

Research

Open Access

Sleeping arrangements and mosquito net use among under-fives: results from the Uganda Demographic and Health Survey

Frederick Mugisha*¹ and Jacqueline Arinaitwe²

Address: ¹African Population and Health Research Center (APHRC), Kenya Shelter Afrique Center, Longonot Road, Upper Hill, P.O Box, 10787 – 00100, GPO Nairobi, Kenya and ²CARE International in Uganda, Kampala, Uganda

Email: Frederick Mugisha* - fmugisha@aphrc.org; Jacqueline Arinaitwe - arinaitwej@yahoo.co.uk

* Corresponding author

Published: 14 November 2003

Received: 12 July 2003

Malaria Journal 2003, 2:40

Accepted: 14 November 2003

This article is available from: <http://www.malariajournal.com/content/2/1/40>

© 2003 Mugisha and Arinaitwe; licensee BioMed Central Ltd. This is an Open Access article: verbatim copying and redistribution of this article are permitted in all media for any purpose, provided this notice is preserved along with the article's original URL.

Abstract

Background: The Roll Back Malaria Initiative has identified the under-fives as one of the high risk groups for malaria, and one of the strategies to fight malaria in this group is increasing mosquito net use. This implies that there must be selective targeting at the household level such that the children are protected. However, the Roll Back Malaria preferences must be reconciled with those at the household level to take into account household level preferences.

Methods: This paper is based on the 2000–2001 Uganda Demographic and Health Survey data in which information on mosquito net ownership and use was collected. The patterns of household mosquito net ownership and use for children under five years of age were examined using both bivariate and multivariate analysis.

Results: The preferences at the household level seem to be different; children use mosquito nets primarily because they happen to share a bed with their parents. A child who shares a bed with the mother is 21 times more likely to use a mosquito net than his/her counterpart.

Conclusion: Increasing mosquito net coverage such that 60% (the target for the RBM) of households have at least one mosquito net will not necessarily protect the under-fives. Either the coverage will have to be expanded or appropriate targeting strategies designed.

Background

The health burden of malaria is immense. Malaria-related illness kills at least one million people each year, and most of these deaths are among African children [1]. Nearly 500 million people suffer a malaria episode every year [2]. Despite decades of effort to combat it, malaria continues to account for 20 per cent of under-fives mortality in Africa and constitutes 10 per cent of the continent's overall disease burden [3]. Malaria also has severe negative effects on maternal health and birth outcomes. Malaria causes anaemia, is associated with increased risks of miscarriage, and is responsible for one third of prevent-

able low birth weight [4]. The rapid expansion of resistance to what were once effective anti-malarial drugs has made the battle against malaria even more urgent as we enter the twenty-first century.

Insecticide-treated bed nets (ITNs) are amongst the most effective tools at our disposal for reducing malaria transmission and mortality. A series of trials in Africa have shown that proper mosquito net use reduces malaria incidence among children by anywhere from 14 to 63 per cent [5]. With ITN use, all cause-mortality in children has been shown to decline by 25 per cent in The Gambia [6], 33 per

cent in Kenya [7], and 17 per cent in Ghana [8]. Based on findings such as these, the promotion of ITN use has become a central element of national and international efforts against malaria. While the evidence base on the effectiveness of ITNs in reducing malaria transmission has grown rapidly in recent years, utilization rates for ITNs in most African countries have not. In most malaria endemic regions, fewer than 10 per cent of children or pregnant women regularly sleep under ITNs. For example, based on the Uganda Demographic and Health Survey (UDHS), it is estimated that only 13 percent of households in Uganda own a mosquito net and eight per cent of under-fives usually use them [9]. Those who use insecticide treated mosquito nets are even fewer. The Uganda Demographic and Health Survey data was used to explore the relationship between mosquito net use and sleeping arrangement among the under-fives.

The African summit on Roll Back Malaria (Abuja, Nigeria, April 2000) set an ambitious target for expanding ITN use in Africa – at least 60% coverage of high-risk groups by the year 2005 [2]. Achieving this goal will not only require a massive increase in ITN acquisition, but also in selective targeting of those most at risk – under-fives and pregnant women.

The under-fives pose a challenge compared to the pregnant women. The elusive question is whether mosquito nets provided to the under-fives will reach them. Do all the under-fives have equal opportunity to use the mosquito nets or will they be transferred to the adults in the household? This paper explores the current mosquito net use among the under-fives in relation to the sleeping arrangements in the household. The over-riding assumption is that if children who sleep under mosquito nets are more likely to share a bed with their mothers in households with at least one mosquito net, then the primary person being protected is not the child; the child benefits because it happens to share a bed with the parent.

Materials and Methods

The Data set

The paper is based on the 2000–2001 Uganda Demographic and Health Survey (UDHS). The Demographic and Health Surveys are usually designed to collect information on demographic, health and family planning. The 2000–2001 survey was expanded in scope to include a detailed module on malaria. This module elicited information on the ownership and use of mosquito nets, and detailed treatment seeking behavior for malaria [9]. The data is also publicly available at http://www.meas_ure-dhs.com.

