majority of the respondents were not utilising ITN. Therefore, leaders in Gulu district should encourage pregnant woman to acquire and use ITN to reduce their vulnerability to malaria.

Key words: Utilisation, ITN, pregnant women, post conflicts, internally displaced persons

African Health Sciences 2013; 13(4): 962 - 969 http://dx.doi.org/10.4314/ahs.v13i4.15

Introduction

Worldwide, nearly 500 million people suffer a malaria episode every year[1,2] and about 90% of all malaria deaths today occur in sub-Sahara Africa[2]. In Uganda, malaria accounts for about 30 - 50% of the outpatient burden and 35% of hospital admissions[3]. During pregnancy, malaria is a common cause of complications to both the mother and her unborn child. The mother may develop severe malaria[4], severe anaemia[5,6,7], placental malaria[4] or may die[8]. The fetus may be aborted, prematurely delivered or stillborn[8,9] and the baby may have a low birth weight[4,5].

The prevention and control of malaria during pregnancy is therefore crucial as it helps to promote the health of the mother and her unborn child. There are currently two methods for malaria control during pregnancy being promoted by Ministry of Health in Uganda. These are chemoprophylaxis using sulfadoxine – pyrimethamine (SP) and insecticide treated net (ITN)[3]. However non adherence to chemoprophylaxis, irregular, late or non antenatal clinic attendance, women not given Intermittent Presumptive Treatment (IPT) by midwife and drug stock outs in most health facilities in Uganda is common[10]. These problems would not be encountered by pregnant women who own an ITN and thus making ITN more effective mean of malaria prevention in Uganda among pregnant women.

Studies in Western Kenya had shown that ITNs were associated with reductions in the incidence of malaria parasitemia and incidence of severe malarial anemia[11]. The prevalence of placental or maternal malaria was reduced resulting in reduced risk of low birth weight babies[12,13]. Studies have shown that free distribution of ITNs leads to increase

***Corresponding author:**
Obol James Henry
Department of Public Health, Faculty of Medicine
Gulu University
P.O Box 166, Gulu
Uganda.
E-mail: obolh@yahoo.com

use[14] with 82% of participants reported using an ITN during pregnancy; 76% used it every night, and 79% reported a net re-treatment date within the last 6 months[15]. In Uganda, the national target of 50% of households to be covered with ITN by the year 2007 has not been met thus leaving many pregnant women at risk of malaria infection during pregnancies[3]. This study therefore aimed to establish the prevalence and factors associated with the utilisation of ITNs by pregnant women in post conflict Gulu district internally displaced person (IDP) camps.

Methods

We conducted a cross-sectional study using quantitative data collection techniques in the IDP camps of Gulu district which is a post conflict area in northern Uganda from March 3 – 19, 2009. Gulu is one of the districts which had been hit hard by the over two decades of arm conflict. The district has two counties and a Municipality. Generally life had been hard in Gulu district. People movement were restricted since the army had put curfew in both the Municipality and in the IDP camps. Most of the roads outlets outside the Municipality and IDP camps were planted with landmines. The IDP camps were situated in the two counties of Aswa and Omoro which were outside the Municipality. All the inhabitants of the IDPs lived in grass thatched hut or tents provided by the relief agencies. Lives in the IDP camps were generally hard as the population were cramped together in a small place. The IDPs were cut off from their farm land and were relying on relief food given by relief agencies. Few people in the IDP camps were able to have some petty businesses. Most of the health centres were non functional as staffs had abandon them due to insecurity. Also, in the IDP camps which do not have a government health facility, emergency relief organisation erected structures to provide some basic health care services. In all the IDP camps, health care services, education, water and sanitation were services provided by the emergency relief organisations and the United Nations.

