Effectiveness of a health education intervention on the use of long-lasting insecticidal nets for the prevention of malaria in pregnant women of Pakistan: A Quasi-experimental study

Ramesh Kumar (drramesh1978@gmail.com)
Health Services Academy https://orcid.org/0000-0002-9701-3179

Midhat Farzeen
Health Services Academy

Assad Hafeez
Health Services Academy Islamabad Pakistan

Baseer Khan Achakzai
Directorate of Malaria

Muskan Vankwani
Dow international medical College Karachi

Manohar Lal
Federal Government Polyclinic Postgraduate Institute Islamabad

Rabia Iqbal
Federal Government polyclinic postgraduate Institute Islamabad

Ratana Somrongthong
Chulalongkorn University

Research

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Abstract

Background: Malaria being a pressing public health issue in Pakistan can be prevented if long lasting insecticides are made freely available in the country. However, the success of this prevention strategy depends upon usage of long-lasting insecticide treated nets (LLINs) by community. Hence the focus of present study was to determine the effectiveness of health education on adoption of LLINs among pregnant women living in remote district Tharparkar Sindh Pakistan.

Methods: A Quasi-experimental study design with control and intervention group was conducted with 200 pregnant women (100in each group). Women in intervention group were provided with health education sessions on malaria for 12 weeks while those in control group obtained routine information by lady health workers (LHWs). Pre and post intervention assessment was done for use of LLINs; and was statistically analyzed using independent sample t-test, chi-square with p values, and mean scores.

Results: Baseline was conducted with 200 pregnant women. Demographic characteristics were similar in both groups except for age, education, income, type of latrine and source of drinking water. After intervention, as compared to baseline, knowledge of participants increased two-fold in intervention group whereas it remained unchanged in control group. Furthermore, statistically significance difference (<0.05) between intervention and control groups on use of LLINs was found with increase in LLINs usage among intervention group.

Conclusions: Results proved that health education could be an effective intervention for improving knowledge and usage of LLINs among pregnant women for preventing malaria. Therefore, such educational interventions have a potential to be implemented at scale by incorporating them into routine health sessions provided by health workers to pregnant women so that maternal and child morbidity and mortality due to malaria can be prevented.

Introduction

Malaria continues to be the most prevalent parasitic infection responsible for high burden of disease and deaths in low-income countries. About half of the world's population lives in malaria endemic areas and pregnant women are considered as the high-risk group for malaria transmission (1). As a result nearly 435,000 deaths annually and 219 million malaria cases were reported in 2017 globally. However, these cases were more concentrated in Africa (92%), South East Asia (5%)and Eastern Mediterranean Region (2%) (2, 3).

Global health experts have found Malaria as a biggest challenge during pregnancy as it poses great threat to mothers and their newborn in low-income countries. In endemic areas, less than half of the pregnant women are expected to be asymptomatic carrier of parasitaemia through placenta (4). Malaria during pregnancy is correlated with multiple health issues including; low haemoglobin level in the blood, termination of pregnancy, miscarriage, undernutrition and premature delivery (5-9). Severity of malarial infection can increase three folds during pregnancy as compared to non-pregnant women which can lead

to mortality in about half of affected pregnant women (10). In malaria endemic regions, it is estimated that 25 million women get pregnant in a year; among which 10,000 deaths in sub-Sahran Africa due to due to this vector borne disease during pregnancy has been reported (11).

Pakistan is among the countries where malaria is highly endemic with one million reported cases of malaria every year. Although about 98% of population in Pakistan is exposed to malaria; however, one-third live in extremely high-risk areas in the country (12). Around 6.5 million malaria suspected cases were screened in Pakistan. Majority of the cases were mainly caused by plasmodium vivax (84%), falciparum (15%) and mix cases (1%). Annual parasite incidence (API) in Pakistan was 1.7, annual blood examination rate 3.0 and total positivity rate 5.7 and with Sindh being the province with highest reported cases of malaria. Migration within country and across international borders, variable transmission, the low immune status of the population, climatic changes, poor socioeconomic conditions, fragile health system, poor resources, illiteracy, and low use of LLINs are some of the complex contributing factors for the transmission of malaria in Pakistan(13).

