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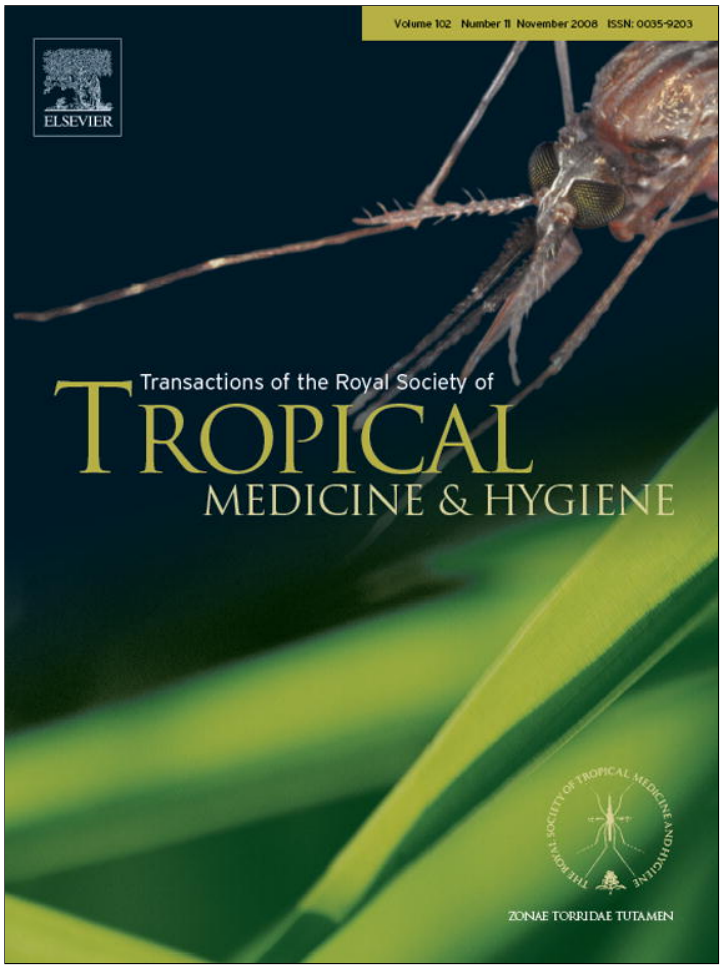

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Community factors affecting long-lasting impregnated mosquito net use for malaria control in Sri Lanka

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Summary The Anti Malaria Campaign distributed approximately 300 000 long-lasting impregnated nets (LLINs) to malaria-endemic areas in Sri Lanka during the years 2005 to 2007. We conducted a community-based cross-sectional survey among 2467 households distributed among the three major ethnic groups of Sri Lanka to study the perceptions and practices with regard to the use of LLINs in order to improve their use. In a majority of households the number of LLINs available was not sufficient for the number of people, although there was a small percentage of households that had excess nets. The information and advice given at the time of distribution regarding use of the nets differed amongst the three groups and was not consistent. Dissemination of this knowledge within the family was not observed. A relationship between knowledge regarding LLINs and reported practices on washing and drying of LLINs was found. It was noted that net shape may influence net use, with cone shaped nets being more popular. Efforts to increase knowledge on LLINs using behaviour change communication techniques would have more effectively contributed to achieve planned outcomes. Proper use of LLINs will undoubtedly contribute to further reduction of malaria in Sri Lanka.

1. Introduction

The development of long-lasting impregnated nets (LLINs) has eliminated the requirement to periodically re-impregnate conventional insecticide-treated nets. These LLINs have proved to be a breakthrough in malaria prevention (Guillet et al., 2001; WHO, 2002). Currently, the use of LLINs is one of the three main strategies advocated by the

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Global Malaria Programme of the World Health Organization (WHO/GMP) to combat the threat of malaria; the other two strategies being indoor residual spraying for vector control and the treatment of patients for parasite control. Malaria control in Sri Lanka over the last several decades has been dependent on the latter two strategies. In the last ten years these have changed to strategies based on integrated vector management, treatment of individuals confirmed as having malaria by blood smear examination and the detection and treatment of asymptomatic parasite carriers. This change facilitated the introduction of large-scale mosquito net programmes, which were later followed by the introduction of impregnated mosquito nets (Anti Malaria Campaign, personal communication). The use of LLINs has been the most recent initiative for malaria control in Sri Lanka.