Gulu district had thirty one (31) IDP camps with a population of 108,099 inhabitants as of June, 2008[16]. The district is a high transmission area for malaria in Uganda. Unpublished data summary from Health Management Information System (HMIS) record of Gulu for malaria cases among pregnant women from July 2007 to June 2008 indicates that on average there were four hundred fifteen (415) cases of malaria among pregnant women per month[17]. Because of the appalling life situation in IDPs camps, non governmental organisations (NGOs) had distributed ITNs to the IDP camps and others through antenatal clinics.

Sample size estimation and Sampling method

The sample size was estimated using the modified Kish and Leslie formula of 1965[18]

$n = [z^2pq/d^2]*2$Where: n = the sample size, z = the standard normal deviate (1.96 for a 95% confidence level), d = the level of precision desired (set at 0.05), p = the proportion of the population having ITN (0.5) (The proportion is unknown), q = the proportion of the population that does not have ITN (1-p) and 2 = Design effect. This gave sample size of 769 pregnant women.

A total of twenty (20) IDP camps were selected using simple random sampling as clusters for survey with ten (10) IDP camps in each County. The name of the IDP camps in each county was written on a piece of paper, folded and put inside a non transparent polythene bag for each county. The pieces of paper with the IDP camp name in them were then picked once at a time without putting it back into the polythene bag until we have generated the names of the 10 IDP camps in each of the two counties. The numbers of pregnant women to be interviewed in each IDP camp was determined using proportion to size cluster sampling method. The numbers of pregnant women to be interviewed in each IDP camp was got by dividing the population of pregnant women in the IDP camp by the total numbers of pregnant women in all the clusters and multiplying by the sample size (769). Within each IDP camp, we determined the centre first and then the direction of movement was got by spinning a bottle. The direction of movement was where the top faced when the bottle stopped spinning. We counted all the households from the centre to the end of the IDP camps/clusters. Each household was given a number on a piece of paper from the first to the last. To determine the starting household for the survey, we randomly picked a piece of paper containing the number assigned to the household. We then use consecutive sampling method by moving to the next nearest household to select pregnant women to be interviewed in each IDP camp.

The inclusion criteria for the study subjects were pregnant women who confirmed that they were pregnant and were resident of the twenty (20) selected IDP camps during the survey and present on the interview date who gave written informed consent to participate in the study. The study was approved by the Faculty of Medicine Research and Ethic Committee, Makerere University.

Data collection

Data was collected on socio-demographic characteristics, sources of ITN and ITN utilisation using a pretested, semi-structured questionnaire by trained research assistants. The respondents were asked whether they have slept under an ITN the night before the survey. ITN utilisation was taken as sleeping under an ITN the night before the survey. The questionnaire was translated into the local language (Acholi) and back translated to English to ensure consistency in meaning.

Data management and analysis

Data was entered into Epidata version 3.1, cleaned, coded, edited and exported to STATA version 11 for analysis. Categorical variables were displayed into frequencies and histogram while continuous variables were grouped into category using mean. We performed univariate, bivariate and multivariate analysis. Any factor at the bivariate level with p-value 0.2 was included in the multivariate analysis model to assess for interaction, confounding and also to determine the independent predictors of ITN utilization. We performed logistic regression model using the stepwise method for the predictors of ITN utilisation to first obtained the crude Odds Ratio and then run the model after adjusting for clustering of the data among the IDP camps. The result was considered to be statistically significance if the p-value < 0.05.

Results

A total of 769 pregnant women were interviewed with age ranging from 14 to 45 years with a mean age of 25.3years and standard deviation (SD) of 6.2. 571 (74%) of the pregnant women had formal education. 477 (62%) of the pregnant women were cohabiting. 442 (58%) of the pregnant women took an hour or more to reach health centre. 648 (84%) of the pregnant women were multigravidae. The mean number of births was 3.6 with SD=2.1 and it ranges from 1 - 13 births. The mean gestation age was 5.7 months and ranges from 1 – 10 months. The mean income was Uganda shillings 14406 with SD = 41858 Shillings and ranges from zero Shillings per month to Shillings 500,000 per month. Figure 1 shows Univariate results for prevalence of ITN utilisation among pregnant women from Gulu district IDP camps. Prevalence of ITN utilisation among pregnant women in a post conflict district of Gulu was quite low at 35% (95% CI 31% - 38%) only.