Pakistan is one of the four regions in EMR where malaria endemic is highest. Therefore health planners make pregnant women living in the country as their top priority as this vulnerable group contributes to high mortality rates in Pakistan(12).It has been proven through previous studies that using LLINs intervention can prevent significant number of deaths due to malaria (14). Frequency of malaria cases could be reduced to half among pregnant women by using LLINs (15). Areas with high burden of disease, using mosquito nets can be preventive as it reduces the possibility of transmission of infection between host and vector thus preventing contamination and spread of malaria infection, morbidity and mortality (16). Lady health workers are the community-based health provider who plays a vital role in providing MNCH related services at the doorstep. Thus, they can easily provide health education to pregnant women in their community. Therefore, this study was conducted to promote and ensure usage of LLINs among pregnant women by delivering Heath education intervention regarding prevention of malaria among pregnant women using lady health workers in Tharparkar district of Pakistan.

Methods

Study design

This study followed a quasi-experimental design with a control and intervention arm and it was conducted at two union councils of Tharparkar. Tharparkar is considered a backward community with people belonging to low socioeconomic strata and it constitutes biggest desert area of Sindh, Pakistan. Each UC has 5 villages with estimated population of 30,000 and they access health services from Basic Health Units present in their community(17). The study took place from January to November 2019.

Health Education based Intervention: The intervention group with 100 women in one selected UC has received one and half-hour health education session per week for eight weeks with a total duration of health education of twelve hours. Researchers have developed modules for education session, which cover health education and were based on behavioural theories. Each session followed a separate module. There were a total of four modules which covered topics such as malaria transmission, clinical features of malaria, complications caused due to malaria during pregnancy, and strategies to prevent malaria during pregnancy.. These sections were named, 'understanding malaria in pregnancy' and 'the main preventive measures for malaria in pregnancy' respectively, and lasted for approximately 30 minutes. The third section was "Insecticide treated nets which lasted for about 30 minutes. Participants were oriented to the use and maintenance of their LLINs, how to prevent malaria, and how to seek medical advice in case malarial symptoms arose. The fourth section which lasted for 30 minutes, was an interactive session named, "commitment for malaria prevention during pregnancy". During this session, real stories and scenarios with experiences of the LLIN use, as identified from previous studies were highlighted, followed by brainstorming among the participants and the facilitator(18-22).

Sample size calculation: The sample size was calculated with 80% power and alpha error of 0.50 to determine 30% improvement in use of LLINs among pregnant women after the intervention. This resulted in a sample of 200 pregnant women for this study with 100 participants in each group.

Sampling technique: A multistage random sampling technique was used in this study to select the study participants. First, the two intervention and control union councils were selected from a list of forty-four union councils in the district (*Primary Sampling Unit*). Next, one union council was assigned to control and the other to intervention arm. In each union council ten villages were selected from a list of villages through simple random sampling method (*secondary sampling Unit*) and in each village ten pregnant women were selected through simple random sampling method from the list provided by the local lady health workers. Pregnant women and mothers of children with 6 months of age were interviewed in their homes. By this way, we interviewed 200 women included in the study. Those women who were ill and did not belong to the study area at the time of the interviews were excluded (**Fig.1**).

