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ORIGIANL REPORT

Effects of Educational Intervention on Long-Lasting Insecticidal Nets Use in a Malarious Area, Southeast Iran

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Abstract- Long-lasting insecticidal nets (LLINs) have been advocated as an effective tool against malaria transmission. However, success of this community based intervention largely depends on the knowledge and practice regarding malaria and its prevention. According to the national strategy plan on evaluation of LLINs (Olyset nets), this study was conducted to determine the perceptions and practices about malaria and to improve use of LLINs in Bashagard district, one of the important foci of malaria in southeast Iran. The study area comprised 14 villages that were randomized in two clusters and designated as LLINs and untreated nets. Each of households in both clusters received two bed nets by the free distribution and delivery. After one month quantitative data collection method was used to collect information regarding the objectives of the study. On the basis of this information, an educational program was carried out in both areas to increase motivation for use of bed nets. Community knowledge and practice regarding malaria and LLIN use assessed pre- and post-educational program. The data were analyzed using SPSS ver.16 software. At baseline, 77.5% of respondents in intervention and 69.4 % in control area mentioned mosquito bite as the cause of malaria, this awareness increased significantly in intervention (90.3%) and control areas (87.9%), following the educational program. A significant increase also was seen in the proportion of households who used LLINs the previous night (92.5%) compared with untreated nets (87.1%). Educational status was an important predictor of LLINs use. Regular use of LLIN was considerably higher than the targeted coverage (80%) which recommended by World Heaths Organization. About 81.1% and 85.3% of respondents from LLIN and control areas reported that mosquito nuisance and subsequent malaria transmission were the main determinants of bed net use. These findings highlight a need for educational intervention in implementation of long-lasting insecticidal nets; this should be considered in planning and decision-making in the national malaria control program during the next campaigns of LLINs in Iran.

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Introduction

The World Health Organization (WHO) estimated that nearly one million people die of malaria, mostly children under 5 years and about 243 million clinical cases occur annually. According to WHO report, 108 countries were endemic for malaria in 2008, with 890000 confirmed cases in Eastern Mediterranean Region. Iran showed evidence of a sustained decrease in the number of cases associated with wide scale implementation of malaria control activities (1).

In 2008, 23 countries in the African region and 35 outside that region had adopted the WHO recommendation to provide bed nets for all age groups

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at risk for malaria; this represents an increase of 13 countries since 2007 (1).

Malaria remains an important vector-borne disease and public health problems in south and southeast of Iran. It is unstable with two seasonal peaks mainly in spring and autumn. These areas include the provinces of Sistan and Baluchistan, Hormozgan and Kerman (2). These provinces incorporated less than 5% of Iran's total population, but include more than 95% of the total incidence of malaria cases in the whole country with *P. vivax* and *P. falciparum* are both present. Hormozgan province is highly endemic for malaria, as it constitutes 38% of all malaria cases reported in the country (3). In this province approximately 625 cases of malaria were reported during 2009. Bashagard district which constitutes only 2.18% of the total population of Hormozgan province, alone contributed 33% of total malaria cases (Hormozgan Health Center, unpublished data). In this part of the country some anopheline mosquitoes including *An. culicifacies*, *An. stephensi*, *An. dthali*, and *An. fluviatilis* are known to be the malaria (4,5).

Indoor residual spraying, accompanied by larviciding, active and passive case detection have been the main malaria control activities in practice in this area. Geographical locations, tropical climate and socio-economic conditions make appropriate condition for occurrence and persistent transmission of malaria in this district.

In areas where access to health services is limited and medication often inappropriate, Insecticide-treated mosquito nets (ITNs) present an attractive option that can effectively compliment the main malaria control strategy based on early diagnosis and prompt treatment (6).

The studies conducted in various parts of the world proved that the use of nets treated with insecticides is an effective tool against mosquito bites and in reducing morbidity and mortality due to malaria (7). Currently, the use of long-lasting insecticidal nets (LLINs) is one of the main strategies advocated by the WHO to combat the threat of malaria (8). However, success of this community based intervention measure largely depends upon social, cultural and behavioural aspect of target population (9,10). The cumulative number of LLINs delivered in 2006–2008 by manufacturers was 141 million, which represents 42% of the 336 million needed in 2008 (1).