Sample design and implementation

The sample consisted of a two-stage design. The first-stage sample frame was a list of Enumeration Areas (EAs) compiled from the 1991 Population Census. In this frame, the EAs were grouped by parish within a sub-county, by sub-county within a county and by county within a district. A total of 298 EAs (102 in urban areas and 196 in rural areas) were selected. Urban areas and districts included in the Delivery of Improved Services for Health (DISH) project and the Community Reproductive Health Project (CREHP) were over-sampled in order to produce estimates for these segments of the population. Within each selected EA, a complete household listing was done based on the 1991 census and updated in the field to provide the basis for the second-stage sampling. The number of households to be selected in each sampled EA was allocated proportionately to the number of households in the EA. However, due to insecurity, four out of 45 districts with approximately five per cent of the population were not included in the survey. A total of 8,792 households were selected in the sample, of which 8,234 were occupied. The short fall was largely due to structures that were found to be vacant. Of the existing households, 7,885 were successfully interviewed, yielding a household response rate of 96 per cent. About 42 per cent of the households had no children under-five years, and in those that did, the average was close to two children (1.8) per household, and the gross (for all households) average was one child per household.

Questionnaires

Three questionnaires were used; the household's, the women's and the men's questionnaires. The household questionnaire was used to list all usual members and visitors in the selected households. Some basic information on sex, age, education and household characteristics, such as source of water, toilets, housing characteristics and ownership of various durable commodities was collected. Of particular interest to this paper, the household questionnaire collected information on whether the household owned a mosquito net and if children in that household slept under a mosquito net. The women's questionnaire was administered to all women aged 15–49 years of age. The women were asked questions related to their background, reproduction and sexual activity, and maternal and child care. For each surviving child born in the preceding five years, detailed information on mosquito net use, their illness and treatment seeking behavior was collected. The men's questionnaire was administered to all men aged 15–54 years of age living in every third household in the UDHS women sample. The men's questionnaire collected information similar to the women's questionnaire but omitted reproductive history and child care.

Variable definition

Individual child characteristics, those of the parents and the household are likely to determine the use of mosquito nets in children under-five years old. These characteristics included the age and sex of the child; those of the parents included their education level, employment status, and exposure to information on the usefulness of mosquito nets, mainly through the media. The household attributes likely to affect mosquito net use in under-five year olds are its income or socioeconomic status, who in the household takes final decisions on issues of expenditure, particularly in relation to health care, whether the household is located in a rural or urban setting, the number of children under five years of age, and whether the household is headed by a male or female. With regard to malaria transmission, the altitude and region where a household is located is also likely to be a determinant.

In this paper, the education level has three categories, 1) no formal education, 2) primary, and 3) secondary and post secondary levels, which correspond to zero, 1–7 years, 8–11 years and more than 11 years of formal schooling. The wealth index was used as a proxy for socioeconomic status of a household. Using factor analysis, the most important household owned durable goods were identified. These were used to categorize households into quintiles by socioeconomic status [9]. For example, ownership of a radio or television is a measure of access to mass media; access to a telephone measures access to efficient means of communication; cupboard and refrigerator ownership indicates the capacity for hygienic storage of foods and utensils; lantern ownership indicates a source of lighting; and ownership of bicycle, motorcycle, boat/canoe, or private car shows the means of transport privately available to the household. Ownership of these items, in turn, has a bearing on the household's access to information and health care – including mosquito nets. Districts included in the survey were categorized as 1,000–1,500 metres, 1,500–2,000 metres, and 2,000–3,000 metres of altitude.

Statistical analysis

Household mosquito net ownership and use among the under-fives were first explored using descriptive statistics. Then multivariate analysis was used to examine differentials in mosquito net use. Where the outcome of interest is a binary choice variable, as in this case of whether a child usually sleeps under a mosquito net, estimation was by the logit model, primarily due to the desire to obtain estimates of odds ratios. [Estimation with the probit model, not unsurprisingly, makes no meaningful difference to the results, and accordingly, only results from the logit estimation are reported.]

Model specification

In the model specification, whether children usually sleep under mosquito nets is considered, regardless of the net treatment status. This is because first, the number of children with treated mosquito nets is so small and second increasing mosquito net usage is a precondition for increasing mosquito net treatment. Once there is a mosquito net in the household, whether children sleep under it or not is no longer a question of the price rather personal and behavioural factors of both parents, in addition to characteristics of an individual child and the household.

Considering the characteristics of a child first, there is evidence in the literature, especially from South-East Asia that females are at a disadvantage when it comes to household resource allocation. [10,11]. The age of a child is another factor that possibly could determine whether a child sleeps under a mosquito net. The hypothesis is that if there is more than one child in a household, then preference would be given to the young one. In a recently completed study in Uganda [12], a number of advantages were given in favour of having under-fives sleeping under a mosquito net, avoiding being bitten by mosquitoes (81%), avoiding getting malaria (62%), keeping warm (22%) and avoiding other pests (17%). Clearly, from the advantages mentioned, they all had to do with protecting the young child. It would, therefore, be reasonable to assume that the young child has preference.

