These seasonal movements in relation to agricultural activities have been identified as risk factors associated with malaria infection [5,7-11]. In Thailand, the relative risk of infection for people who slept in farm huts was three times higher than that of people staying in residential villages [5]. In Vietnam, farmers who regularly slept in plot huts in the forest were approximately three times more likely to be infected with malaria than those involved in other work [7].

Two environmental factors for higher risk of malaria infection have been identified among those who stayed overnight in farm huts. First, malaria transmission is more intense in the farm huts than in the village settlements. Second, farm huts are poorly constructed with fewer barriers against mosquitoes [5]. In addition to these environmental factors, social factors were also noted. A shortage of nets leads people to keep their valued nets in their village houses, which are more secure and it may be cumbersome for people to carry and set up their nets in their farm huts [12].

Recently, the Global Fund to Fight AIDS, Tuberculosis and Malaria and other global efforts rapidly increased the coverage of ITNs in many malaria endemic countries. In Laos, ITN coverage reached 77.5% of the target population in 2003 [13]. Furthermore, 1,672,500 ITNs, including long-lasting ITNs, were distributed amongst the population of five million between 2004 and 2007 [14]. With the assumption that two people use a net together, this covered 67% of the total population.

Although the coverage has been increased in many countries, few studies have documented the association between malaria infection risk and overnight stay in a farming hut in a setting of high ITN coverage. Most of the previous studies about overnight stay provided little information on whether ITNs or any nets were used among their target populations [5,7-9], and others were conducted in the settings where no use or use of untreated bed nets was more common than use of ITNs [10,11]. Thus, this study sought to assess whether staying overnight in a farming hut is associated with malaria infection among farmers and their family members in a rural district of Laos.

Methods

Study site

This study was carried out in the Lamarm district of Sekong province, in the southern region of Laos in 2008. The annual incidence of malaria in 2003 was 15.4 cases per 1,000 people in the province, the highest in the country [2]. Falciparum malaria accounted for more than 95% of the confirmed cases [13]. The rainy season is from April to November, with peak rainfall in July or August [15]. As irrigation is not well developed in most areas, the rice farming season coincides with the rainy season.

Sekong province consists of four districts. With 27,000 people and 66 villages, Lamarm is the most populous district. This district was selected because access to villages in rainy seasons is known to be very difficult in other two districts. The remaining one district contained only a small number of villages. Governmental healthcare facilities in the Lamarm district include one provincial hospital and four health centres that serve rural communities.

In the district, the National Malaria Control Programme has been annually distributing conventional bed nets since 2000. During distribution, bed nets are sold in communities at a subsidized price (8,000 Kip: approximately 1 USD); insecticide treatment services are provided for free. Since 2009 long-lasting ITNs have been distributed instead of conventional nets with insecticide treatment. Indoor residual spraying has not been adopted. The use of personal spray, mosquito coil, and repellent appeared to be rare.

For the target village selection, two-stage cluster random sampling was used. First, one out of the four health centres was randomly selected, and then three of the ten villages were randomly selected from the catchment area of the health centre.

Study population

From the three selected villages (Village A, B, and C), a total of 143 households (85 in Village A, 41 in Village B, and 17 in Village C) were registered in the village census. An attempt was made to include all of the households in a survey. Data were collected from 134 households in the March survey, and 135 in the August survey. In both the surveys, seven households that were not engaged in farming were excluded. In total, data of 127 households (72 in Village A, 39 in Village B, and 16 in Village C) with 891 people (445 in Village A, 262 in Village B, and 184 in Village C) and 128 households (76 in Village A, 37 in Village B, and 15 in Village C) with 919 people (472 in Village A, 253 in Village B, and 194 in Village C) were analysed in the March survey and in the August survey, respectively. Of the 127 households surveyed in March, 104 with 761 people were included in both surveys.

Variables and measurements

The outcome in this study was the infection status of *Plasmodium falciparum*, as measured by rapid diagnosis test (Paracheck Pf®, Orchid Biomedical Laboratories, Goa). Malaria infection was defined by positive test result with or without clinical symptoms. The independent variable was the frequency of overnight stays in farming huts in the two weeks prior to each survey, as measured by a question with possible response options such as 0 day, 1-4 day, and 5 days or more. Because the

respondents of an interview pre-test had difficulty in answering the number of exact days where they slept in huts, the question was asked in the categorical manner. Other variables included socio-demographic variables (sex, age, and number of household members), socio-economic variables (educational attainment of household head and household possession of assets, such as radio, bicycle, motorbike, and car), bed net-related variables (use of ITN, number of people sharing the same family type net (with or without insecticide treatment), presence of hung ITN in main residence, and presence of hung ITN in hut), rice farming-related variables (type of rice farming and distance to farming hut), and a cluster-related variable (village). These variables were measured by conducting interviews with household members and observing the bed nets.