Table 1: Socio-demographic characteristics of respondents

Variable	n (%)
Age	
14 - 25	423 (55)
26 - 45	346 (45)
Education	
No Formal education	198 (26)
Had Formal education	571 (74)
Education level	
Primary	541 (95)
Secondary	026 (05)
Tertiary	002 (00)
Marital status	
Married	232 (30)
Single	058 (08)
Cohabiting	477 (62)
Divorced	001 (00)
Widowed	001 (00)
Religion	
Catholic	627 (82)
Anglican (Protestant)	088 (11)
Moslem	005 (01)
Pentecostal	046 (06)
Others	002 (00)
Time taken to reach Health unit in hours	
<1	442 (58)
>1	315 (42)
Gravidity	
Multigravidae	648 (84)
Primigravidae	121 (16)
Parity	
Para 0	127 (17)
Para 1 - 2	232 (30)
Para >3	410 (53)
Engage in business	
No	620 (81)
Yes	147 (19)
Awareness about ITN	
No	230 (30)
Yes	535 (70)
Being Employed (Salary earning)	
No	761 (99)
Yes	007 (01)
Gestation age in Trimesters	
First Trimester	152 (20)
Second Trimester	296 (39)
Third Trimester	314 (41)
Income per month	
<Shs 14406	600 (79)
>Shs 14406	160 (21)

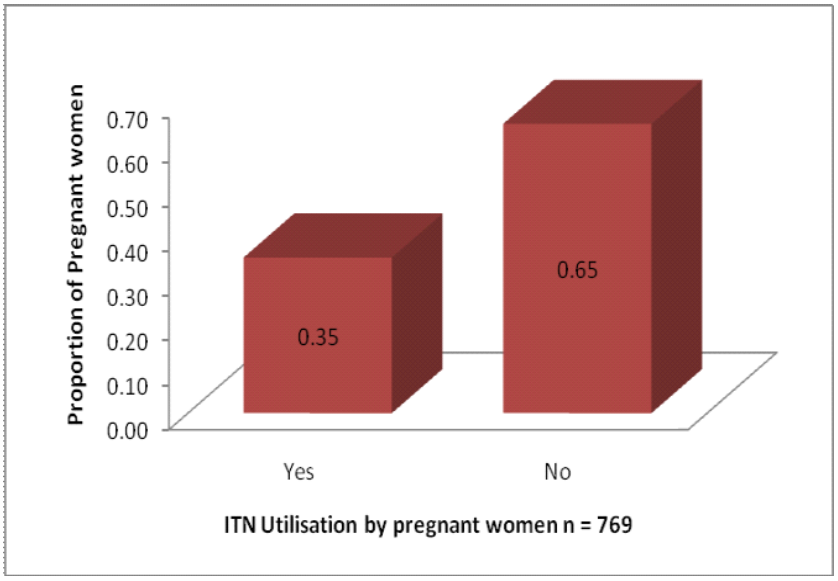

Figure 1: Prevalence of Insecticide treated net (ITN) utilisation

Factors which promoted ITN use at the bivariate level were ante-natal attendance (OR = 1.99, 95% CI 1.42 - 2.79, p-value 0.000), willingness to purchase ITN (OR = 2.51, 95% CI 1.83 – 3.44, p-value 0.000), being engaged in business (OR = 1.56, 95% CI 1.08 - 2.26, p-value = 0.017) and awareness about ITN (OR = 1.61, 95% CI 1.15 - 2.26, p-value = 0.005). Factors which hinder ITN utilisation among pregnant women were being Single/Widow/Divorce (OR = 0.19, 95% CI 0.08 - 0.45, p-value = 0.000) and time taken to reach health centre in hours (OR = 0.69, 95% CI = 0.50 - 0.94, p-value = 0.017). Table 2 summarises results for bivariate analysis of factors associated with ITN utilisation.