Data collection: Pre and post measurements were made by modifying Malaria Indicator Survey questionnaires developed by the Roll Back Malaria Partnership Monitoring and Evaluation Reference Group. The tool was initially pre-tested by piloting on 20 pregnant women in adjacent union council with similar kind of population before the study (23). The validity and reliability of tool was established through piloting the tool prior to start the data collection process. The health education intervention was prepared and pre-tested by delivering it to a sample of 20 pregnant women in adjacent area. The intervention was delivered in local language and was appraised by a midwife, health educationist, experts in this field and an Obstetrics and Gynaecology specialist for necessary corrections and modifications. The variables include the baseline characteristics and knowledge about malaria of the selected

participants at the first contact. Other variable includes health seeking behaviour of participants, training of health care workers, training of pregnant women in management of malaria. Four data collectors were trained before to start the data collection process. The data collector introduced himself/herself to the respondent and explained the objectives of the study. Pattern and time required for the interview was also conveyed to the respondent before the start of the interview.

Statistical analysis: The statistical analyses were performed to see the effect of the several individual characteristics on the outcomes of interest (knowledge and use of LLINs) by using appropriate bivariate analysis such as chi-square test for categorical variables and *t*-test for continuous variables. Paired and unpaired *t* test were used to see the effectiveness of health education with and within the groups. Main outcome of interest was knowledge about malaria and LLINs use among pregnant women. Pre-intervention survey was conducted before the intervention and post intervention survey was conducted three months after the intervention. Statistical Package Social Science version 23 was used for data analysis (24).

Ethical approval: Ethical approval was obtained from Ethics Review Committee at the Health Services Academy, Islamabad, Pakistan (F.No.7/82/2017-IERB). Written informed consent was obtained from all participants in the form of signatures or thumb impressions. The participants were assured that they would not be subject to any undue discomfort during the interview and participants were informed that they would not receive any monetary incentive for participating in the study. They had been informed of their right to refuse to participate in the study at any time during the interview. The respondents were assured of the confidentiality of the information that they provided.

Results

At baseline, the age of the women in control and intervention groups ranged between 18 to 45 years with a mean age of 27. Very few women in control and intervention group (16&13%) had completed primary school education and most were uneducated. More than 60% of the women were married off at or earlier than 18 years of age. More than half of the women in both groups had three to four children. Most women lived in mud houses consisting of three to four rooms (>0.05), did not own a mobile phone, and they did not have an improved source of drinking water, latrine and sewage drainage system in their households. Approximately 35% and 20% women in control and intervention areas respectively experienced stillbirths. Similarly, about a quarter of the women said that they had at least one newborn death in the past. Only about a quarter of the women from both groups said that they were counseled by an antenatal care provider about protection against malaria and the commonest topic on which the women in the control and intervention groups received any instruction was indoor residual spray, 27% and 19% respectively. 32 percent women in control and 21% in intervention group identified health workers as the most common source of information about Malaria. Most women in both groups were aware that the malaria was caused by the mosquitoes (**Table- 1**).

Table 1: Baseline characteristics and information about malaria among control and intervention groups in the study

Variables		Control group (n=100)	Intervention group (n=100)	p-value
Age	≤25 years	22	39	0.029*
	26-30	53	39	
	31 and above	25	22	
Education	Uneducated	62	83	<0.001*
	Primary	16	13	
	Any Other Type of Education	22	4	
Number of living children	1 - 2	17	10	0.111
	3 - 4	54	63	
	5 - 6	9	15	
	7 - 9	20	12	
Age at marriage	15,16	12	11	0.073
	17	18	34	
	18	43	36	
	19-22	27	19	
Type of Household	Mud house	79	82	0.592
	Brick house	21	18	
Number of Rooms	1-2	30	21	0.144
	3-4	70	79	
Owns a mobile phone	Yes	54	21	<0.001*
	No	46	79	
Source of drinking water	A Well outside home	71	49	0.001*
	A Well Inside home	29	51	
Type of latrine	Open	51	26	<0.001*
	Pit Latrine	49	74	
Mode of sewage drainage in house	Open Sewers	64	33	<0.001*
	Underground Sewers	2	25	
	In open Pond	34	42	
Income (PKR)	5000	37	76	<0.001*
	6000-10000	48	22	
	11000-15000	15	2	
Previous stillbirth (28 weeks)	Yes	35	20	0.018*
	No	65	80	
Previous newborn death	Yes	26	18	0.172
	No	74	82	
ANC counseling on malaria	Yes	35	24	0.088
	No	65	76	
Counseling topics	Use LLINs	4	3	0.925
	Indoor Spray	27	19	
	Take preventive medicine	4	2	
Malaria during any previous pregnancy	Yes	15	29	0.017*
	No	85	71	