The free distribution of LLINs (Olyset; Sumitomo Chemicals, Tokyo, Japan) is a malaria control intervention initiated by the Anti Malaria Campaign, Sri Lanka, funded by the Global Fund to fight AIDS, Tuberculosis and Malaria, with nets purchased by a non-governmental organization (Sri Lanka Sarvodhaya Shramadana Movement). In total approximately 300 000 Olyset nets were distributed during the years 2005 to 2007 to malaria-endemic districts of the country. In order to obtain the optimum benefit of LLINs a high degree of community awareness on their proper usage is essential. The objective of this study was to describe the knowledge, perception and practices with regard to the use of Olyset nets in three different ethnic groups 1—2 years after distribution. Performing qualitative and quantitative research at community level in order to understand people's attitudes and acceptance of an intervention has been identified as critical to the success and sustainability of the intervention.

2. Materials and methods

2.1. Study design

The study was a community-based cross-sectional survey of Grama Niladari Divisions (GND, the smallest administrative unit in the country) where LLINs had been distributed. The districts of Anuradhapura and Vavuniya, both of which are endemic for *Plasmodium falciparum* and *P. vivax* malaria, were selected for the study. The two districts reported the highest prevalence of malaria in Sri Lanka in 2006. Only GNDs considered accessible based on the security situation prevailing in the area at the time were selected for the survey. It was noted that a considerable number of recently displaced persons had settled in the selected GNDs in the Vavuniya district.

2.2. Sampling

The expected prevalence of knowledge on the use of LLINs was not known. Therefore an estimate of 50% was assumed for the sample size calculation with a desired precision of 5%, and a design effect of two was used in the calculation. Thus, a sample size of 800 individuals was selected from each of the three major ethnic groups.

A household was the unit of study and was identified as a group of persons who cook their food together. A GND was considered as the primary sampling unit, with a cluster of 25 households being selected from each GND. A multistage cluster sampling technique was used to identify 800 households from each ethnic group. The populations in all GNDs identified as accessible for study were listed by ethnic group. The 32 clusters required for each ethnic group were allocated separately, proportional to the population size of each ethnic group in the GND; for example, a GND having a larger Muslim population would have a correspondingly larger number of clusters of Muslim households. The starting household for a cluster was selected randomly using the household registers maintained for each GND. The data collectors proceeded from the initial household to the one nearest and to the left until the cluster was completed. If the occupants were not available at the time of the survey the house was revisited on two subsequent occasions. After two attempts the house was excluded and the cluster extended to include a new household. A total of 2467 households distributed among the three major ethnic groups, Sinhalese, Tamil and Muslim, were selected using the above procedure.

2.3. Data collection

Prior to the survey two focus group discussions were held in each community to understand the local terminology, local beliefs and practices regarding mosquito net use and other methods of protection from malaria. The information from these discussions was used to guide formulating questions for the survey. Pre-testing of the questionnaire was done and adjustments made accordingly. Verbal informed consent was obtained from all individuals enrolled in the study after explaining its purpose.

After consent was obtained, the chief female occupant or the chief occupant available in the household at the time of the visit was interviewed in their mother tongue. Prior to the commencement of the study the interviewers were trained in the identification of the different shapes and sizes of LLINs and how they differed from normal and impregnated nets.

The study took place between June 2007 and January 2008; data collection was carried out in June—July 2007 and enrolled individuals were followed up for 6—7 months to observe their sleeping arrangements under the LLINs.

2.4. Data analysis

Data were entered into an SPSS database (SPSS Inc., Chicago, IL, USA) and analyzed using EpiInfo (CDC, Atlanta, GA, USA) and SPSS. The frequency distribution of the characteristics of the population, the information received at the time of net distribution and the perceptions, practices and knowledge of the population were compared between the three ethnic groups.

The knowledge questions regarding LLINs were scored and the resulting scores were related to the reported practices of LLIN use, which were also graded. The knowledge regarding LLINs was also compared with the educational status of the respondents. Correlation coefficients were calculated for the knowledge regarding LLINs and the reported practices. A parametric regression analysis was performed to determine the contribution of knowledge regarding the

use of LLINs, ethnicity and education level to the variation of the practices of LLIN use.