Maternal characteristics which will influence whether children sleep under mosquito nets include her education, exposure to the media and whether she works outside the home. All these factors are related to exposure to information and the level of understanding regarding protective measures. Exposure to the media is defined as 1 if the mother reads a newspaper, listens to a radio or watches television at least once a week and 0 otherwise. The hypothesis is that if a mother is exposed to knowledge and has a higher understanding, then her children are more likely to sleep under the mosquito net once one is available within the household. Similar characteristics of the husband, such as education and employment are regarded as having the same effect.

The household characteristics considered include sex of the household head, wealth of the household, type of residence (urban or rural), number of children under-fives, and whether the mother has final say in seeking health care. There is evidence that women are more likely to spend their money on their children than men [13] and, therefore, in households headed by women, children are more likely to sleep under mosquito nets once available. This argument holds for households where the mother has the final say on seeking health care.

Table 1: Possession of Mosquito nets: Households that own at least one mosquito net

Background characteristic	Percent of households that own at least one net	Total number households sampled	Percentage of children under age 5 living with mothers who:		
			usually sleep under a mosquito net	slept under a mosquito net last night	Number
Region					
Central	15.3	2,603	8.4	7.5	2,173
Eastern	15.4	2,106	11.0	9.9	2,305
Northern	14.6	1,191	10.6	9.6	1,316
Western	5.5	1,985	2.4	2.2	1,878
Residence					
Urban	32.9	1,174	23.3	21.1	821
Rural	9.2	6,711	6.3	5.6	6,850
Altitude in meters					
1000–1500 m	14.6	5,642	9.5	8.5	5,398
1500–2000 m	9.5	1,758	5.6	5.0	1,855
2000–3000 m	3.1	485	1.8	1.8	419
Wealth Index Quintile					
Lowest	7.1	1,772	6.0	5.8	1,745
Next to lowest	10.2	1,636	6.2	5.8	1,678
Middle	7.0	1,475	5.8	5.1	1,565
Next to highest	8.1	1,449	5.0	4.1	1,457
Highest	31.9	1,554	20.3	17.9	1,228
Sex of household head					
Male	12.9	5,714	7.8	7.0	3,814
Female	12.5	2,171	8.4	7.5	3,858
Total	12.8	7,885	8.1	7.3	7,672

Household wealth or socioeconomic status is a tricky factor. It is expected that the rich are more likely to own mosquito nets, and, therefore, the proportion of children sleeping under mosquito nets is larger in rich households. However, is it the case when the net is already available in the household? It is proposed and argued that perceived vulnerability is higher among the poor because of the limited options available to them once the child gets sick. So it is likely that children from poorer households are likely to sleep under a mosquito net once it is available in the household.

Additionally, urban households generally have better incomes than rural households and therefore are thought to own mosquito nets, but what of their use among the under-fives? Whether it is also related to more perception of the level of vulnerability in rural areas or the inability for the wealth index to capture incomes levels, is unclear. It is proposed that under-fives in rural households are more likely to use mosquito nets, given that one is available in the household. Factors relating to the area of residence, including altitude and region, were also considered.

Based on the above, the equation for use of mosquito nets among under-fives is as follows:

$$\cup (C, H, F, M, A)$$

where C, H, F, M, A are vectors of the child, household, partner, husband or father, mother, and area characteristics.

Results

Ownership, use and treatment of mosquito nets

Table 1 shows the selected background characteristics of households that own mosquito nets, under-fives who usually sleep under a mosquito net, and whether they slept under the net the night preceding the survey.

The results show that only thirteen per cent of households in Uganda have mosquito nets. Mosquito nets are less available in households in the western region than in the other regions (six per cent compared to fifteen per cent). Comparing this to malaria endemicity in the country, out of the ten districts in the western region, seven are considered non-endemic (see figure 1), although the country is considered endemic to malaria. The mapping in figure 1