Malaria during the current pregnancy	Yes	2	1	0.561
	No	98	99	
Ever heard about Malaria	Yes	34	23	0.085
	No	66	77	
Source of information about Malaria	Health Worker	32	21	0.683
	Other	2	2	

**Significant (p=<0.05)*

Both intervention and control groups were tested by using independent sample t test before the intervention to find any significant difference regarding use of LLINs between the two groups (**Table 2**). The women's perception that malaria was a harmful disease increased from 75% to 97% after the intervention, whereas in the control arm this change was only 10 percent points from 30% to 40%. The use of LLINs has increased in the intervention group at post intervention assessment due to health education from 10-30%; while in the control group only 1-3% has improved. Most of the study population has increased their knowledge on mode of transmission from (75-97%) about malaria in intervention group. Most of the participant heard about the mosquito nets after the intervention (58-100%) and their ownership regarding mosquito nest has increased up to 76% after intervention (<0.05). The Lady health workers were the most prominent source of obtaining malaria information and it significantly increased in intervention group (<0.05). LLINs use is important in prevention of malaria both in mothers and child and it has increases substantially after the intervention (<0.05). Generally, community knowledge regarding malaria prevention was high. Mosquito nets use during the pregnancy (practices), importance of LLINs during pregnancy (Knowledge) and its importance (attitude) has been increased in both groups however significant change (<0.05) was observed in intervention group (31-73%). Participants have shown a positive improvement while using the indoor mosquito spray after intervention (<0.05). Most of the respondents reported that they used LLINs last night while sleeping; the frequency of LLINs users has also increased after intervention (<0.05). However, no significant differences were found between the groups at baseline except source of information, type of LLINs available and its importance (p >0.05).

Table 2: Comparison of change in the use LLINs and other malaria preventive measures (before and after, and between control and intervention groups)

Variables		Control (n=100)			Intervention (n=100)		
		Before	After	p value	Before	After	p value
Transmission	Insect bite	21	17	0.106	25	3	0.765
	Mosquito bite	79	83		75	97	
Symptoms	Fever	69	66	0.314	61	77	0.286
	Headache	31	34		26	23	
Severity	Yes	30	40	0.210	75	97	0.002*
	No	70	60		25	3	
Complications	Fever	69	66	0.314	61	77	0.286
	Vomiting	31	34		39	23	
Prevention	By using LLINs	46	44	0.255	31	87	0.893
	Spray	54	46		69	13	
Heard about LLINs	Yes	61	48	0.065	58	100	<0.001*
	No	39	52		42	0	
Information Source LLINs	TV & Radio	44	54	0.072	42	0	>0.05
	LHW	56	46		58	100	
LLINs presence	Yes	81	70	0.091	85	97	0.003*
	No	19	30		15	3	
LLINs use	Prevents newborn	46	50	0.093	28	6	0.053*
	Prevents mother	54	50		72	94	
Use LLINs prevents malaria	Yes	35	40	0.465	100	100	<0.001*
	No	65	60		0	0	
Use LLINs in pregnancy	Yes	35	39	0.474	31	73	<0.001*
	No	65	61		69	27	
LLINs use are important in pregnancy	Yes	35	39	0.474	31	73	<0.001*
	No	65	61		69	27	
Use LLINs last night	Yes	35	36	0.883	31	96	<0.001*
	No	65	64		69	4	
Use spray in last 3months	Yes	35	33	0.765	31	81	<0.001*
	No	65	67		69	19	

**Significant (p=<0.05)*

Results of independent t-test to determine group simple effect on total knowledge and use of LLINs scores are presented in (**Table 3**). There were no significant differences between the mean knowledge and use of LLINs scores of the groups at baseline. The mean knowledge and use of LLINs scores of the intervention group were higher than that of the control group after intervention.