Table 2: Bivariate analysis of factors associated with ITN utilisation

Variables	Frequency	Utilised ITN		OR	95% CI	P-value
	N	Yes	No			
Age						
14 - 25	423	157	262	1.00		
26 - 45	346	114	232	0.84	0.62 – 1.14	0.262
Education						
No Formal education	198	063	135	1.00		
Had Formal education	571	208	363	0.80	0.57 – 1.14	0.214
Religion						
Catholic	627	219	408	1.00		
Anglican (Protestant)	088	027	061	0.82	0.51 - 1.33	0.427
Moslem	005	002	003	1.24	0.21 - 7.48	0.815
Pentecostal	046	021	025	1.56	0.85 - 2.86	0.145
Others	002	000	002	0.00		0.300
Engage in Business						
No	620	205	415	1.00		
Yes	147	064	083	1.56	1.08 - 2.26	0.017
Marital status						
Married/Cohabiting	709	263	446	1.00		
Single/Widow/Divorce	060	006	054	0.19	0.08 - 0.45	0.000
Willingness to purchase ITN						
No	382	096	286	1.00		
Yes	374	171	203	2.51	1.83 - 3.44	0.000

Continuation of table 2

Variables	Frequency N	Utilised ITN Yes	No	OR	95% CI	P-value
Time taken to reach Health Unit in hours						
<1	442	169	273	1.00		
>1	315	094	221	0.69	0.50 - 0.94	0.017
Awareness about ITN						
No	230	064	166	1.00		
Yes	535	205	330	1.61	1.15 - 2.26	0.005
Sources of Information about ITN						
From Community	095	029	066	1.00		
Health Centre	202	096	106	2.06	1.22 - 3.48	0.006
Radio	228	077	151	1.16	0.69 - 1.95	0.572
ITN Sources						
Given from Health Centre	233	200	033	1.00		
Given by NGO	041	029	012	0.40	0.18 - 0.87	0.016
Bought it Myself	041	034	007	0.80	0.33 - 1.96	0.627
Others	008	005	003	0.28	0.06 - 1.22	0.069
Ante-Natal Visit						
No	255	064	191	1.00		
Yes	512	205	307	1.99	1.42 - 2.79	0.000
Income per Month						
<Shs 14406	600	205	395	1.00		
>Shs 14406	160	064	096	1.29	0.90 - 1.85	0.163
Gestation Age (Months)						
First Trimester	152	041	111	1.00		
Second Trimester	295	100	195	1.39	0.90 – 2.14	0.136
Third Trimester	314	126	188	1.81	1.18 – 2.78	0.006

The study showed that pregnant women who are single/widow/divorce were significantly less likely to utilise ITN than married/cohabiting pregnant women (AOR = 0.21, 95% CI 0.09 – 0.46, p-value = 0.000) and pregnant women who take more than one hour to reach health unit were significantly less likely to utilise ITN than their counter part who take an hour or less to reach health centre (AOR = 0.64, 95% CI 0.40 – 1.00, p-value = 0.050). However, pregnant women who were aware of ITN were 1.65 times more likely to utilise ITN than pregnant women who were not aware of ITN (AOR = 1.65, 95% CI 1.17 – 2.32, p-value = 0.004). Also pregnant women who were willing to purchase ITN were 2.37 times more likely to utilise ITN than those who were not willing (AOR = 2.37, 95% CI 1.43 – 3.93, p-value = 0.001), and pregnant women who have gone for antenatal visit were 1.83 times more likely to utilise ITN than those who have not gone for antenatal services (AOR = 1.83, 95% CI 1.25 – 2.66, p-value = 0.002).