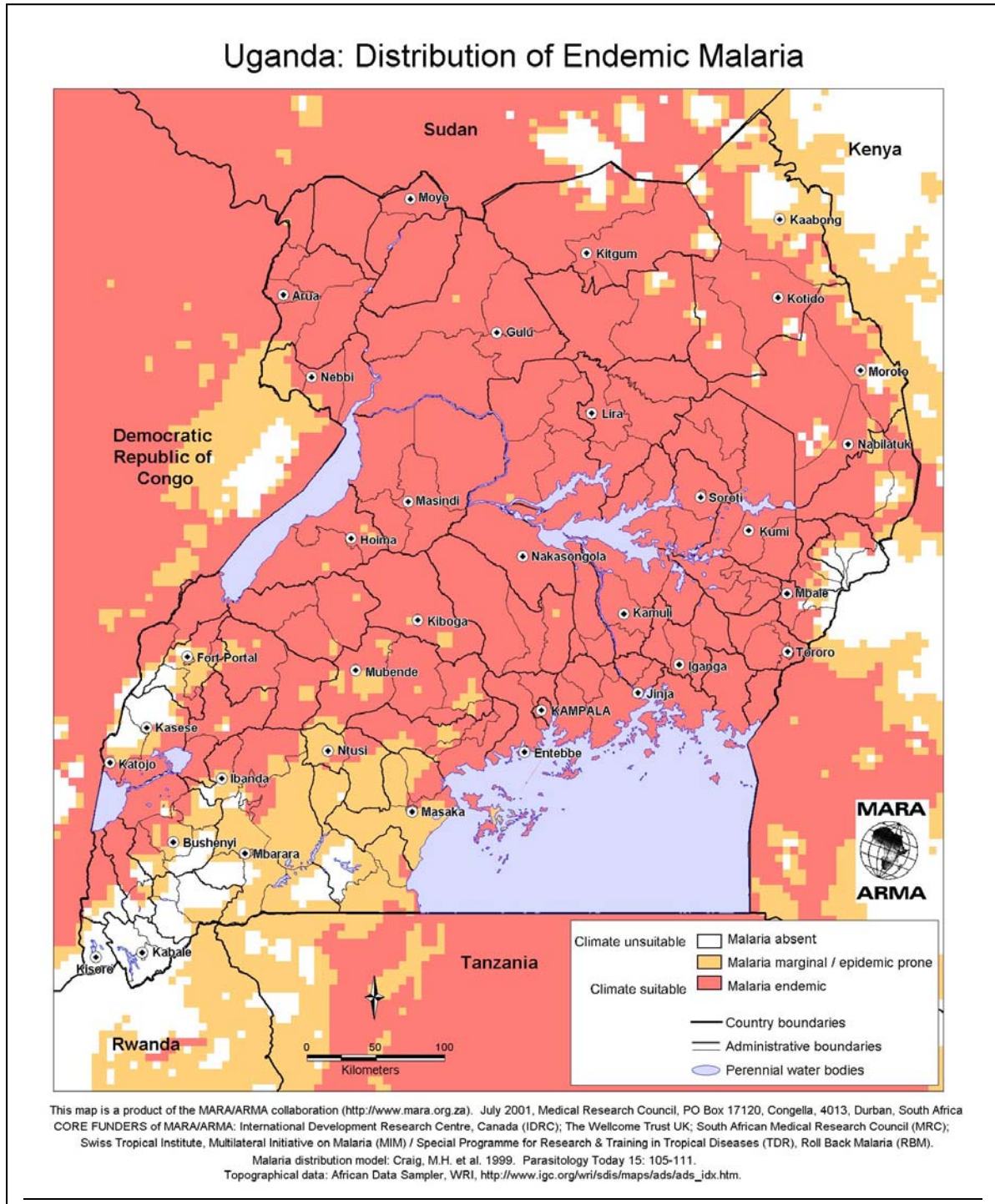


Figure 1

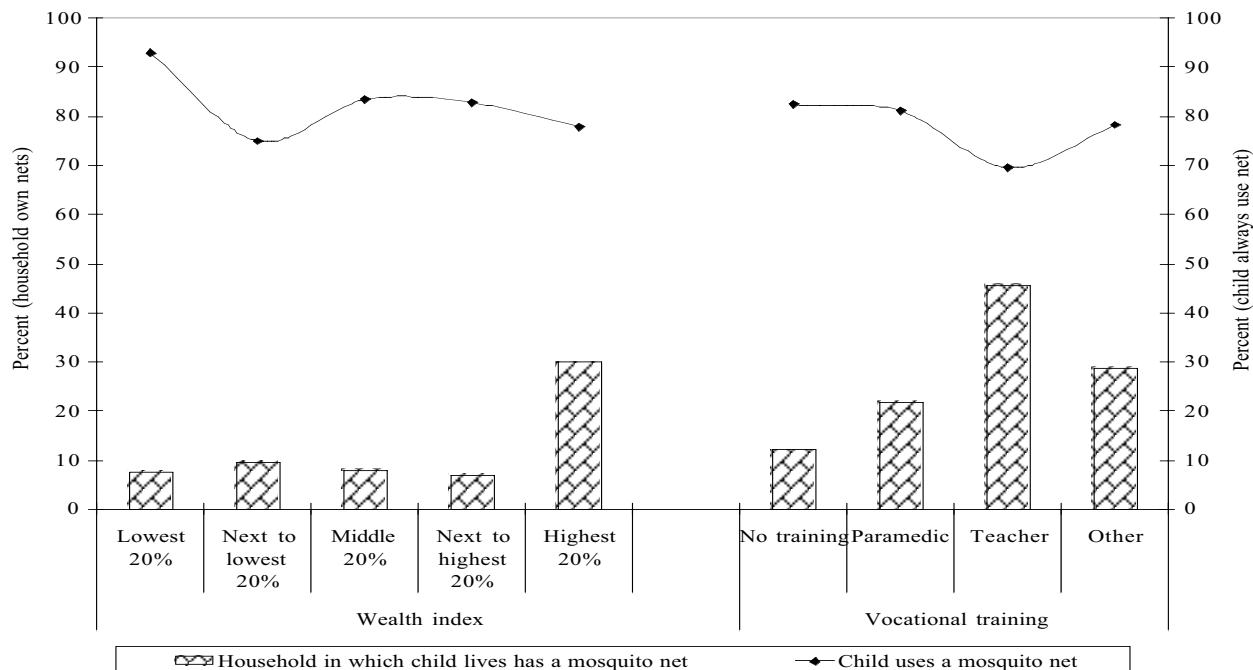


Figure 2

shows the theoretical suitability of local climatic conditions to malaria. However, areas where climate is "unsuitable", may actually have endemic malaria because of the presence of surface water, as it is increasingly becoming the case with Kabale district considered to be malaria free, according to climate suitability. [14,15]. Urban households are more than three times more likely to have a mosquito net than rural households. The proportion of children from households in the highest 20 per cent of the wealth index quintile use mosquito nets compared to the lowest 20 per cent. Households in lowland districts are also more than four times more likely to have mosquito nets than those in highland districts. Households headed by male and female have similar levels of net ownership.

The last three columns in table 1 refer to under-fives who live with their mothers in the same household. Eight per cent of these children usually sleep under a mosquito net, and seven per cent spent the night before the survey under a mosquito net. As there are fewer mosquito nets in the Western province, a smaller proportion of children from this province sleep under the mosquito nets. However, notice that, comparatively, fewer children sleep under mosquito nets in the central province, since the difference between ownership and use is slightly larger than the rest. The eastern province has the highest percentage of chil-

dren sleeping under mosquito nets. Urban children are more than three times more likely to sleep under mosquito nets. A lower proportion of children from high altitudes (2,000–3,000 metres) districts a sleep under mosquito nets compared to districts at low altitudes (1,000–1,500 metres). The sex of the household head and the child does not seem to affect whether one usually sleeps under a mosquito net or just the night before the interview. A higher proportion of children in the wealthiest 20 per cent of the households sleep under mosquito nets compared to the poorest 20 per cent.