Malaria control programme in Iran over the last several decades has traditionally focused its efforts on controlling the vector and parasite (2). In the last ten years this control strategy has changed to strategies based on integrated vector management. The National Malaria Control Programmes in Iran currently relies on strategies targeting mosquito vector control, that involve the use of permethrin- impregnated Olyset® net, which has a WHO Pesticide Evaluation Scheme (WHOPES) recommendation, declaring it safe and effective for the prevention and control of malaria (11).

The free distribution of LLINs (Olyset® nets) is a malaria control intervention initiated by the Center for Diseases Management and Control (CDMC), Iran, funded by the Global Fund to fight AIDS, Tuberculosis and Malaria. In 2009, approximately 80000 Olyset® nets were distributed in malarious areas in south and southeast of the country (Iranian Ministry of Health, unpublished data). In this context, Bashagard district was selected for the evaluation of LLINs in southeast Iran. Since fundamental knowledge and understanding of the factors influencing practice development and behavioural patterns of people is necessary for successful malaria control plan and no study has addressed this issue, therefore present study aimed to assess factors associated with use of LLINs among mosquito net owners, and also generate information on knowledge and practices regarding malaria and it's preventive measures in general and LLINs use in particular and finally formulate recommendations to improve use of LLINs.

Materials and Methods

Study area

The study was carried out in Bashagard of Hormozgan province, one of the affected districts by malaria in Iran. Annual parasite index (API) was 6.5/1000 in 2009 (Hormozgan Health Center, unpublished data). The district is located between 26º 04´- 26º 58´ N latitude and 57º 23´-59º 02´ E longitudes. Most of the region in Bashagard is mountainous with deep valley and steep slopes. The weather is warm with an average temperature of 12-50º C, relative humidity 40-60% and 40-150 mm annul rain fall. Entire district is 10000 km^2 in area and having the population of 31293. Approximately 90% of district's population live in rural area and the main economic activities are farming and livestock herding. The villages are small, scattered and relatively inaccessible with low population. Majority of the population lives in hills and foot-hills and most of their houses are very small with thatched roofs. The study area presents a typical low socioeconomic

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status of the people and is one of the poorest areas in Iran.

Malaria is a major public health problem in this district and occurs year-round with peaks after the two annual rainy seasons (April-June and October - December).

Study design and data collection

The study was an intervention community-based cross-sectional survey conducted in rural areas of Bashagard district.

On the basis of available epidemiological data and average malaria incidence rate in the Hormozgan health center, 14 villages in two groups were selected for implementation of LLINs. These villages were selected randomly in two clusters, and assigned to either intervention (Olyset® nets) or control area with untreated (Plain) nets. Cluster 1 (Olyset® nets) comprised eight villages (population 1588) and cluster 2 (Plain nets) had six villages with 975 inhabitants. The study design is shown in figure 1.

The study was carried out in four phases. Phase 1 started with net distribution in September, a month before beginning the second malaria transmission season. Nets were distributed and delivered free at health facilities. Before the distribution of nets, the trained health workers team convinced community assemblies in each selected village to explain the purpose of the study. Nets were distributed to the all households in the selected villages, two nets to each household. In total, 720 Olyset® nets and 464 plain nets were distributed, respectively in intervention and control area.

In the second phase, a base line knowledge and practice survey was conducted in October immediately after bed nets were distributed. Issues addressed included malaria transmission, sleeping patterns of households and factors that affected regular use of bed nets.

A pre-test questionnaire was used for the survey. The questions included respondents' demographic characteristics, knowledge and practice about malaria transmission, bed net usage and coverage. The interviews were conducted in local language by health workers from the Bashagard health center and were supervised in the field by the principal investigator.