Table 3: Comparison of mean Knowledge and use of LLINs scores of intervention and control group at baseline and post-intervention

Variables	Scores	Mean (SD)		df	t-value	Mean Difference (95% CI)	p value
		Interven-tion n=100	Control n=100				
Knowledge	Baseline	5.68 (2.37)	5.25 (2.03)	198	-1.379	-.430 (-1.045, .185)	.169
	Post-Intervention	10.42 (0.89)	5.82 (2.18)	131.199	-19.56	-4.600 (-5.07 , -4.13)	.000
LLINs Use	Baseline	4.51 (1.81)	4.53 (1.65)	198	.082	.020 (-.463, .503)	.935
	Post-Intervention	8.19 (0.88)	4.85 (1.73)	147.349	-17.18	-3.340 (-3.72 , -2.96)	.000

The mean knowledge scores showed an increasing trend from baseline (time 1) to the time of post intervention (time 2) after three months of follow up for both groups, as shown in **Figure 1**.

The mean scores on use of LLINs showed an increasing trend baseline (time 1) to 3 months post-intervention (time 2) after three months of follow up for both groups, as shown in **Figure 2**.

Discussion

Based on baseline information, it was found that participants had some knowledge about malaria but it was inadequate. Their existing knowledge regarding causes and symptoms of malaria could be due to the routine health campaigns and antenatal counseling received from local lady health workers. It was known previously that the community workers are the main source of information and can play a vital part in prevention of diseases(25). However, the post-intervention assessment revealed that mean scores of participants in intervention group increased two-fold showing increase in their knowledge whereas the scores in control group remained unchanged. This increasing trend in knowledge in intervention group was significant and thus it could be attributed to the effectiveness of health education-based intervention. These findings are very similar with those reported in a study conducted in neighboring country (26). Similar results have been reported from other studies conducted in African countries

showed that knowledge scores were higher among people who received intervention about malaria (21, 27, 28).

Most of the respondents in study had LLINs available at their home and were well informed on the symptoms of malaria however its usage was minimal in both groups at baseline. Intervention effectiveness was also seen in form of LLINs use among participants of intervention group which doubled after intervention. This increasing trend reflects that after getting adequate knowledge about malaria and benefits of using LLINs, usage of LLINs increased significantly in intervention group. Health education intervention has remained effective in imparting behavior change by improving knowledge about malaria and benefits of using LLINs (21). Border country has successfully conducted a mass distribution of LLINs along with health education sessions and found a significant change on the use of LLINs among community (29). These findings are comparable with previous study which has shown that knowledge based interventions can result in improving knowledge about symptoms of malaria among most people thus more people use nets to prevent this disease(5). Another study shows that the use of LLINs increased up to 30% after the education intervention among rural population (19). In the study area, Malaria is being transmitted throughout the year and most people report being bitten by mosquito at night usually outside their home. Individuals who spend majority of their time outside home are at greater risk of getting malarial infection. Many reports suggest that the regular use of LLINs could prevent this disease (30).

The improvement in knowledge scores and usage of LLINs by pregnant women in intervention arm could only be associated with the health education intervention provided to them during this study (30). As each group was taken from separate union council thus it could be assumed that due to distance between the two areas, chances of contamination were minimized. This adds value to the inference that difference in scores between groups is valid and that the increase in knowledge and use of LLINs in intervention group only is due to the intervention received by pregnant women of this group.