Figure 2 shows the percentage of households with children under-five years of age that own mosquito nets, and percentage of children who live with their mothers in these households that always use mosquito nets classified by household wealth index and vocational training of the mother. From the figure, households in the wealthiest 20 per cent own more nets than the poorest 20 per cent, although the ownership does not seem to follow a trend with increasing socioeconomic status. In the same figure, children from households in the poorest 20 per cent are more likely to always sleep under mosquito nets compared to the wealthiest 20 per cent. The same trend is observed with respect to vocational training. Mothers who are teachers come from households with the highest mos-

Table 2: Determinants of using mosquito nets among the under-fives in Uganda with and without interaction for child and mother using nets

Variable	Basic estimation			with interaction term for youngest child whose mother sleeps under a mosquito net		
	Odds Ratio	Std. Err.	Z-statistic	Odds Ratio	Std. Err.	Z-statistic
Single birth (1=yes, 0=no)	1.03	0.57	0.06	0.90	0.70	-0.13
Sex of Child (1=male, 0=female)	1.11	0.29	0.39	0.96	0.24	-0.18
Current marital status [never married]						
Married	3.79	1.90	2.67**	5.65	2.83	3.46**
Living with partner	3.97	2.15	2.55**	5.46	2.88	3.22**
Not living with partner	1.13	0.88	0.16	1.50	1.15	0.52
Vocational training [None]						
Teacher	0.28	0.18	-1.97*	0.40	0.27	-1.34
Paramedical	0.28	0.40	-0.88	0.29	0.53	-0.68
Others	0.48	0.19	-1.83	0.60	0.22	-1.40
Wealth index [lowest 20%]						
Next from lowest	0.10	0.09	-2.7*	0.09	0.07	-3.11*
Middle	0.15	0.14	-2.08*	0.21	0.17	-1.97*
Next from highest	0.12	0.11	-2.35*	0.11	0.09	-2.77*
Highest	0.07	0.07	-2.84**	0.06	0.05	-3.41**
Residence (0=urban, 1=rural)	0.42	0.17	-2.09*	0.37	0.15	-2.46*
Youngest child (1=yes, 0=no)	3.33	0.97	4.14**			
Mother sleeps under a mosquito net (1 = yes, 0 = no)	17.64	5.26	9.62**			
Children whose mothers sleep under mosquito net (1=yes, 0=no)				20.99	8.06	7.92**

[] comparison category **significant at 99% confidence level *significant at 95% confidence level Note: education level, ownership of property (radio, television, refrigerator, and bicycle), and religion were not significant and therefore not shown.

quito net ownership yet children from these households are less likely to always use mosquito nets.