In this study, ITN was defined as a conventional net, which was treated with insecticide in the past twelve months. The possibility that households possessed a long-lasting ITN was not taken into account, not only because the National Malaria Control Programme had not provided long-lasting ITNs in the study site, but also because they were rarely available at retailers. The use of ITN was defined as the sleeping under an ITN during the previous night.

Reliability and validity of the measurements

Paracheck Pf® is a rapid diagnostic test kit which detects *Plasmodium falciparum*-specific protein (histidine-rich protein-2) in human blood. In Laos, this test tools are widely used in two settings: one is at rural health centres where microscopy examinations are often unavailable and another is by village health volunteers in communities [16]. A review study reported that histidine-rich protein-2-based tests including Paracheck commonly give sensitivity > 90% and specificity >85% in clinical cases [17]. Paracheck test results performed by village health volunteers in Laos showed that sensitivity, specificity, positive predictive value, and negative predictive value were 74.3%, 99.3%, 83.9%, and 98.7%, respectively [16].

With the exception of four variables (frequency of overnight stays in farming huts, number of people sharing the same family type net, distance to farming hut, and rice farming type), measurements were based on questions drawn from the Multiple Indicator Cluster Survey Questionnaire 3 developed by the United Nations Children's Fund. Surveyors also confirmed the presence and type of bed nets left in each household's main residence. To increase the validity of the measurements, interview procedures were pre-tested with surveyors at 25 households in a village. Questions that respondents had difficulty in answering were modified.

Data collection

A pair of cross-sectional surveys was conducted in March (during the dry season) and August (during the rainy season), 2008. Each survey consisted of interviews with household members with particular focus on heads and blood examinations aiming at all household members.

Five health workers from local health offices were recruited and trained as surveyors. They made household visits and conducted interviews with household heads. The surveyors invited a household head to be the main interviewee. In cases where the head could not participate in the interview, the next responsible person (e.g. a spouse) was chosen. Other household members were encouraged to help the household head to correctly respond to the interview questions.

Blood examinations of villagers to determine the prevalence of *P. falciparum* in the villages were conducted on the same days as the interviews. All villagers were invited to assemble at a mobile laboratory that was set up at a designated place including a village health volunteer's house and a primary school. Blood samples were collected from those who gathered and consented to their participation. For child participants, their guardians consented to their participation. Two laboratory technicians from the Center of Malariology, Parasitology, and Entomology, collected a finger prick blood sample from the participants for testing by rapid diagnosis test. Collected blood was immediately used for testing. Results of Paracheck assay were read at 15 minutes from the starting of testing and interpreted by both the technicians. In case that Paracheck turned out to be invalid or technicians did not reach an agreement on interpretation, a blood sample was collected for re-testing. Laotian medical doctors from the same institute treated all participants who tested positive by giving Coartem® or artesunate suppository according to the National Malaria Treatment Guideline. Except one field surveyor, the same members worked for the data collection both in the March and August surveys.

Statistical analysis

A sample size of 516 people was needed to detect a statistically significant difference in malaria prevalence between people who stay overnight in farming huts and those do not, with 80% power at 95% significance level. It was hypothesized that 90% of villagers would be farmers or a farmer's family members and that half of them would have stayed overnight in a farming hut in the two weeks prior to the survey. It was also hypothesized that 70% of them would participate in a blood examination on the basis of the study conducted in the district [18], and the difference in the prevalence of malaria would be 10% among people who would stay overnight in a

farming hut (estimated at 20%) and those who would not (10%). The sample size was increased to 700 people to protect against uncertainties in the sample size estimations.

Bivariate and multivariate analyses were done to examine the association between the outcome variable and both independent and confounding variables. For the analysis, each confounding variable was categorized as follows: age (< 5 years, 5-14 years, or ≥15 years); number of household members (< 4 people, 4-9 people, or ≥10 people); educational attainment (no education, primary, or secondary and above); possession of asset (no radio or bicycle/motorbike/car, radio or bicycle without motorbike/car, or motorbike/car); number of people sharing the same family type net (1-2 people, 3-4 people, or ≥5 people); distance to farming hut (< 3 km or ≥3 km); and type of rice farming (paddy only, slash-and-burn only, both). Odds ratios (OR) and 95% confidence intervals (CI) of the outcome for each variable were estimated using logistic regression analysis. The multivariate model was adjusted for all the variables other than the independent variable (frequency of overnight stays). Statistical analysis was performed using SPSS 17.0 (SPSS Inc., Chicago, IL). A *P*-value of < 0.05 was accepted as statistically significant.

Ethical clearance

This study was approved by the National Ethics Committee for Health Research, Ministry of Health, Lao People's Democratic Republic (No. 044/NECHR). The participants knew that their participation would be voluntary and that all data obtained would be confidential. Verbal and written consent was obtained from all the participants before conducting the survey.