3. Results

3.1. Characteristics of the study population

A total of 2467 individuals from the three main ethnic groups in Sri Lanka participated in the study. Approximately one-third (32%) were Sinhalese. Tamils and Muslims each represented 34% of the study population. The mean age of respondents was 39.2 years. The majority of the participants (80%) of all three ethnic groups consisted of females and there were no significant differences in the gender of the respondent amongst the three ethnic groups ($P = 0.087$). Only 3% of the Sinhalese had no formal education, compared with 14% of the Tamils and 13% of the Muslims. The difference in the educational level amongst the three ethnic groups was statistically significant ($P < 0.001$). The mean number of individuals living in the Sinhalese and Tamil households was similar (4.0 and 4.2, respectively) and lower compared with the Muslim households, where the mean number was 5.1. More than 60% of participants of all three groups had an income less than Rs 5000 per month.

3.2. Information regarding mosquito nets available in the household

Information regarding mosquito nets available in the household is given in Table 1. Nets available in the household were physically checked by the interviewer. Over 90% of the population possessed at least one mosquito net (plain, impregnated or LLIN) in their household. The mean number of nets available in the Sinhalese households was 2.4, compared with 1.2 and 1.4 in the Tamil and Muslim households, respectively. The total number of net spaces available was calculated taking into account information on number of nets and size of nets (double or single). Overall, 70% of households had less than one net space per person; 44% of Sinhalese, 80% of Tamils and 84% of Muslims fell into this category.

Table 2 gives information regarding the number of LLINs available in the household, their size, shape and source. LLIN distribution in the three population groups had taken place at different times, with most being distributed over a year prior to the study being carried out. Over 90% of the study population had a LLIN at home. However, in all three groups a few had more than one LLIN. A higher proportion (13%, $n = 108$) of Tamil participants did not have a single LLIN. Most of the nets provided to Tamil and Muslim populations were square in shape (70%). The total number of net spaces available for LLINs was calculated as before. Overall, 90% of households had less than one LLIN space per person. A LLIN space per person was available in 8% of households, and in 2.5% of households more than one LLIN space per person was available.

Approximately 60% of the Sinhalese households had cone shaped nets, compared with 27% of Tamil households. None of the Muslim households in the study population had received cone shaped nets. The participants had received these nets from different sources, with a large percentage of all three ethnic groups receiving LLINs from the state (Table 2). A payment for these nets was made by less than 10% of households in all three ethnic groups, predominantly to a shop or to a neighbour. The price paid varied from Rs250 to Rs1500 (approximately US$ 2.2—14.0)

3.3. Information received at the time of distribution of LLINs

The information and advice provided at the time of net distribution regarding the use of LLINs differed amongst the three groups and was not consistent, as shown in Table 3. Only 0.5% of the population indicated they had received a book or card at the time of distribution, but none of the respondents could produce this. Approximately 40% of Tamil respondents indicated that they did not receive any specific information at the time of LLIN distribution, compared with 2% of Sinhalese and 18% of Muslims. Only around 50% of the population received instructions on washing and drying the net or were told that the net given was a LLIN. The majority of the Sinhalese and Muslims indicated that they were asked not to use soap or detergents during washing (71% and 24%, respectively). Seven percent of the Sinhalese population indicated that they were advised to wash LLINs once in 6 months, while 40% of the Muslim population indicated that they were advised to wash it once in 5 years. Approximately equal proportions of Tamil respondents indicated that they were asked to wash their nets once in 6 months and once in 5 years (17% and 15%). Advice regarding drying was not received by 85% of the Tamil respondents, with only 9% indicating that they were asked to dry the net in the shade. This percentage was lower than observed among Sinhalese

Table 1 Mosquito nets and net spaces available in the household

	No. (%)		
	Sinhalese ($n = 794$)	Tamil ($n = 833$)	Muslim ($n = 840$)
Households with a mosquito net	785 (98.9)	753 (90.4)	802 (95.5)
Mean no. of nets available in household	2.4	1.2	1.4
Total net spaces per person			
<1	352 (44.3)	665 (79.8)	701 (83.5)
1	190 (23.9)	111 (13.3)	82 (9.8)
>1	252 (31.7)	57 (6.8)	57 (6.7)

Table 2 Information regarding long-lasting impregnated nets (LLIN) available in the household