Table 3: Logistic regression analysis of predictors of ITN utilisation among pregnant women

Variables	Crude OR	95% CI (P-value)	Adjusted OR	95% CI (P-value)
Being Single/Widow/Divorce	0.21	0.08 - 0.54 (0.001)	0.21	0.09 - 0.46 (0.000)
Awareness about ITN	1.65	1.15 - 2.37 (0.007)	1.65	1.17 - 2.32 (0.004)
Willing to buy ITN	2.37	1.71 - 3.27 (0.000)	2.37	1.43 - 3.93 (0.001)
Antenatal Visit	1.83	1.28 - 2.60 (0.001)	1.83	1.25 - 2.66 (0.002)
Time taken to reach Health Unit in hours	0.64	0.46 - 0 .88 (0.007)	0.64	0.40 - 1.00 (0.050)

Variables in the model were adjusted for clustering of data among the IDP camps

Discussion

Our study indicates that ITN utilisation by pregnant women in Gulu district IDP camps was low at about only 35% compared with national target of 50% to have been achieved by the year 2007[3]. This low ITN utilisation could be because of fewer pregnant women owning at least one ITN in Gulu district IDP camps as shown by the result of the Uganda Demographic and Health Survey (UDHS) of 2006 which indicates that 41.8% of the households in the IDP camps had at least one ITN. The report further reveals that only 20.9% of pregnant women had slept under an ITN a night before the survey in the IDP camps[19]. Our finding was similar to other studies done in Luwero district of central Uganda which showed that 31.3% of pregnant women reported using mosquito net during their previous pregnancy[20], in Ethiopia which indicates that 58% of pregnant women slept under ITN[21] and in Kenya which found that only 5% of pregnant women slept under ITN[22]. Our study has revealed several factors that promoted ITN utilization including ANC attendance, awareness about ITN and willingness to purchase ITN. The findings revealed that those who have at least attended ante-natal services were 1.83 times more likely to utilise ITN than those who had not (p-value = 0.002). This could be explained by the fact that those who initially had no ITN got it from health centre during ANC visit and was told the benefits of utilising ITN. A study by Gikandi *et al* in Kenya found that more than half of the net used by pregnant women were obtained from antenatal clinics[23]. Also, those who were having ITN were encouraged to utilise their ITN because of the benefits that they and their unborn baby will have if she utilise ITN. Also, warning of the consequences of not utilising ITN both to her and her unborn baby could have been given which ensure compliance with ITN utilisation.

Also pregnant women who had indicated that they would be willingness to purchase ITN were 2.37 times more likely to utilize ITN than those who were not willing to purchase ITN (p-value = 0.001). This could be attributed to the benefits of using ITN which they knew and that is why they were willing to purchase ITN. Other studies have indicated that cost was a barrier to ownership and use of ITN[24,25,26]. In our study, the majority of ITNs owned by the pregnant women were provided through health centres which were free of charge.

The pregnant women who reported to be aware of ITN were 1.65 times more likely to utilise ITN than those who were not aware of ITN (P-value = 0.004). However, when this was stratified according to the various sources, those who attributed hearing about ITN for the first time from health centre were about twice more likely to utilise ITN than those who reported hearing from the community (P-value = 0.006). While those who reported hearing about ITN for the first time over the radios were about 1.2 times more likely to utilise ITN though this was not statistically significant (P-value > 0.05). This could be because in the health centres, pregnant women are usually taught on the importance of protecting themselves against malaria during pregnancy and the danger associated with malaria during pregnancy to themselves and their unborn babies. Pregnant women who indicated that they have heard about ITN from within community were less likely to utilise ITN because the message given to them may not stress the importance of ITN utilisation by pregnant women and thus fail at influencing ITN utilisation. Other study had found that having ever heard a message about ITN was not associated with ITN use[27].The study also revealed other factors that hindered ITN utilisation including marital status i.e. being single/widowed/divorce and time taken to reach Health Unit in hours. Marital status when adjusted for clustering was found to be highly significant at determining ITN utilisation with pregnant women who were single/widow/divorce were 0.21 times less likely to utilise ITN than married/cohabiting pregnant women (P-value = 0.000). This could be because of social support that married women received from their husbands, i.e. reminding them in case they had forgotten to hang their ITN up or encouraging them to use their ITN in case they are feeling lazy/reluctant to use ITN. Similar results were obtained in other studies[14,27]. Also a study in Kinshasa among pregnant women indicated that husbands were supportive of their wives to sleeping under their nets[29].