True randomization and financial constrains were the major limitation in this study as no financial benefits were provided to respondents. Furthermore, endpoint assessment was done when intervention completed its period of 3 months. Thus the increase in knowledge and usage scores could be claimed as immediate impact of intervention. However, long lasting effects of intervention and true behavioral change can only be ensured if follow-up assessment is done, which was not done in this study. Therefore, for this intervention to be claimed as having long-lasting behavioral change outcomes, follow-up assessments should be made in future studies, which have similar objectives. Lastly, this research might not have benefited all the pregnant women across the country due to the nature and time constraints for the intervention. True randomization and financial constrains was the major limitation in this study as no financial benefits were provided to respondents. Despite having large distance between the selected UCs, as they were located within same district, it increases the probability of contamination between the groups.

Conclusion

The results of this study revealed that the health education intervention is effective and can improve use of LLINs among pregnant women for malaria prevention in rural area of Pakistan. Hence, it is recommended that the health policy makers and programme authorities must include this health education intervention in the routine sessions provided by lady health workers to pregnant women. This could not only be beneficial in preventing malaria and reducing its burden of disease but due to ease in its implementation at scale, it can also improve maternal morbidity and mortality indicators of Pakistan.

Abbreviations

TDR: Tropical Disease Research; EMRO: Eastern Mediterranean regional Office; UC: Union Council; LLINs: long-lasting insecticide treated nets; LHW: lady health worker; BHU: basic health unit; SGS: Small Grant Scheme; WHO: world health organization.

Declarations

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Availability of data and materials: The datasets used and/or analysed during the current study are available from the corresponding author on reasonable request.

Author's contributions: RK conceptualized this study, MF & MV drafted the manuscript and ML & BKA helped in the data analysis, RI did data analysis. AH & RS supervised this research and finalized the manuscript.

Ethics approval and consent to participate

All respondents provided written informed consent obtained before to include in this study and ethical approval were taken from IRB of HAS Pakistan.

Consent for publication

Not applicable.

Competing interests:

The authors declare that they have no competing interests.