	No. (%)		
	Sinhalese ($n = 754$)	Tamil ($n = 725$)	Muslim ($n = 749$)
How long ago net was received/purchased			
6 m – 1 year	297 (39.4)	0	0
>1 year	457 (60.6)	725 (100.0)	749 (100.0)
No. available in household			
1	751 (99.6)	643 (88.7)	745 (99.5)
2	3 (0.4)	78 (10.8)	4 (0.5)
3	0	4 (0.6)	0
LLIN space per person[a]			
<1 LLIN space per person	730 (91.9)	717 (86.1)	769 (91.5)
1 LLIN space per person	53 (6.7)	82 (9.8)	54 (6.4)
>1 LLIN space per person	11 (1.4)	34 (4.1)	17 (2.0)
Net shape			
Cone	472 (62.6)	196 (27.0)	0
Square	282 (37.4)	529 (73.0)	749 (100)
Size			
Single	302 (40.0)	0	0
Double	452 (60.0)	725 (100.0)	749 (100)
Source			
Government	590 (78.2)	586 (80.8)	657 (87.7)
Non government	131 (17.4)	53 (7.3)	5 (0.7)
Purchased	5 (0.7)	40 (5.5)	50 (6.7)
Don't know	28 (3.7)	46 (6.3)	37 (4.9)
If purchased to whom payment was made			
Shop	3 (60.0)	26 (65.0)	22 (44)
Neighbour	2 (40.0)	10 (25.0)	21 (42)
Don't know	0	4 (10.0)	5 (10)
Not answered	0	0	2 (4)
Amount paid for net (SL Rs)			
<500	3 (60.0)	23 (57.5)	32 (64)
501–1000	2 (40.0)	14 (35.0)	10 (20)
>1000	0	3 (7.5)	0
Don't know	0	0	6 (12)
Not answered	0	0	2 (4.0)

[a] LLIN net space per person calculation included those individuals who did not have a LLIN in the household. Therefore, the total number of households has been used: Sinhalese = 794, Tamil = 833, Muslim = 840.

and Muslim respondents (81% and 34% respectively). It is interesting to note that approximately 25% of the Sinhalese respondents had been told that they would be penalized if they gave the LLIN away or sold it.

3.4. Practice, knowledge and perceptions regarding LLINs

The LLIN was used for sleeping in most (over 90%) households as indicated in Table 4. However, the usage pattern was markedly different between the three ethnic groups. While the majority of Sinhalese (82%) and Muslims (76%) used their nets daily, only 28% of Tamils used it on a daily basis. The others in the Tamil population used it only when the mosquito density was high or when it was raining (Table 4). In a majority of Sinhalese households the nets were hung all the time (78%), while among 87% of Tamil and 68% of Muslim households the net was hung only when sleeping.

The manufacturer's instruction for washing Olyset LLINs is once in 6 months (Hill et al., 2006). Based on this, the practice of LLIN washing was determined in the study population. Of the individuals who responded to the question, only 51% of Sinhalese, 34% of Tamils and 41% of Muslims washed their nets once in 6 months. Details of net washing and drying practices are shown in Table 4. A high percentage of Tamils and Muslims (36% and 46%, respectively) indicated that they had never washed their LLINs, although all these individuals had received the net over a year before the survey. Of those who reported washing the nets, the correct procedure for drying (which is in the shade) was practiced by 92% of Sinhalese and 85% of Muslims as compared to 70% of Tamils.

Table 3 Information and advice received at the time of long-lasting impregnated net (LLIN) distribution