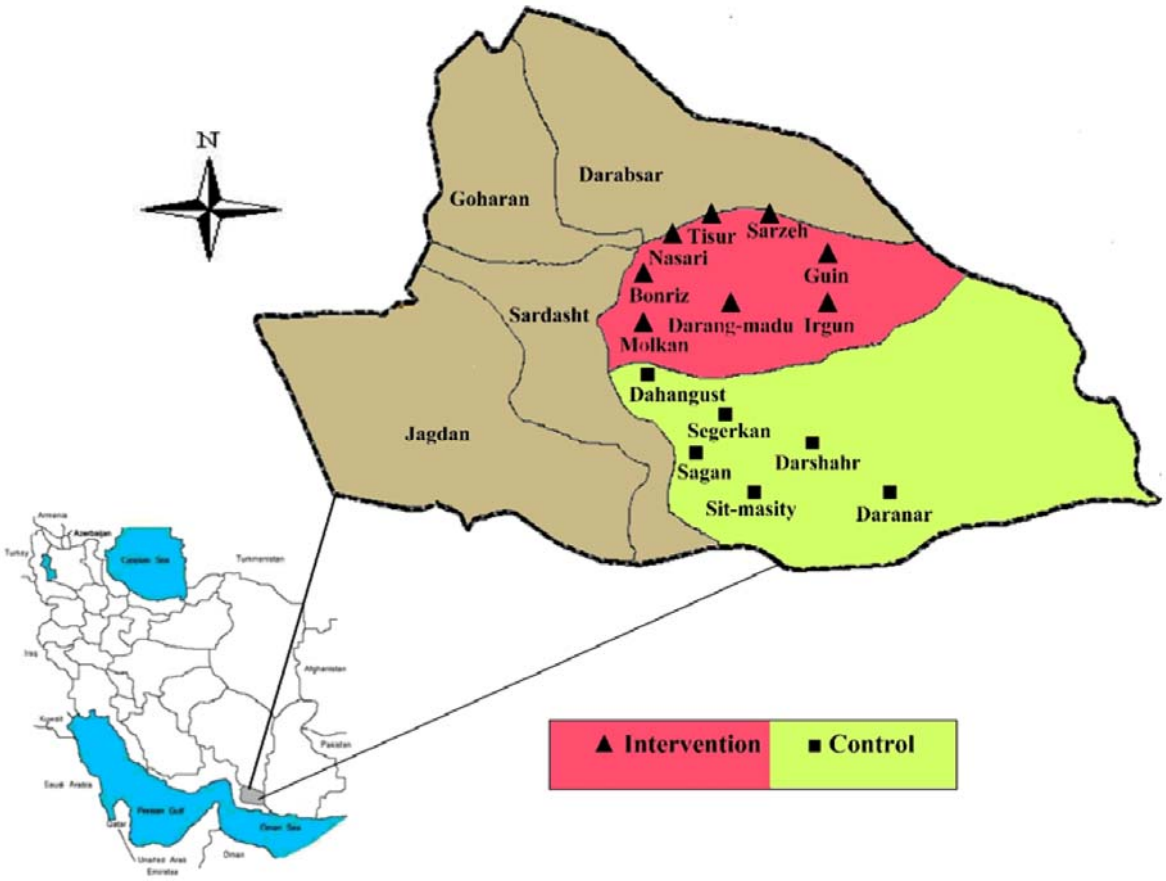

Figure 1. Map showing the provinces of Iran, highlighting the position of Bashagard district villages (study villages).

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The interviewers were trained about the study objects and the questionnaires. They had at least high school education, could speak, read, and write the Persian language and spoke fluent local language. The interviewers explain the purpose of survey and informed the participant in the study. In each consecutive household only mother was interviewed.

In phase 3, the education programs were held by former interviewers in November. Mothers from each household assigned to the education group were educated together as units immediately after pre-test questionnaire were administered. The intervention consisted of education about transmission and prevention of malaria, information about the benefits of bed nets, the appropriate time of bed net usage, maintaining bed net during daytime and frequency of washing bed nets.

Phase 4 carried out in June, at the end of first malaria transmission season. All participants who received educational programs were administered the same questionnaire used in the baseline assessment.

Specification of bed nets

The Olyset® nets made of blue polyethylene monofilament fiber, 150 denier strength with 72 meshes (8 by 9 holes/ in^2). The nets blended with 1000 mg a.i/m^2 permethrin (2%w/w). Olyset® nets were manufactured by Sumitomo Chemical Co., Ltd and then supplied by the Ministry of Health & Medical Education of Iran. Plain nets made of white polyester polyfilament fiber, 100 denier strength with 156 meshes (12 by 13 holes/ in^2). All nets (LLINs/ Plain nets) were rectangular shaped and extra family size (width, 180 cm; length, 190 cm; high, 150 cm).