Differential use of mosquito nets among the under-fives: role of the mother

Table 2 shows the results regarding mosquito net use among the under-fives in Uganda. Children whose mothers use mosquito nets are more likely to use them. For example, a child whose mother uses a mosquito net is 17.64 times more likely to use it compared to the one whose mother do not use a net. In addition, the youngest child is 3.33 times more likely to use a mosquito net than any other.

Also children of married mothers and those mothers living with their partners are about four times more likely to use mosquito nets compared to children whose mothers have never married. These results point to the likelihood that sleeping arrangements within the household may have something to do with the use of mosquito nets and are explored further.

Based on the results so far, it is proposed that if a child and his/her mother use a mosquito net, and the child is the youngest in the home, then the possibility that they share

a bed is high. [The demographic and health survey does not provide information on whether a mother sleeps with the child. No information is provided on how many mosquito nets a household has either]. In the second part of table 2, an interaction term between the fact that a mother and her youngest child sleep under a mosquito net is introduced, thus defining the resulting variable as 1 if mother and her youngest child sleep under a mosquito net and 0 otherwise. The results in the second part of table 2 (with interaction term for youngest child whose mother sleeps under a mosquito net) show that the youngest child whose mother uses a mosquito net is almost 21 times more likely to use a mosquito net as well, compared to the one whose mother does not. This brings us closer to the conclusion that since it is the youngest child, these two people do share a bed.

Finally, the first model on which the results of the first part of table 2 are based is run separately for children whose mothers use mosquito nets and those that do not. The idea is that, if the youngest child is likely to use a net for mothers who use them, and not for mothers who don't then they surely share a bed. The results are in table 3: the first part shows the odds ratio, standard error and Z-statistic for a subset of children whose mothers use mosquito

Table 3: Determinants of mosquito net use among the under-fives in Uganda – separately for mothers using and not using mother using nets, 2000

	Mother sleeps under mosquito net			Mother does not sleeps under mosquito net		
	Odds Ratio	Std. Err.	Z-statistic	Odds Ratio	Std. Err.	Z-statistic
Single birth (1 = yes, 0 = no)				0.21	0.22	-1.52
Sex of Child (1 = male, 0 = female)	0.80	0.29	-0.62	1.10	0.47	0.22
Current marital status [never married]						
Married	3.53	2.32	1.92	16.25	14.33	3.16*
Living with partner	8.49	6.49	2.8*	21.03	20.66	3.1*
Not living with partner	1.87	1.98	0.59	1.62	2.23	0.35
Vocational training [None]						
Teacher	0.48	0.37	-0.95	0.02	0.03	-2.5*
Paramedical	0.21	0.30	-1.08			
Others	0.57	0.27	-1.17	0.34	0.22	-1.66
Wealth index [lowest 20%]						
Next 20% from lowest	3.74E-08	3.11E-08	-20.6**	0.03	0.03	-3.23**
Middle 20%	8.01E-08	.	.	0.02	0.03	-2.25*
Next 20% from highest	1.74E-08	1.27E-08	-24.5**	0.08	0.10	-1.98*
Highest 20%	7.82E-09	5.84E-09	-25.0**	0.04	0.05	-2.67*
Residence (0 = urban, 1 = rural)	0.77	0.39	-0.52	0.09	0.07	-3.21**
Youngest child (1 = yes, 0 = no)	9.17	3.65	5.57**	1.33	0.62	0.61

[] comparison category **significant at 99% confidence level *significant at 95% confidence level Note: education level, ownership of property (radio, television, refrigerator, and bicycle), and religion were not significant and therefore not shown.

nets, and the second part provides similar statistics for children whose mothers do not use mosquito nets. The youngest child is 9.17 times more likely to use a mosquito net compared to other children in the subset of children whose mothers use a mosquito net. Therefore, in the subset of children whose mothers do not use a mosquito net, the likelihood of the youngest child using a mosquito net is the same as any other child in the household.

Thus, children whose parents sleep under mosquito nets and they share a bed with them are more likely to use a mosquito net. What the results suggest is that the decision at the household level is to use mosquito nets primarily for the parents. Child protection is simply a coincidence when a child happens to share a bed with the parents. This has implications for the Roll Back Malaria goal of protecting those most vulnerable by increasing mosquito net coverage to 60% by 2025 – that is, the percentage of households with at least one mosquito net. In the next section, this is discussed and its implications for selective targeting are explored.

Differential use of mosquito nets among the under-fives: other results

From tables 2 and 3, children whose mothers have vocational training, come from wealthy households are less likely to use mosquito net. Although these factors are predictors of having mosquito nets in the household (see table 1 and figure 2), they are not necessarily predictors of

"always use" once a household has a mosquito net. In fact it is the reverse.

Discussion

Although the paper sheds some light on an issue that is of practical relevance for insecticide treated nets (ITN) programmes, that is, the question of how well a very young child is protected in relation to other household members, and especially their mother, the authors acknowledge some limitations especially in relation to the data. The cross-sectional nature of the Demographic and Health Survey provides less opportunity for deeper investigation and its being multi-purpose means that a few standard questions related to a specific topic can be asked. For example the DHS does not provide information on whether a child sleeps with the mother and the number of mosquito nets a household has.