	No. (%)		
	Sinhalese ($n = 754$)	Tamil ($n = 725$)	Muslim ($n = 749$)
Method by which information was given[a]			
Verbal	673 (97.3)	348 (90.9)	560 (98.4)
Book/card	0	11 (2.9)	2 (0.4)
Both	5 (0.7)	4 (1.0)	0
Not answered	14 (2.0)	20 (5.2)	7 (1.2)
Information given at the time of LLIN distribution			
Nothing specific	16 (2.1)	310 (42.8)	137 (18.3)
Don't give away	183 (24.3)	2 (0.3)	2 (0.3)
Use only for sleeping	44 (5.8)	0	0
Instructions on washing and drying	381 (50.5)	221 (30.5)	334 (44.6)
Impregnated net	9 (1.2)	151(20.8)	168 (22.4)
Other responses[b]	75 (9.9)	9 (1.2)	65 (8.7)
Not answered	46 (6.1)	32 (4.4)	43 (5.7)
Advice received on washing of the net			
No advice received	16 (2.1)	411 (56.7)	132 (17.6)
Wash every 6 months	52 (6.9)	122 (16.8)	46 (6.1)
Wash once a year	2 (0.3)	3 (0.4)	0
Wash once in 2—3 years	0	31 (4.3)	3 (0.4)
Wash once in 5 years	14 (1.9)	112 (15.4)	301 (40.2)
Wash without soap/detergent	534 (70.8)	7 (1.0)	179 (23.9)
Other responses[b]	87 (11.5)	8 (1.1)	53 (7.1)
Not answered	49 (6.5)	31 (4.3)	35 (4.7)
Advice received regarding drying the net			
No advice received	42 (5.6)	613 (84.6)	366 (48.9)
Dry in the shade	613 (81.3)	67 (9.2)	254 (33.9)
Dry in the sunlight	2 (0.3)	0	3 (0.4)
Dry inside the house	0	0	14 (1.9)
Put in a bag till dry	0	0	20 (2.7)
Other responses[b]	47 (6.2)	15 (2.1)	56 (7.4)
Not answered	50 (6.6)	30 (4.1)	36 (4.8)

[a] Excludes individuals who did not receive information at the time of distribution (62 Sinhalese, 342 Tamils and 180 Muslims).
[b] Includes those who could not remember and those who responded as not knowing answer to question.

Approximately 85% of respondents did not know that it was not necessary to re-impregnate an LLIN (Table 4). Not a single respondent knew the reason for washing the LLIN in the stipulated time period of once in 6 months. The main reason given for washing nets was accumulation of dirt. In the case of Tamil respondents it was specifically mentioned that due to oil fumes from bottle lamps the entire net becomes blackened, as even though the net is not hung it is stored in the corner of the room. When the knowledge regarding drying practices was compared, the majority of the Sinhalese and Muslims (81% and 69% respectively) said that they dried the LLIN in the shade to avoid the removal of chemicals. The Tamils (57%) who reported drying the net in shade did so because that is the usual practice for drying wet clothes (Table 4). Proportions varying from 7% to 30% who had washed their LLINs stated that they dried the LLIN in direct sunlight so as to avoid the bad smell emitted when the water is not drained off adequately.

The preferences for the shape of the LLIN distributed were determined. It was noted that cone shaped nets had not been distributed among the Muslim population. The majority of the Sinhalese and Tamil populations (95% in both cases) who had been given cone shaped nets liked the shape. Among those who were given square shaped nets the majority of Tamils and Muslims liked the shape, however, 63% of Sinhalese given square nets disliked the shape (Table 4).

3.5. Knowledge and practice scores on the use of LLINs and their correlation

Practices were scored based on the reported frequency of washing the LLIN and the place of drying. Respondents were given a score of 10 if they had washed the LLIN every 6 months, which is the practice recommended, and a score of 5 if they had washed it every 4—5 months. A score of 0 was given for other responses. Similarly, a score of 10 was given if they reported the correct practice, which is drying the net in the shade. The range of scores for practices was 0—20. Knowledge was scored on whether the participants knew the correct information regarding the long-lasting effect of the chemical impregnated in the LLIN, why they washed the LLIN

Table 4 Knowledge, perceptions and practices regarding long-lasting impregnated nets (LLIN)