Results

Household characteristics

The mean number of household members was 7.0 (891/127) in the March survey, and 7.2 (919/128) in the August survey (Table 1). Educational attainment of the household heads was mostly primary level. Most of the households (74.8% in March, 71.9% in August) practiced paddy rice farming with or without slash-and-burn rice farming and the remainder exclusively practiced slash-and-burn rice farming. In both surveys, the median distance between the permanent residence and the rice paddies or slash-and-burn field was 3.0 km. Farming huts were constructed of wood and/or bamboo with a thatched roof. The front sides were largely or completely open. Although most main residences had a window without mosquito-proof net, main residences appeared to be more protected than farming huts in terms of mosquito invasions.

Individual characteristics

The total population reported from the households was 891 in the March survey and 919 in the August survey (Table 2). Adults (15 years old or older) and females accounted for nearly a half of the population.

In the March survey, 13.7% of the population reported that they stayed overnight in a farming hut in the two weeks prior to the survey. In contrast, 74.6% reported doing so in the August survey. Children under five years who stayed overnight in farming huts accounted for 20.8% (33/159) in the March survey and 80.2% (138/172) in the August survey. These percentages were higher than any other groups: for children aged 5-14 years the percentages were 7.7% (21/273) in the March survey and 75.1% (208/277) in the August survey; for adults there were 14.8% (68/459) in the March survey and 72.1% (339/470) in the August survey.

Use of ITN was common both in farming huts and main residence. In the March survey, 66.3% (53/80) of those who stayed overnight in farming huts used an ITN, and 85.8% (680/793) of those who stayed overnight in their main residence used one. In the August survey, 95.2% (555/583) of those who stayed overnight in farming huts used an ITN, and 92.5% (309/334) who stayed overnight in their main residence used one.

People commonly shared one net with multiple people. In the March survey, the most commonly reported number of people sharing a net was three to four (48.8%; 435/891), followed by one to two (31.0%; 276/891) and five or more (17.8%; 159/891). Likewise, in the August survey the most commonly reported number of people sharing was three to four (45.7%; 420/919), followed by one to two (40.8%; 375/919) and five or more (13.2%; 121/919).

For blood examination, 73.8% (658/891) and 69.4% (638/919) participated in the March and August surveys, respectively. The prevalence of falciparum malaria was 15.3% (101/658) in the March survey and 22.9% (146/638) in the August survey. Of the people who participated in the blood examination in March, 64 (positive: 16, negative: 48) had self-reported fever that occurred in the past one week and the remaining 594 (positive: 85, negative: 509) had no fever. Of the people who participated in the blood examination in August, 60 (positive: 26, negative: 34) had fever and the remaining 578 (positive: 120, negative: 458) had no fever. Of the 101 people who were tested positive in March, 18 were also tested positive, 59 negative, and 24 not participating in August.

Bed net characteristics

In total, there were 528 nets in the March survey and 560 in the August survey (Table 3). In the March survey, 61.9% were used in the main residence, while 32.9% were not used either in the main residence or farming

Table 1 Household characteristics

		March (n = 127)			August (n = 128)		
		n	%	95% CI[a]	n	%	95% CI[a]
Mean number of household members (SD)		7.0	(4.1)	6.3, 7.8	7.2	(4.3)	6.4, 7.9
House type							
	Bamboo	36	28.3	13.6, 43.0	28	21.9	6.6, 37.2
	Wood	90	70.9	61.5, 80.3	99	77.3	69.0, 85.6
	Cement	1	0.8	-16.7, 18.3	1	0.8	-16.7, 18.3
Educational attainment of household head							
	No	21	16.5	0.6, 32.4	17	13.3	-2.8, 29.4
	Primary	85	66.9	56.9, 76.9	90	70.3	60.9, 79.7
	Secondary or above	21	16.5	0.6, 32.4	21	16.4	0.6, 32.2
Farm type							
	Paddy	47	37.0	23.2, 50.8	56	43.8	30.8, 56.8
	Slash	32	25.2	10.2, 40.2	36	28.1	13.4, 42.8
	Paddy and slash	48	37.8	24.1, 51.5	36	28.1	13.4, 42.8
Household assets							
	None	45	35.4	21.4, 49.4	49	38.3	24.6, 51.8
	Radio and/or bicycle	48	37.8	24.1, 51.5	44	34.4	20.4, 48.4
	Motorbike and/or car	34	26.8	11.9, 41.7	35	27.3	12.5, 42.1

[a]: 95% confidence interval for the estimated proportion or mean.

hut, although some of them were hung. In the August survey, 43.2% and 29.1% were used in the farming hut and main residence, respectively. The remainder (27.7%) was not used either in the main residence or farming hut. Insecticide-treated nets accounted for 83.5% of the total nets in the March survey and 93.6% in the August survey. Almost all were family type nets, which can cover two to three people. The mean number of nets per household was 4.2 (528/127) in the March survey, and 4.4 in the August survey.