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Figures

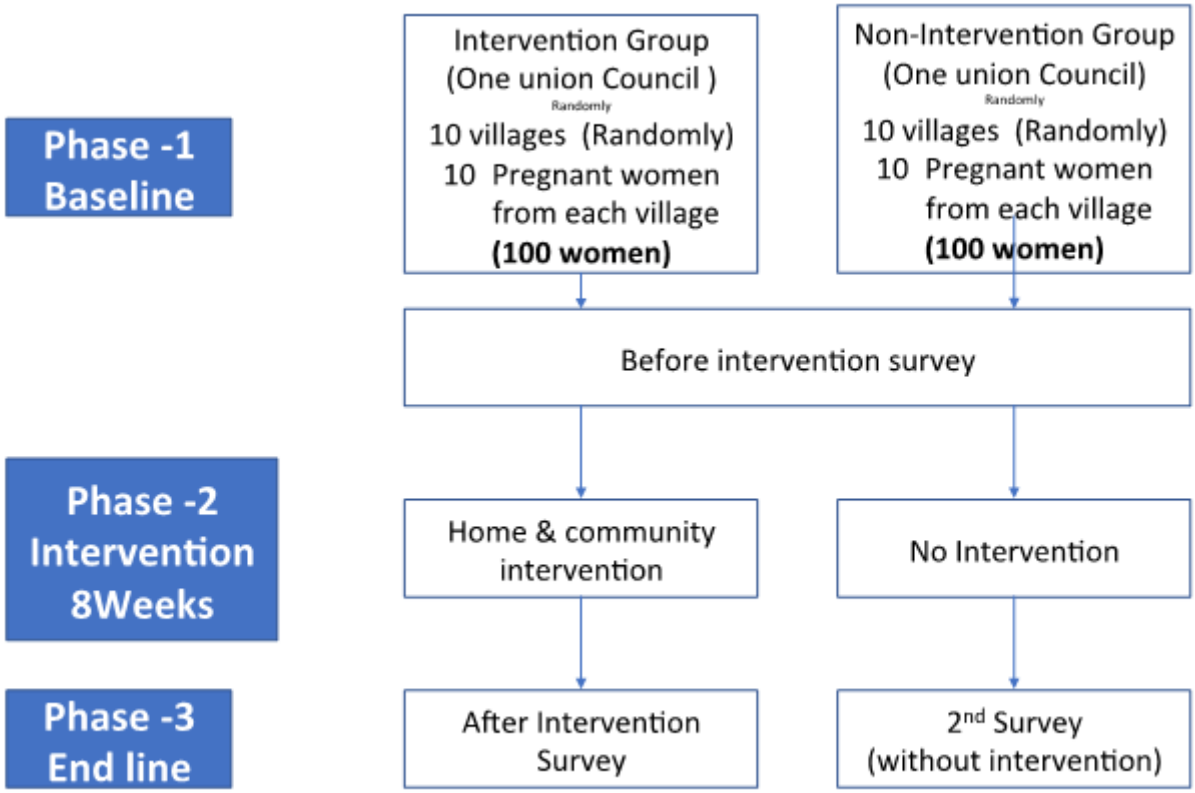

Figure 1

Flow diagram for Quasi-experimental study

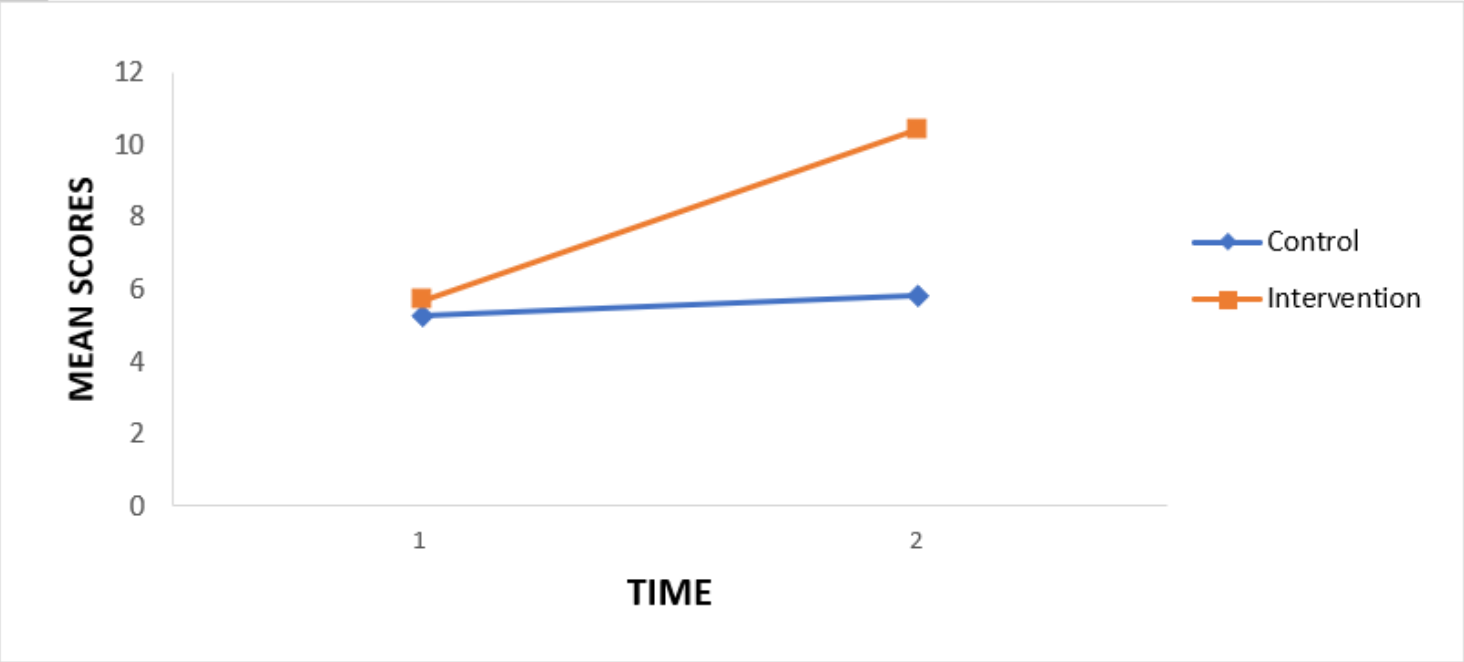