	No. (%)		
	Sinhalese ($n = 754$)	Tamil ($n = 725$)	Muslim ($n = 749$)
Practices regarding LLINs			
Is the net used for sleeping?			
Yes	679 (90.1)	659 (90.9)	671 (89.6)
No	19 (2.5)	36 (5.0)	38 (5.1)
Not answered	56 (7.4)	30 (4.1)	40 (5.3)
If yes, pattern of net use[a]			
Daily	557 (82.0)	182 (27.6)	510 (76.0)
On rainy/cold days	57 (8.4)	170 (25.8)	25 (3.7)
High mosquito density	65 (9.6)	307 (46.6)	136 (20.3)
Is the net hung all the time?			
Yes	587 (77.8)	83 (11.4)	229 (30.6)
Only when sleeping	155 (20.6)	632 (87.2)	510 (68.1)
Not answered	12 (1.6)	10 (1.4)	10 (1.3)
How often do you wash your net? (if received 6—12 months ago)[b]			
Not washed	115 (16.6)		
Once in <6 months	30 (4.3)		
Once in 6 months	109 (15.7)		
Once in 7—12 months	24 (3.5)		
How often do you wash your net? (if received >12 months ago)[b]			
Not washed	29 (4.2)	249 (36.2)	325 (46.2)
Once in <6 months	69 (9.9)	122 (17.7)	30 (4.3)
Once in 6 months	246 (35.4)	234 (34.0)	289 (41.1)
Once in 7 or less frequently	72 (10.4)	83 (12.1)	59 (8.4)
How did you dry the net after washing?[c]			
In the shade	506 (92.0)	305 (69.5)	321 (84.9)
In the sunlight	41 (7.5)	134 (30.5)	57 (15.1)
Other	3 (0.5)	0	0
Knowledge regarding LLINS			
Why do you wash it within this time period?[c]			
Net is dirty	446 (81.1)	424 (96.6)	371 (98.1)
Prevent the chemical being washed off	88 (16.0)	15 (3.4)	0
Other	16 (2.9)	0	7 (1.9)
Why was it dried in shade?			
Avoid removal of chemicals	410 (81.0)	11 (3.6)	222 (69.1)
Instructions given	49 (9.7)	60 (19.7)	42 (13.1)
Sunlight is harmful	47 (9.3)	59 (19.3)	57 (17.8)
To dry the net	0	175 (57.4)	0
Why was it dried in sunlight?			
To drain water	5 (12.2)	52 (38.8)	47 (82.4)
Neighbour said so	10 (24.4)	0	3 (5.3)
To avoid bad smell	26 (63.4)	63 (47.0)	0
No room inside the house	0	19 (14.2)	7 (12.3)
Do you need to re-impregnate the LLIN with chemicals at frequent intervals?			
No	126 (16.7)	127 (17.5)	71 (9.5)
Incorrect responses	628 (83.3)	598 (82.5)	678 (90.5)
Perceptions regarding LLINS			
Cone-shaped			
Like	451 (94.5)	184 (94.8)	0
Dislike	26 (5.5)	10 (5.2)	0
Square shaped			
Like	102 (36.8)	473 (89.4)	583 (77.8)
Dislike	175 (63.2)	56 (10.6)	166 (22.2)

[a] Missing data from 75 Sinhalese, 66 Tamils and 78 Muslims.
[b] This question applied only to those who had a LLIN in the household. Sixty Sinhalese, 37 Tamils and 46 Muslims were classified as missing data and excluded as they did not respond.
[c] Includes only those respondents who indicated they had washed their nets, i.e. 550 Sinhalese, 439 Tamils and 378 Muslims.

Table 5 Knowledge and practice scores for the use of long-lasting impregnated nets (LLIN) and their correlation

	Sinhalese	Tamils	Muslims	*F*-value	*P*-value
Mean knowledge scores (±SD)	6.26 (±0.39)	2.08 (±0.15)	3.45 (±0.18)	141.525	<0.001[a]
Mean scores of practices (±SD)	11.77 (±0.59)	7.52 (±10.57)	8.18 (±0.63)	70.603	<0.001[a]
Correlation coefficient	0.585	0.301	0.695		<0.001

Correlation coefficient for whole group is 0.578; $P < 0.001$.
[a] *P*-value given for the *F*-test, which compares the means for all three ethnic groups.

at the time intervals specified above and why they dried it as indicated above. Correct answers for questions were scored to give a composite score out of a maximum of 25.

The mean knowledge score was significantly different between the three ethnic groups ($P < 0.001$), with the Sinhalese scoring significantly more highly (6.26; SD ± 0.39) (Table 5). Mean knowledge scores about LLIN use were low among the Tamils (2.08; SD ± 0.15) (Table 5). The mean practice score was significantly different among the three groups ($P < 0.001$).

Knowledge regarding the use of long-lasting impregnated bed nets and its relationship to practices among those who possessed a LLIN was further studied by calculating Pearson's correlation coefficient. Calculation of correlation coefficients was done for the entire study population who possessed a LLIN and thereafter separately for each ethnic group (Table 5). A significant positive correlation of 0.578 was observed between the knowledge and practices of the entire study population who possessed a LLIN ($P < 0.001$). The correlation was also significant among all ethnic groups and was highest among but Muslims (0.695) and lowest among Tamils (0.301) ($P < 0.001$).