Factors associated with malaria infection status

Logistic regression analysis for the March survey showed no association between malaria infection status and frequency of overnight stays in huts even after adjustment for the confounding variables (Additional File 1). Among variables other than frequency of sleeping in huts, "number of people sharing the same family type net with or without insecticide treatment" and "rice farming type" were associated with increased risk of malaria infection in the multivariate model. People who shared one net with five people or more had a greater risk of malaria infection than those sharing one net with up to two people (adjusted OR 2.22, 95% CI 1.15-4.27). Additionally, people who predominately practiced slash-and-burn farming were more likely to be infected with malaria than those practicing paddy farming alone (adjusted OR 2.12, 95% CI 1.03-4.35).

In the August survey, logistic regression analysis showed no association between malaria infection status and frequency of overnight stays in huts even after adjustment for potential confounding variables (Additional File 2). Among the confounding variables, "rice farming type" was found to be associated with the risk of malaria infection in the bivariate model. After adjustment, however, the variable was found to be not statistically significant. No statistical association was found with any other variables.

Discussion

The primary finding was that overnight stays in farming huts was not associated with the risk of malaria infection in either the dry or rainy seasons in the study site in Laos, where ITNs were widely used both in permanent residences and farming huts.

This finding suggests that previously reported associations might be due partly to insufficient coverage or improper use of ITNs in the farming huts. This finding was in line with that of the Tanzania study that reported no association between overnight stays in the farming huts and incidence of febrile illness episodes in the malaria endemic area of the country [6]. In that study, 97.9% of the people who stayed overnight in farming huts reported that they used a bed net and nearly 60% of the nets were ITNs.

The finding is important not only because overnight stays in farming huts are reported in malaria endemic countries other than Laos, but because overnight stays in farming huts are not confined to adult population. As shown both in the present study and by Hetzel *et al* [6], children under five years of age, those most vulnerable to malaria infection, were taken to the farming huts by their parents. Although the coverage of ITNs is high in

Table 2 Individual characteristics

		March (n = 891)			August (n = 919)		
		n	%	95% CI[a]	n	%	95% CI[a]
Age (years)							
	<5	159	17.8	11.9, 23.7	172	18.7	12.9, 24.5
	5-14	273	30.6	25.1, 36.1	277	30.1	24.7, 35.5
	≥15	459	51.5	46.9, 56.1	470	51.1	46.6, 55.6
Sex							
	Male	433	48.6	43.9, 53.3	446	48.5	43.9, 53.1
	Female	458	51.4	46.8, 56.0	473	51.5	47.0, 56.0
Frequency of sleeping in hut (number of days during past two weeks)							
	0	769	86.3	83.9, 88.7	234	25.5	19.9, 31.1
	1-4	58	6.5	0.2, 12.8	223	24.3	18.7, 29.9
	≥5	64	7.2	0.9, 13.5	462	50.3	45.7, 54.9
Slept under net (any type) the preceding night							
	Yes	870	97.6	96.6, 98.6	916	99.7	99.3, 100.1
	No	6	0.7	-6.0, 7.4	3	0.3	-5.9, 6.5
	Unknown	15	1.7	-4.8, 8.2	0	0.0	
Slept under insecticide-treated net the preceding night (at hut)							
	Yes	53	66.3	53.6, 79.0	555	95.2	93.4, 97.0
	No	3	3.8	-17.8, 25.4	9	1.5	-6.4, 9.4
	Unknown	24	30.0	11.7, 48.3	19	3.3	-4.7, 11.3
Slept under insecticide-treated net the preceding night (at main residence)							
	Yes	680	85.8	83.2, 88.4	309	92.5	89.6, 95.6
	No	48	6.1	-0.7, 12.9	6	1.8	-8.8, 12.4
	Unknown	65	8.2	1.5, 14.9	19	5.7	-4.7, 16.1
Slept under insecticide-treated net the preceding night (overall)							
	Yes	733	82.3	79.5, 85.1	864	94.0	92.4, 95.6
	No	55	6.2	-0.2, 12.6	15	1.6	-4.8, 7.9
	Unknown	103	11.6	5.4, 17.8	40	4.3	-2.0, 10.6
Number of people sharing any one net							
	1-2	276	31.0	25.5, 36.5	375	40.8	35.8, 45.8
	3-4	435	48.8	44.1, 53.5	420	45.7	40.9, 50.5
	≥5	159	17.8	11.9, 23.7	121	13.2	7.2, 19.2
	Not using a net/unknown	21	2.4	-4.1, 8.9	3	0.3	-5.9, 6.5

[a]: 95% confidence interval for the estimated proportion.