Figure 2

Trend of mean knowledge scores for intervention and control groups

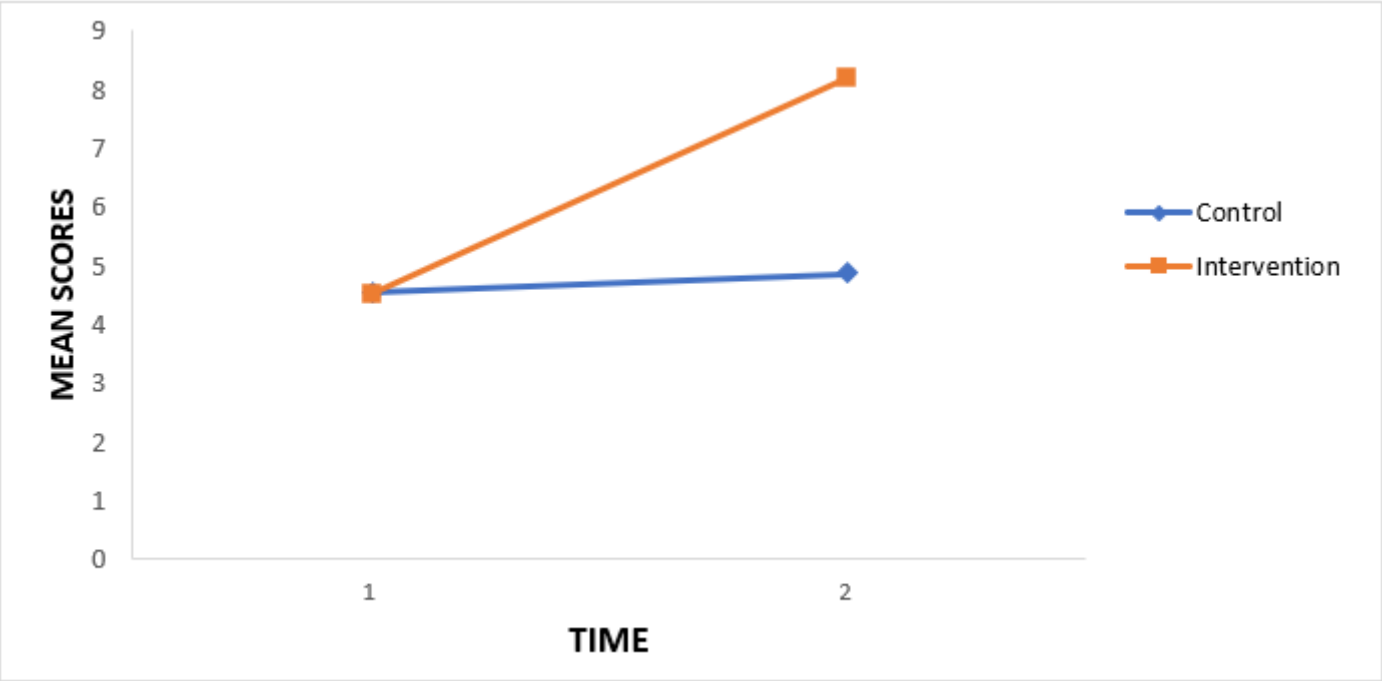

Figure 3

Trend of use of LLINs mean scores for intervention and control groups