The descriptive results suggest three target population sub-groups that need increased mosquito net coverage: the poor, the rural households and those in highland districts. The question, which is the subject of this paper, however, remains: if the above sub-groups are targeted, do all the under-fives have an equal opportunity to use the mosquito nets? The discussion does concentrate on differential mosquito net use among the under-fives. The discussion on differential use of mosquito nets among the under-fives is along two lines: increasing coverage of net ownership for rural, poor, and those households in high-

land districts; and increasing their use among the under-fives. The results showed that increasing household net ownership does not necessarily increase their usage by the under-fives, and, therefore, different but coordinated policies need to be thought through.

For the under-fives to use mosquito nets, they must be available in the households. The results suggested that households in highland districts are less likely to own mosquito nets. Highland districts have historically been non-endemic for malaria because their climate has not been conducive (see figure 1) [14,15]. Theoretically, other methods of malaria control such as early detection and prompt treatment may be better suited for these districts. However, increasingly these districts are experiencing malaria all year round [15] and it may be practical for the government to initiate efforts to increase mosquito net coverage in these districts as well. There are already efforts by the government of Uganda to increase mosquito net coverage in rural areas through social marketing.

The Roll Back Malaria Initiative and, indeed, the government of Uganda have identified the under-fives as one of the high risk groups for malaria, and one of the strategies to fight malaria in this group is increasing mosquito net use. This implies that there must be selective targeting at the household level such that the children are protected. However, the Roll Back Malaria Initiative and the Ugandan government preferences must be reconciled with those at the household level, since it mosquito nets must be owned before they can be used. The preferences at the household level seem to be different though; children are protected simply because they happen to share a bed with their parents. These results are consistent with other findings. A recent study investigating the strength and weakness of the indicators 'proportion of households possessing mosquito net(s)' and 'proportion of children under five years of age who slept under a net the preceding night' for monitoring malaria control came up with similar results. In households owning mosquito nets, only 55 per cent of children slept under it. In-depth surveys suggested that nets were not always for children [16]. Another study in neighboring Kenya that explored factors affecting use of permethrin-treated bed nets during a randomized controlled trial found that children less than five years of age were less likely to use nets compared to the individual adults [17]. Studies in other areas that have explored household resource allocation have found increasing that bread winners are usually allocated more household resources than either the children or the elderly – they are usually middle aged [18]. This paper adds a new dimension to the fact that even if children are less likely to use mosquito net(s), those that do not share a bed with their parents are even less likely. It also provides an avenue for targeted interventions focusing on pregnant women, and

for devising other mechanisms to provide protection for other children. The advantage with targeting mothers is that they are also vulnerable and are likely to protect their new born babies for at least one year, if they share a bed. Fortunately, this corresponds to the period of highest malaria susceptibility in children [19]. This is because, based on the same dataset, a mother will have one child every two years. Working backwards, it means that once the mother becomes pregnant, a child is usually separated from her, which leaves only one year of protection. Secondly, husbands are likely to be more willing to spend on mosquito nets when they understand that their wives are at risk during pregnancy.

The other possibility the government could think about in the bid to increase net coverage is to use the existing Expanded Programme on Immunization network throughout the country. In this manner, more children are likely to be reached, since there are already mechanisms of ensuring compliance to immunization. It would be worthwhile knowing exactly how much it would cost and the likely savings from reduced episodes of illness and associated expenditures, both on the part of the government and the household. The end result is that either the initiative will have to revise its target or design better targeting strategies to reach the under-fives.

Young children in poor households are more likely to share a bed with their parents [20], probably because they are poor. Given that breadwinners are more likely to receive protection [18], this explains why children with mothers who are married or are in some living arrangement with their spouses or partners are more likely to sleep under the mosquito nets – primarily for the protection of their mothers' husbands.

The fact that children whose mothers have vocational training and those from wealthy households are less likely to use mosquito nets after controlling for other variables can be explained by the perceived vulnerability by these households. Perceived vulnerability is higher among the poor because of limited options when the children get sick. The likelihood of mothers protecting their children against malaria is, therefore, expected to be high especially when the mosquito net is available. Another possible explanation is the fact that the poor are likely to share a bed with their children [20]. Since those children that share a bed with their parents are more likely to use mosquito nets, it follows that children from wealthy households are comparatively less likely to use mosquito nets.

Conclusion

The study has revealed that the primary protection by mosquito net is not for the under-fives, which contradicts the policies pursued by the Roll Back Malaria Initiative

and the Ugandan government through the Ministry of Health. Children sharing a bed with their mother are more likely to use a mosquito net. Either targeting will have to be expanded or appropriate targeting strategies will have to be designed to reach the under-fives. It would be worthwhile investigating how cost-effective distribution at immunization points would be in terms of reduced morbidity and mortality and their associated costs.

Contribution of the Authors

Both authors participated in the conception, analysis strategy and writing up of the paper. FM, however, took the lead in drafting the paper and, therefore, became the first and corresponding author.