Laos, it remains low in many malaria endemic countries [13]. Efforts should be made to increase ITN coverage to protect this vulnerable group.

The second important finding was that using one family type net with five or more people significantly increased the odds of malaria infection risk. In the study site, almost all the nets were family type, which are usually designed to cover up to three adult people. Thus, sharing one family type net with five or more people quite obviously exceeds its capacity. The finding is in line with a study from Vietnam that reported that people sharing one net with four to six people were more likely to have malaria than those who shared with up to three people [19]. However, their results were not adjusted for potential confounding variables. Results of the present study showed that the association was found even after adjustment for age, the number of household members, and insecticide-treatment status.

The importance of health education regarding the proper use of nets has been recognized in malaria control [20,21]. However, such education does not necessarily cover how many people can share a net [22,23]. Additionally, Roll Back Malaria indicators, which are often used to assess progresses of malaria control efforts, focus only on whether people sleep under a net or not and pay little attention to proper net use [24]. Thus, this study suggests that number of people sharing one net should be emphasized in health education and be included as an indicator to assess the proper use of nets.

An interesting finding was that although the association between the number of people sharing the same family type net and malaria infection was statistically

Table 3 Household bed net characteristics.

		March (n = 528)			August (n = 560)		
		n	%	95% CI[a]	n	%	95% CI[a]
Place where any nets were used/not used the night before the survey							
	Placed in main residence and used	327	61.9	56.6, 67.2	163	29.1	22.1, 36.1
	Placed in main residence but not used[b]	65	12.3	4.3, 20.3	106	18.9	11.4, 26.4
	Placed in farming hut and used	27	5.1	-3.2, 13.4	242	43.2	37.0, 49.4
	Placed in farming hut but not used[b]	109	20.6	13.0, 28.2	49	8.8	0.9, 16.7
Net type							
	Family	525	99.4	98.7, 100.0	557	99.5	98.9, 100.1
	Double	2	0.4	-8.3, 9.1	2	0.4	-8.3, 9.1
	Single	1	0.2	-8.6, 9.0	1	0.2	-8.6, 9.0
Insecticide treatment status							
	Treated	441	83.5	80.0, 87.0	524	93.6	91.5, 95.7
	Not treated	35	6.6	-1.6, 14.8	12	2.1	-6.0, 10.2
	Unknown	52	9.8	1.7, 17.9	24	4.3	-3.8, 12.4
Mean number of any nets per household (SD)							
	Main residence	3.1	(1.6)	2.8, 3.4	2.1	(1.6)	1.8, 2.4
	Hut	1.1	(1.3)	0.9, 1.3	2.3	(1.7)	2.0, 2.6
	Overall	4.2	(2.1)	3.8, 4.5	4.4	(1.9)	4.0, 4.7
Mean number of ITNs per household (SD)							
	Main residence	2.7	(1.7)	2.4, 3.0	2.0	(1.7)	1.7, 2.3
	Hut	0.9	(1.2)	0.7, 1.1	2.1	(1.7)	1.8, 2.4
	Overall	3.5	(2.3)	3.1, 3.9	4.1	(2.1)	3.7, 4.5

[a]: 95% confidence interval for the estimated proportion or mean.
[b]: These unused nets included both hung and not hung nets.

significant in the March survey, no association was found in the August survey. This difference might be related to the decreased repellent effects of ITNs. In the study site, the National Malaria Control Programme annually provides net treatment around April, and people have little chance to treat their nets with insecticide except the programme-led treatment exercise. Although the repellent effect on mosquitoes is strongest soon after treatment, the effect gradually decreases as time passes [25]. Thus, the reason for the lack of association in the August survey might be due to the effects from insecticide remaining on the nets. Alternatively, the finding could be due to the results of increased number of ITNs and its use. In the August survey, ITNs accounted for 93.6% of the total nets, while 83.5% in the March survey.

The results suggest that people who practice seasonal movements may need a greater number of nets than those who do not. In March, 25.7% of the total bed nets were placed in the farming huts even though the study respondents reported that they rarely stayed at the huts overnight. There were two possible reasons for this: first, the nets may be used for nuisance protection during the day, as was reported in a number of studies [26,27]; second, the difficulty involved with frequently carrying a net between the main residences and farming huts [12]. Programme planners need to take the extra nets used in farming huts into account when they decide how many nets are required for distribution.

In this study, blood examinations were performed with Paracheck, which is based on the detection of histidine-rich protein-2 produced by falciparum parasites. Because this protein can remain in blood for several weeks even after successful treatment, some of the study participants who tested positive might not have had parasitaemia (false-positive). However, it is unlikely that many of them resulted from false-positives; studies that assessed the performance of Paracheck among asymptomatic population in Asian settings showed that sensitivity, specificity, positive predictive value, and negative predictive value were 92.3%, 97.2%, 83.7%, and 98.8% in Thailand (prevalence: 15.0%), and 94.4%, 89.0%, 70.3%, and 98.3% in India (prevalence: 24.4%), respectively [28,29].