Ethical consideration

Households of study villages were informed about the objectives and procedures of the study. Participants were informed that their participation was purely voluntary and assured of the confidentiality of all data collection. No identifiers were written on the data collection instrument and a code was used instead.

Statistical analysis

The data were entered into SPSS V. 16 and analyzed. Descriptive statistics were carried out to measure percentages, averages, and relative frequencies of the variables. Cross tabulations of variables were done and Chi-squared test (χ^2) was used to determine the statistical significance of differences of relative frequencies. The result were considered significant at 5% level of significance ($P<0.05$). Graphs were prepared using Excel software.

Results

Characteristics of the study population

A total of 592 households were interviewed, 360 from intervention and 232 from control area. The mean age of the respondents in intervention group, was 38.9 ± 14.98 years (mean±SD) ranging from 17 to 76 years. The majority of the women either had no education (60%) or had only primary education (31.4%). Demographic data revealed that the ages for the respondents in the control group ranged from 15-73 years with the mean, median and standard deviation of 35.9, 32 and 14.2, respectively. Overall, 76.7% of the study populations in control area were illiterate. The mean number of individuals living in the intervention and control area households was similar (4.4 and 4.2, respectively).

Table 1. Demographic characteristics of the study population in Bashagard district, Southeastern Iran.

Characteristics	Intervention N (%)	Control N (%)	Total N (%)
Age groups (years)			
15-24	65(18.1)	51(22.0)	116(19.6)
25-34	114(31.6)	77(33.2)	191(32.3)
35-44	51(14.2)	41(17.7)	92(15.5)
45+	130(36.1)	63(27.1)	193(32.6)
Education			
Illiterate	216(60.0)	178(76.7)	394(66.5)
Primary	113(31.4)	49(21.1)	162(27.4)
Secondary	22(6.1)	3(1.3)	25(4.2)
High school	9(2.5)	2(0.9)	11(1.9)
Family size			
1-2	62(17.2)	60(25.9)	122(20.6)
3-4	126(35.0)	86(37)	212(35.8)
5-6	95(26.4)	57(24.6)	152(25.7)
7+	77(21.4)	29(12.5)	106(17.9)

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The demographic characteristics of the study population are shown in Table 1.

Knowledge about malaria transmission and mosquitoes breeding places

Before educational program, 77.5% and 69.4% of respondents in intervention and control area correctly mentioned that malaria was transmitted through mosquito bites, respectively (Table 2). Even though, a majority of respondents were aware of the cause of malaria, still 17.2 % and 24.2 % of respondents had misconceptions such as drinking dirty water and eating contaminated food in intervention and control group, respectively. Overall, knowledge of intervention and control group about malaria transmission was not statistically significant different (P>0.05). Following the educational program, respondent's knowledge regarding malaria transmission was increased to 90.3% and 87.9% in intervention and control area, respectively (Table 2). Knowledge of respondents regarding mosquitoes breeding places significantly improved in the both area, however the percentage of respondents who had correct knowledge about mosquito breeding sites was slightly higher in control than intervention groups (89.6 vs. 86.6%, Table 2).

Practices regarding use of LLINs

Before educational program, 58.3% and 47.8% of respondents reported regular use of bed nets in intervention and control area, respectively. The proportion of households using bed nets was significantly higher in intervention than control group (Table 3).

Table 2. The effect of educational program on respondent's knowledge about malaria transmission and mosquitoes breeding places.

Study parameters	Intervention		*P*	Control		*P*
	Pre-education N (%, 95% CI)	Post-education N (%, 95% CI)		Pre-education N (%, 95% CI)	Post-education N (%, 95% CI)	
Malaria transmission			0.004			0.002
Mosquito bites	279(77.5, 72.6-82.4)	325(90.3, 87.1-93.5)		161(69.4, 62.3-76.5)	204(87.9, 83.4- 92.4)	
Drinking dirty water	50(13.9, 4.3-23.5)	22(6.1, -3.9-16.1)		45(19.4, 7.9-30.9)	20(8.6, -3.7-20.9)	
Eating contaminated food	12(3.3, -6.8-13.4)	7(1.9, -8.2-12.0)		11(4.8, -7.8-17.4)	3(1.3, -11.5-14.1)	
Don't know	19(5.3, -4.8-15.4)	6(1.7, -8.6-12.0)		15(6.4, -5.9-18.8)	5(2.2, -106-15)	
Mosquito breeding places			0.003			0.001
Stagnant water	258(71.7, 66.2-77.2)	312(86.6, 82.8-90.4)		125(53.9, 45.2-62.6)	208(89.6)	
Rubbish	48(13.3, 3.7-22.9)	24(6.7, -3.3-16.7)		63(27.1, 16.1-38.1)	12(5.2, -7.4-17.8)	
Don't know	41(11.4, 1.7-21.1)	19(5.3, -4.8-15.4)		39(16.8, 5.1-28.5)	10(4.3, -8.3-16.9)	
Others	13(3.6, -6.5-13.7)	5(1.4, -8.9-11.7)		5(2.2, -10.6-15.0)	2(0.9, -12.2-14.0)	