Acknowledgements

We would like thank Mary Amuyunzu-Nyamongo, Negussie Tafta, and Gloria Chepngeno of the African Population and Health Research Center for their valuable comments. We also acknowledge all those who participated in the collection of the Ugandan Demographic and Health Survey 2000–2001, including the respondents themselves.

References

1. WHO: **World Health Report 1999**. World Health Organization. Geneva, Switzerland 1999.
2. Malaria Consortium: **Conference on Insecticide-Treated Nets in the 21st Century**. London School of Tropical Medicine and Hygiene. Conference Proceedings 1999.
3. WHO: **World Health Report 2000**. World Health Organization. Geneva, Switzerland 2000.
4. Steketee R, Wirima J, Hightower A, Slutsker L, Heymann D, Breman J: **The effect of malaria and malaria prevention in pregnancy on offspring birthweight, prematurity, and intrauterine growth retardation in rural Malawi**. *Am J Trop Med Hyg* 1996, **55**:33-41.
5. Lengeler C: **Insecticide-treated bednets and curtains for preventing malaria**. *Cochrane Database System* 2000, **2**:CD000363.
6. D'Alessandro U, Olaleye B, McGuire W: **Mortality and morbidity from malaria in Gambian children after introduction of an impregnated bednet programme**. *Lancet* 1995, **345**:479-483.
7. Nevill C, Some E, Muga'la V, Mutemi W, New L, Marsh K, Lengeler C, Snow R: **Insecticide-treated bednets reduce mortality and severe morbidity from malaria among children on the Kenyan coast**. *Trop Med Int Health* 1996, **1**:139-146.
8. Binka F, Kabaje A, Adjuik M, Williams L, Lengeler C, Maude G, Kajihara B, Adiamah J, Smith P: **Impact of permethrin impregnated bednets on child mortality in Kassena-Nankana district, Ghana: a randomized controlled trial**. *Trop Med Int Health* 1996, **1**:147-154.
9. Uganda Bureau of Statistics (UBOS), ORC Macro: **Uganda Demographic and Health Survey 2000–2001**. Calverton, Maryland USA, UBOS and ORC Macro 2001.
10. Caldwell J, Reddy P, Caldwell P: **The social component of mortality decline: an investigation in South India employing alternative methodologies**. *Population Studies* 1983, **37**:185-206.
11. Chen L, Huq E, D'Souza S: **Sex bias in family allocation of health care in Bangladesh**. *Population and Development Review* 1981, **7**:55-70.
12. NetMark: **Baseline Survey on Insecticide Treated Materials (ITM) in Uganda**. NetMark Project, Academy for Educational Development 2001.
13. Tucker K, Sanjur D: **Maternal employment and child nutrition in Panama**. *Soc Sci Med* 1988, **26**:605-612.
14. Lindblade K, Walker E, Onapa A, Katungu J, Wilsom L: **Land use change alters malaria transmission parameters by modifying temperature in a highland area of Uganda**. *Trop Med Int Health* 2000, **5**:263-274.
15. Uganda Ministry of Health: **Malaria incidence in Uganda in 1999**. 2002.
16. Korenromp LE, Miller J, Cibulskis ER, Cham KM, Alnwick D, Dye C: **Monitoring mosquito net coverage for malaria control in Africa: possession vs. use by children under 5 years**. *Trop Med Int Health* 2003, **8**:693-703.
17. Alaii J, Hawley W, Kolczak M, ter Kuile F, Gimnig J, Vulule J, Odhacha A, Oloo A, Nahlen B, Phillips-Howard P: **Factors affecting use of permethrin-treated bed nets during a randomized controlled trial in western Kenya**. *Am J Trop Med Hyg* 2003, **68**:137-141.
18. Sauerborn R, Berman P, Nougara A: **Age bias, but no gender bias, in the intra-household resource allocation for health care in rural Burkina Faso**. *Health Transition Review* 1996, **6**(2):131-45.
19. Snow R, Omumbo J, Lowe B, Molyneux C, Obiero O, Palmer A, Weber W, Pinder M, Nahlen B, Obonyo C, Newbold C, Gupta S, Marsh K: **Relation between severe malaria morbidity in children and level of Plasmodium falciparum transmission in Africa**. *Lancet* 1997, **349**:1650-1654.
20. Tuohy P, Counsell A, Geddis D: **Sociodemographic factors associated with sleeping position and location**. *Arch Dis Child* 1993, **69**:664-666.

Publish with **BioMed Central** and every scientist can read your work free of charge

"BioMed Central will be the most significant development for disseminating the results of biomedical research in our lifetime."

Sir Paul Nurse, Cancer Research UK

Your research papers will be:

- available free of charge to the entire biomedical community
- peer reviewed and published immediately upon acceptance
- cited in PubMed and archived on PubMed Central
- yours — you keep the copyright

Submit your manuscript here:
http://www.biomedcentral.com/info/publishing_adv.asp