We found that the time taken to reach health unit in hours was significant at determining ITN utilisation with those who reported to take more than an hour to reach health unit were 0.64 times less likely to utilise ITN than those who took an hour or less to reach health unit (P-value = 0.050). Similar result was obtained in a study by Gikandi *et al* where fewer women reported ITN use if they lived more than an hour walking distance to ante-natal clinic[23]. This could be because of lack of transport to the health unit or because of social responsibility in the home which can not make them free and they missed

out ITN and vital health messages from the antenatal clinics, which could have influence over their attitude toward ITN utilisation.

Conclusion

Majority of the pregnant women in the post conflict IDP camps in Gulu district had not utilised ITN. Only about a third of the pregnant women had utilized ITN which is below the 50% target set by the Ministry of Health of ITN coverage among vulnerable people by the year 2007.

Recommendations

Stakeholders (Ministry of Health and NGOs) should ensure adequate supply of ITN to pregnant women who live in post conflict areas like Gulu district and also sensitise them on the benefits of ITN utilisation. Also, leaders in the post conflict areas should encourage pregnant women to acquire and use ITN as a mean of reducing their vulnerability to malaria disease since they live in housing that offers little protection against mosquitoes.

Acknowledgements

The authors acknowledge with thanks the following: Gulu University Faculty of Medicine, Makerere University Clinical Epidemiology Unit and the Belgian Technical Cooperation in Uganda for their Scholarship which made this study possible.

References

1. WHO. The World Health Report, Making a Difference; 1999. Downloaded on 31/3/2008 at http://www.who.int/whr/1999/en/whr99en.pdf.
2. WHO. The African Malaria Report 2003 from WHO and UNICEF; 2003. Downloaded on 31/3/2008 at http://www.rbm.who.int/amd2003/amr2003/amr_doc.htm.
3. Ministry of Health. Republic of Uganda. Annual Health Sector Performance Report; October 2007.
4. Stephen JR, Elena P, Abera G, Eyob T, Valentino ML & Malcolm EM. Placental Monocyte Infiltrates in Response to Plasmodium Falciparum Malaria Infection and Their Association With Adverse Pregnancy Outcomes. *Am. J. Trop. Med. Hyg* 2003; 68**:** 115 -119.
5. Adeyemi AS, Adekunle DA and Akinota SE. Use of Prevalence of insecticide treated mosquito bednets among pregnant population in Osogbo, Nigeria. *Nigerian Medical Pract* 2007; 52 (2): 29-3.
6. Brabin BJ. An analysis of malaria in pregnancy in Africa. *Bulletin of the World Health Organization* 1983; 61: 1005–1016.
7. Menendez C. Malaria during pregnancy: a priority area of malaria research and control. *Parasitology Today* 1995; 11: 178–183.
8. Menendez C, Ordi J, Ismail MR, Ventura PJ, Aponte JJ, Kahigwa E, Font F & Alonso PL. The Impact of Placental Malaria on Gestational Age and Birth Weight. *The Journal of Infectious Diseases* 2000; 181**:** 1740–1745.
9. Steketee RW, Nahlen BL, Parise ME, Menendez C: The Burden of Malaria in Pregnancy in Malaria-Endemic Areas. *Am. J. Trop. Med. Hyg* 2001; 64**:** 28-35.
10. Ndyomugyenyia R and Katamanywa J. Intermittent preventive treatment of malaria in pregnancy (IPTp): do frequent antenatal care visits ensure access and compliance to IPTp in Ugandan rural communities? *Transactions of the Royal Society of Tropical Medicine and Hygiene* 2010; 104: 536–540
11. Gamble C, Ekwaru JP & Ter Kuile FO. Insecticide-treated nets for preventing malaria in pregnancy. *Cochrane Database Systematic Reviews* 2006; CD003755.
12. Ter Kuile FO, Dianne JT, Penelope APH, *et al.* Reduction of Malaria during Pregnancy by Permethrin-Treated Bed Nets in an Area of Intense Perennial Malaria Transmission in Western Kenya. *Am. J. Trop. Med. Hyg* 2003; 68: 50-60.
13. William AH, Ter Kuile FO, Steketee RW, *et al.* Implications of the Western Kenya Permethrin-Treated Bed Net Study for Policy, Program Implementation, and Future Research. *Am. J. Trop. Med. Hyg* 2003; 68: 168–173.
14. Marchant T, Schellenberg JA, Edgar T *et al.* Socially marketed insecticide-treated nets improve malaria and anaemia in pregnancy in southern Tanzania. *Tropical Medicine and International Health* 2002; 7: 149–158.
15. Van Eijk AM, Blokland IE, Slutsker L *et al.* Use of intermittent preventive treatment for malaria in pregnancy in a rural area of western Kenya with high coverage of insecticide-treated bed nets. *Tropical Medicine and International Health* 2005; 10**:** 1134-1140.
16. United Nation High Commissioner for Refugee unpublished data from Gulu office 2008.
17. Gulu district Health Management and Information System record. Unpublished data from July 2007 - June 2008.