Table 3. The effect of educational program on respondents' practice regarding use of bed nets.

Study parameters	Intervention		*P*	Control		*P*
	Pre-education N (%, 95% CI)	Post-education N (%, 95% CI)		Pre-education N (%, 95% CI)	Post-education N (%, 95% CI)	
Using frequency			0.003			0.002
Always(regularly)	210(58.3, 51.6-65.0)	333(92.5, 89.7-95.3)		111(47.8, 38.5-57.1)	202(87.1, 82.5-91.7)	
Never	150(41.7, 33.8-49.6)	27(7.5, -2.4-17.4)		121(52.2, 43.3-61.1)	30(12.9, 0.9-24.9)	
Hanging time			0.002			0.001
Overnight	99(27.5, 18.7-36.3)	186(51.6, 44.4-85.8)		70(30.2, 19.4-41.0)	108(46.5, 37.1-55.9)	
Sleeping time (9.00-12.00pm)	261(72.5, 67.1-77.9)	174(48.4, 46.1-50.7)		162(69.8,62.7-76.9)	124(53.5, 44.7-62.3)	

Table 4. Comparison the effect of educational program on respondents' practice regarding use of bed nets.

Study parameters	Intervention N (%, 95% CI)	Control n (%, 95% CI)	*P*
Reason for use of bed nets			0.063
Prevent mosquito nuisance	292(81.1, 76.6-85.6)	198(85.3, 80.4-90.2)	
Prevent scorpion stings	57(15.8, 6.3-25.3)	26(11.2, -.09-23.3)	
Others	11(3.1, -7.1-13.3)	8(3.5, -9.2-16.2)	
Hanging place			0.004
In courtyard	277(76.9, 71.9-81.9)	187(80.6, 74.9-86.3)	
In thatched houses	55(15.3, 5.8-24.8)	29(12.5, 0.5-24.5)	
In house	28(7.8, -2.1-17.7)	16(6.9, -5.5-19.3)	
Maintaining place			0.001
In thatched houses	257(71.4, 65.9-76.9)	150(64.6, 56.9-72.3)	
In house	103(28.6, 19.9-37.3)	82(35.4, 25.0-45.7)	
Washing Frequency			0.003
Every 6 months	248(68.9, 63.1-74.7)	177(76.3, 70.0-82.6)	
Once a year	112(31.1, 22.5-39.7)	55(23.7, 12.5-34.9)	

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Most of intervention and control households hung the bed nets over the sleeping time (72.5% and 69.8%, respectively) and 27.5% of intervention and 30.2% of control groups the nets were hung in overnight (Table 3). After educational program, the rate of bed nets usage increased to 92.5% in intervention and 87.1% control area. The proportion of bed net users was significantly higher in intervention than in control group. In addition, a significant increase was seen in the bed net use during overnight in the households who had LLINs, compared with the control group (Table 3).

Analysis of factors influencing use of bed nets by respondents indicated that bed net use was positively associated with education status in intervention and control group (*P*=0.063). Age and family size did not influence the use of bed nets by respondents. The main reason cited for using LLINs and plain nets was to avoid mosquito nuisance (81.1% and 85.3%, respectively; Table 4).

A total of 76.9% of households hanged the LLINs in courtyards, 15.3% in the thatched houses and the rest were using them in the houses (7.8%) Similar results were also obtained in the control area (Table 4).