This study asked people's behaviors regarding overnight stay in farming huts in the past two weeks. The use of the two weeks duration is reasonable to minimize the potential recall bias associated with self-report, but may not be enough to assess an association between sleeping in farming hut and malaria infection, particularly when the extended period of persistence of histidine-rich protein-2 is considered. However, it is likely that the study

population who frequently slept in farming huts for the past two weeks were more likely to choose to sleep in farming huts around the survey period, compared to those who never slept in farming huts.

In this study there were five major limitations. First, nearly 30% of the people did not participate in blood examinations. Logistic regression analysis was conducted using data from those who participated. Thus, results are not free from selection bias. Those who did not participate in blood examinations were more likely to sleep in huts for five days or more compared to those who participated in March (10.7% vs. 5.9%) and in August (52.1% vs. 48.7%). It suggests that one reason for non-participation might be due to people working in the farms and that the association between malaria infection and frequency of overnight stays might be underestimated. In a future study, performing blood examinations at the time of interview is recommended to avoid potential loss due to non-response. Second, because any entomological surveys were not conducted, it is unclear how intensive transmissions were in permanent residences and farming huts. Third, because the data collection was limited to only one health zone in the district, the samples of this study might not reflect the entire population of the district. However, as other health zones have the similar ecological setting and the same ethnic group (Lao Thueng), differences in malaria epidemiology and people's behaviors seem to be small. Fourth, the association might be somewhat underestimated in case sleeping in farming huts was associated with low-level parasitaemia. Finally, although the estimated minimum sample size was multiplied by 1.5, the increase might be insufficient to fully address the design effect of the sampling strategies used in this study. The estimated sample size should have been multiplied with consideration to design effect related to cluster surveys.

Conclusions

This study showed that staying overnight in farming huts was not associated with an increased risk of malaria infection in the setting where ITNs were widely used in farming huts. It suggests that malaria infection during overnight stays in farming huts might be preventable if ITNs are properly used in rural Laos.

Additional material

Additional file 1: Logistic regression analysis which examined the associations of variables with malaria infection status in March survey.

Additional file 2: Logistic regression analysis which examined the associations of variables with malaria infection status in August survey.

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Authors' contributions

DN was the principal investigator and was responsible for the entire process. SL, JK, KB, VH, and SP contributed to the development of the study design and coordinated the field work. JK, SK, JY, and MJ contributed to data analysis and to review of the manuscript. All authors read and approved the final manuscript.

Competing interests

The authors declare that they have no competing interests.

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Content analysis of school textbooks on health topics: A systematic review

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Summary **High-quality textbooks and learning materials are especially important for school children, but school textbooks may contain incorrect health information. The objective of this study was to review the findings of analytical studies about the contents of textbooks used in elementary, junior high, or high schools. Of 450 studies we screened, we reviewed 14 that met the inclusion criteria, and summarized information regarding: *i*) authors and publication year, *ii*) target country, *iii*) topics selected, *iv*) school level, *v*) textbook subject(s), *vi*) analytical methods, and *vii*) findings. Of the selected 14 studies, 9 were conducted in the United States and Spain. Health topics focused mainly on sexuality, HIV/AIDS, and nutrition. The reviewed studies were classified according to the amount of topic information they contained, the accuracy of the health information provided, and the health information priorities conveyed. The findings of reviewed studies can be summarized as follows: some current school textbooks provide insufficient content and contain inaccurate or out-of-date health information. This study found through health-related content analysis of the school textbooks that textbooks in the United States and Spain cover sexuality, sexually transmitted diseases, and nutrition more often than do textbooks in other countries. Content quality is sometimes inappropriate and requires improvement.**

Keywords: School textbooks, school health, health education, content analysis, systematic review

1. Introduction

School health education has proven to be effective in increasing knowledge and improving attitudes, beliefs, and skills needed to practice healthy behaviors (*1*,*2*). School textbooks are essential materials for school health education (*3*,*4*). Particularly in resource-limited settings, school textbooks can play an important role as a source of reliable information (*5*). Because school textbooks can provide health information on disease prevention and essential health skills, the information they contain must be reliable. The United Nations Educational, Scientific and Cultural Organization (UNESCO) emphasizes improving the quality of textbooks as one of its policy recommendations within the Education For All Framework (*6*).