18. Kish Leslie et al. survey sampling. John Wiley and Sons NY. 1965.
19. Uganda Bureau of Statistics. Uganda Demographic and Health Survey report 2007.
20. Mpungu KS & Mufubenga P. Use of antenatal care, maternity services, intermittent presumptive treatment and insecticide treated bed nets by pregnant women in Luwero district, Uganda. *Malaria Journal 2008;* 7.
21. Mebrahtom B and Wakgari D. Use of insecticide treated nets by pregnant women and associated factors in a pre-dominantly rural population in northern Ethiopia. *Tropical Medicine and International Health 2008;* 13: 1303–1313.
22. Guyatt HL, Noor AM, Ochola SA & Snow RW. Use of intermittent presumptive treatment and insecticide treated bed nets by pregnant women in four Kenyan districts. *Tropical Medicine and International Health* 2004; 9**:** 255-261.
23. Gikandi PW, Noor AM, Gitonga CW, Ajanga AA & Snow RW. Access and barriers to measures targeted to prevent malaria in pregnancy in rural Kenya. *Tropical Medicine and International Health* 2008; 13**,** 208-217.
24. Noor AM, Omumbo JA, Amin AA, Zurovac D, Snow RW. Wealth, mother's education and physical access as determinants of retail sector net use in rural Kenya. *Malar J* 2006; 5.
25. Guyatt HL, Ochola SA, Snow RW. Too poor to pay: charging for insecticide-treated bednets in highland Kenya. *Trop Med Int Health* 2002; 7: 846-50.
26. Osero JS, Otieno MF, Orago AS. Mothers' knowledge on malaria and vector management strategies in Nyamira District, Kenya. *East Afr Med J* 2006; 83: 507-14.
27. Gashaw D and Wakgari D. Knowledge and Utilisation of insecticide treated mosquito nets among freely supplied households in Wonago Woreda, Southern Ethiopia. *Ethiop. J.Health Dev.* 2008; 22: 34-41
28. Kagoma SM, Kabalimu TK & Mbaruku G. Determinants of Utilisation of Mosquito Bednets for Malaria Prevention among Pregnant Women in Kigoma Urban District, Western Tanzania. *East African Journal of Public Health* 2006; 3**:** 31 -34.
29. Audrey P, Eboni T, Nku D *et al.* Free distribution of insecticide treated bed nets to pregnant women in Kinshasa: an effective way to achieve 80% use by women and their newborns. *Tropical Medicine and International Health* 2009; 14: 20–28.