When the practice regarding maintaining bed nets was compared, the majority of intervention and control respondent (71.4% and 64.6%, respectively) said that they maintain the bed nets in the thatched houses during the day (Table 4). The results showed that, 68.9% and 76.3% of households washed their bed nets once in a year, respectively in intervention and control area (Table 4)

Discussion

This is the first formal report of knowledge and practice regarding LLINs use in the southeast of Iran. It was found that before educational program most of households were aware of malaria transmission. These findings are similar to the observations which reported from other countries such as Uganda, Ghana, India, Swaziland and Nigeria (12-16). Moreover other studies conducted in southeast of Iran also showed a high awareness of malaria transmission among people (17,18).

Despite high illiteracy, the knowledge of households as observed in this study could be the result of their long-term exposure to disease and malaria educational activity by health workers and also by mass media in the villages.

According to the results, a quarter of illiterate respondents revealed a gap of knowledge on malaria transmission by stating that drinking dirty water and contaminated food could cause malaria. This misconception could adversely affect preventive behaviour. This fact emphasizes the need for effective educational intervention to improve the level of knowledge in the study population which is critical for the malaria prevention and control using LLINs. In this study, following the educational program, knowledge of illiterate respondents regarding malaria transmission significantly increased. Active educational intervention play important role in people's perception and

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knowledge promotion has a great impact on success and sustainability of malaria control strategies (9).

The results also showed that majority of the respondents are aware that the use of bed nets prevents mosquito bite and subsequently malaria transmission. Such awareness could be employed to promote the use of LLINs as an effective personal protective measure. Results of previous study in southeast of Iran showed that a major proportion of people believe that malaria is preventable by means of personal protective measures (18). These results are in agreement with other studies in Tanzania, Ghana and India (19-21).

Another important finding of this study was a significant increase in the regular use of bed nets following educational program, especially in the intervention villages where the use rate of LLINs was slightly higher. There were several reports that regular use of insecticide-treated nets increased when individual received educational activity about mosquito nets (19,22).

In present study regular use rate of LLINs was about 92%, which is considerably higher than the target coverage (80%) of the Roll Back Malaria campaign to be achieved by 2010 (23). This increasing could be explained by increasing perception of households about regular use of LLIN and its benefit.

Another important finding of our study is a significant increase in proportion of households who hung the LLINs in overnight. Hanging the LLINs in overnight, especially in the evening protect the people against many of mosquito vectors that are active in this time.

Our finding also indicated higher education status as a significant positive explanatory factor for the use of bed nets among households. This association was usual because people with a high education status are likely to have more knowledge about mode of transmission and benefits of nets as a preventive measure. Many studies in the other endemic countries have recognized the positive relationship between educational status and improved use of bed nets (24,25).

The increase in motivation for the use of LLINs could also be explained by the free distribution and delivery of LLINs at health facilities. Recent studies carried out in Sierra Leone supported our findings (26). Insecticide treated nets should be either free of charge or highly subsidized. Cost should not be a barrier to making them available to all people at risk, especially young children and pregnant women (27).

Finally our findings also showed that the proportion of households washing bed nets was slightly lower in intervention than control area. The manufacturer's maintenance instructions recommend a washing frequency of once in 6 months because washing could affect
the long-lasting efficacy of the nets as a large proportion of the insecticide is removed during the washing process (6). Based on this, reason for this trend could be due to increasing awareness of respondents about washing frequency of LLINs following educational program. Similar finding has been reported from Sri Lanka (8).

The results of present study indicate that educational intervention to improve knowledge and practice of people about LLIN use is important and will help for decision-making in the national malaria control program campaigns using LLINs in Iran. It is therefore recommended that other malarious districts provide baseline information about local community's perception and practice regarding LLINs.

Provision of inclusive behavior change communication through media which are available, appropriate and inexpensive for vulnerable population would increase the participation of the population in different socioeconomic levels. Such efforts should focus on correcting misconceptions regarding malaria transmission and its preventive measures.

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Ethical consideration

This research study is a part of national strategy plan for malaria control and elimination. It is a joint project among different inter-sectoral organization including Tehran University of Medical Sciences, Hormozgan

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University of Medical Sciences and Centre for Disease Control, Ministry of Health & Medical Education of Iran, so that it got an ethical approval from the Ethical Review Committee of the Tehran University of Medical Sciences.

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