Finally a multiple regression analysis was done to determine the contribution of knowledge regarding use of LLINs, ethnicity and education level as factors in the variation of practices with respect to LLINs and it was shown that these three factors contributed to 34% (adjusted $R^2 = 0.335$) of the variation in practices. Combining knowledge regarding use of LLINs and ethnicity, or knowledge regarding use of LLINs and education level did not cause the adjusted R^2 to vary from its previous value, which confirmed that knowledge regarding use of LLINs was the factor which explained the majority of the variation in the practices with respect to LLINs. Better knowledge regarding the use of LLINs ($\beta = 0.567$, $P < 0.001$) emerged as a significant predictor of better practices (Table 6).

Table 6 Analysis of variance using practices of long-lasting impregnated nets (LLIN) as the dependent variable

Factors	Standardized β coefficients	Significance (*P*-value)
Higher level of knowledge regarding use of LLINs	0.567	0.001
Sinhalese ethnicity	0.043	0.026
Higher educational level	0.004	0.828

β: regression coefficient.

4. Discussion

The results of our survey indicated that in a majority of households the number of LLINs available was not sufficient for the number of people, although there was a small percentage of households which had excess nets. If the nets are to be effective, a high proportion of the population should sleep under them. This means that distribution of nets should take into account the number of household members as well as replacements necessary for wear and tear. It is also important to ensure equity in distribution. As a small percentage of respondents in the study population indicated that these nets were purchased, it is assumed that some of the distributed LLINs were sold.

Dissemination of knowledge on LLIN use, specifically instructions regarding washing and drying, was to have taken place at the time of distribution. The study found that information and advice on the use of LLINs given at the time of net distribution differed amongst the three groups and was not consistent. A reason for this may be that advice was given orally at the time of distribution to one member of the family who may not have been the respondent in the present study. Dissemination of this knowledge within the household was not observed. Considering the high literacy rates in Sri Lanka, it would have been more effective if printed health education material was provided with the LLIN. The study also showed a relationship between the knowledge regarding LLINs and the practices on washing and drying. This observation could either be due to a higher level of knowledge leading to better practices or reporting of good practices.

The manufacturer's maintenance instructions recommend a washing frequency of once in 6 months. Of those who had washed their nets the majority had followed these instructions, mainly because the net became dirty and not necessarily because of the instructions they had received. Eleven percent of the study population had actually washed the nets more frequently. Frequent washing could affect the long-lasting efficacy of the nets as a large proportion of the insecticide is removed during the washing process. A similar proportion of households (11%) had washed it at less frequent intervals ranging from once in 7 months to once a year, which could also have an adverse effect on the LLIN as washing every 6 months is required to maintain efficacy.

In many instances the washed nets were reported to be dried in the shade. The respondents may have been following the advice given by the healthcare workers, or following the regular practice of drying clothes in the shade because of the intense heat. It should be noted that a small proportion in each ethnic group indicated that they dried the LLINs under direct sunlight. Drying nets under direct sunlight is not recommended by the manufacturer as it could affect

the potency of the net. The manufacturer recommends drying nets in black vinyl bags under direct sunlight to hasten regeneration. However, this advice had been given to only 3% of the Muslims in the study population but was not practiced by any of the households.

A significant correlation was seen between the knowledge regarding LLINs and the practices adopted by the population to maintain them. The correlations between practices and ethnicity or education were low compared to that between practices and knowledge. When a regression analysis was carried out, ethnicity did not add to the explanation of variation seen in the outcome variable. However, ethnicity remained statistically significant in the final model. This could be due to the fact that the sample of the Tamil population studied consisted mostly of internally displaced persons.

The results indicate that net shape may influence net use. As such it may be worthwhile and cost effective to consider the distribution of cone shaped nets, which appeared to be popular among the majority of users. It is also recommended that written instructions be given on net maintenance. The poor practices observed in this study, especially among communities studied in conflict areas, suggest that efforts to increase knowledge on LLINs using behaviour change communication techniques would effectively contribute to achieving planned outcomes. In purchasing and distributing nets in the future, it will be necessary to take into consideration the number of individuals in the household to ensure that there is one LLIN net space per person, and to consider shape preferences. Equitable distribution should be carried out. Current evidence indicates that a high proportion of LLIN use in the population interrupts the transmission of malaria (Hill et al., 2006; Lengeler et al., 1996; Teklehaimanot et al., 2007). The results of the study indicate that interventions to improve practices with regard to LLIN use are important and will contribute to further reduction of malaria in Sri Lanka.

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