Despite the importance of accuracy, however, previous studies have indicated that school textbooks contain incorrect or insufficient health information (*7*). To reduce the likelihood of students receiving and accepting incorrect information, regular revision and regular improvement of content quality is essential for raising the health levels of students and their family members. Reviews of school textbooks by government authorities and the inclusion of priorities of national health policies are also recommended, yet few studies have assessed textbooks in terms of their health information content or examined their accuracy and frequency of revision.

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The objective of this study was to review the findings of analytical studies of the contents of textbooks used in elementary, junior high, and high schools.

2. Methods

2.1. *Search strategy and inclusion/exclusion criteria*

We did a search for eligible literature regarding school health and school textbooks. First, we conducted an electronic search of popular academic databases for health and education. Our electronic search strategy was first to look at the PubMed and the Education Resources Information Center (ERIC) Internet databases. PubMed is a service of the U.S. National Library of Medicine from MEDLINE and other life science journals of a biomedical nature. ERIC is an online digital library of education research and information, sponsored by the Institute of Education Sciences of the U.S. Department of Education. Both databases seemed appropriate choices because they are widely used in their respective fields (medicine and education) and cover the key words of the reviewed studies. In both PubMed and ERIC, the key words "schools" AND "textbooks" AND "health" were used to retrieve articles published between January 1980 and June 2009, with no language restrictions. The search strategy also included a review of the references cited by the identified studies. The process and the number of systematic reviews are shown in Figure 1.

The inclusion criteria were the following: the study must include content analysis of school textbooks; the textbooks examined must be used in elementary, junior high, or high school; the textbooks must include health-related information; and the articles must have been published between 1980 and 2009. As education systems in different countries differ, school levels were classified according to grades or ages, and defined as elementary school, junior high school, or high school. Content analysis is defined as the systematic, objective, qualitative analysis of message characteristics (*8*). Exclusion criteria were content analysis of content unrelated to health, use of intervention analysis, or use of the textbooks in kindergartens or college/university-level education.

Titles and abstracts of studies were screened primarily using the key words. Two reviewers independently assessed all titles and abstracts retrieved through the electronic searches. An initial relevance screening generated 450 studies in total from the literature search, including 245 studies from PubMed

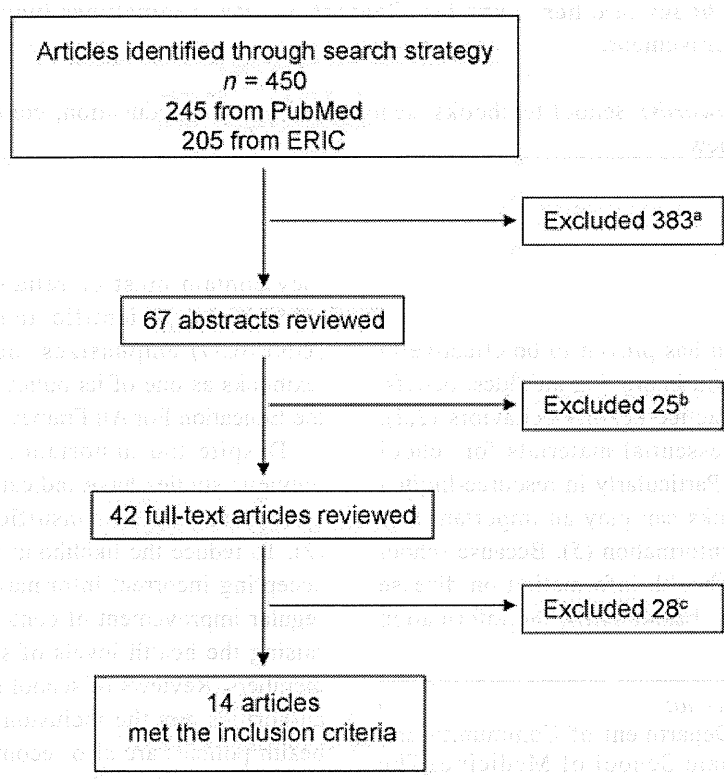

Figure 1. Flow chart of the study selection process. [a] The 383 excluded articles included those with no content analysis or content analysis on other topics. [b] These 25 articles were excluded because target school levels did not meet the inclusion criteria. [c] These 28 excluded articles included intervention studies or content analysis not related to health topics.

and 205 from ERIC.

Of these 450 studies, 383 were excluded due to a lack of content analysis or a suggestion in the titles or abstracts that the content analysis was of non-health-related content. This screening yielded 67 studies that met the initial inclusion criteria. Next, the abstracts of the 67 studies were collected and independently reviewed, and excluded from full-text review if the content analysis was not focused on school textbooks or if the topic was not health-related.

Of the 67 studies, 25 were excluded because their target school levels did not meet our inclusion criteria. The remaining 42 studies returned by the searches were included in the full-text review. Full-text copies of the 42 studies identified as potentially relevant were retrieved; their full texts in English were collected and reviewed; they included 8 non-English studies that had been translated into English. In cases where reviewers disagreed on the eligibility of reviews, a discussion was held in order to obtain consensus. The studies in full-text were included if they met all of the above-mentioned inclusion criteria (use of content analysis, use of textbooks in elementary, junior high, or high school, and focus on health information, including hygiene, infectious diseases, and other health topics). We excluded intervention studies and systematic reviews. The 42 full-text screened studies were reexamined several times by two reviewers.

Of the 42 full-text studies, 28 were excluded because they included intervention studies or systematic reviews, or they analyzed non-health content. Ultimately 14 studies met the inclusion criteria and were examined. Of the 14 studies, 5 were not written in English: 3 were in Spanish (*4,9,10*), 1 was in Portuguese (*11*), and 1 was in German (*12*). We asked native speakers of Spanish, Portuguese, and German to translate the 5 studies into English and reviewed the English translations. Searches were conducted between May and August 2009.

2.2. *Assessment*

All the studies of content analysis were examined from two aspects: the content of relevant domains, and the total numbers of pages, tables, figures, and pictures/illustrations. All were summarized using a form containing 7 categories for comparison. The 7 categories included: *i*) authors of references and year of publication, *ii*) target country, *iii*) specific health topic, *iv*) school level or grade, *v*) textbook subject(s), *vi*) analytical method(s), and *vii*) findings. This process resulted in a document with tables.

3. Results

We summarized the characteristics of the 14 studies of content analysis we examined in Table 1.

3.1. *Target country*

Of 14 studies, 12 were conducted in North America or Europe. The target countries were: the United States in 6 studies, Spain in 3, and Brazil, Canada, Mexico, Switzerland, and the United Kingdom in 1 each. Twelve of the studies were conducted in developed countries, 2 in middle-income countries, none in low-income countries.

3.2. *Specific health topics covered*

Of the 14 studies, 2 evaluated the priorities of the health information content in the textbooks (*4,9*). The main health topics in 12 studies were sexuality, sexually transmitted diseases (STDs), and nutrition. Of the included studies, 4 focused on sexuality, including reproductive health, gender representation, and STDs (*7,13-15*), 3 focused on nutrition or diet, including excessive intake of sugar-rich food (*12,16,17*), and 1 each focused on HIV/AIDS (*10*), mental health (*18*), hearing health (*19*), oral cancer (*20*), and vaccination (*11*). Two other Spanish studies identified the priorities of health topics covered. In a study conducted by Catalán in 2003, the priorities were hygiene, followed by eating (*9*); in the other study conducted by Barrio Cantalejo *et al.* in 2008, they were diet, physical exercise, and the impact of environmental contamination (*4*).

3.3. *Target school levels and textbook subjects*

Target school levels and textbook subjects were diverse. Of the 14 studies, 9 studies targeted a single school level: 5 targeted elementary schools, 3 targeted junior high schools, and 1 targeted high schools. The remaining 5 targeted multiple school levels: 1 study each targeted elementary and junior high schools, elementary and high schools, or junior high and high schools; the remaining 2 studies targeted all three school levels. The textbooks examined covered the full range of subjects: health science, language, arts, mathematics, history, science, arithmetic, algebra, and chemistry.

3.4. *Analytical methods*

All 14 studies examined were descriptive studies of content analysis. Content analysis is an in-depth analysis of messages using quantitative or qualitative techniques. The studies' analytical methods fell into three main patterns: *i*) analysis of the amount of topic information in words, pictures, and/or illustrations (8 studies); *ii*) examination of the accuracy of health information (2 studies); *iii*) identification of health-related topics and their priorities (2 studies). Of the two remaining studies that did not fall into any of the three main patterns, one identified the impact of political and

Table 1. Results of reviews by target country, school grade level, subjects, and methodology

Author, year	Target country	Specific health topics	School level and grades	Subjects of texts	Analytical methods	Findings
Tolan and Lounsbury, 1982	US	Mental health	High school. No information about grades.	Health textbooks	Examination of community mental health ideology presented in high school health textbooks.	Information in high school health textbooks does not adequately represent modern mental health knowledge or practice. It does not meet society's mental health needs.
D'Onofrio and Singer, 1983	US	Nutrition, sugar, sweets	Grades K-3 in elementary school.	Readers, pre-readers, and reading workbooks	Analysis of food-related content in words and pictures in texts.	Food-related content in the texts revealed an excessive emphasis on sweets in both words and pictures. The poor results of nutrition education have been publically decried. Unintended messages may work against the promotion of healthy eating habits. Textbook revision is clearly indicated.
Kroger and Yarber, 1984	US	STD and sexuality	Junior high school. No information about grades.	Health science and sex education	Assessment of potential contribution of textbooks to STD control objectives.	Sex education textbooks contribute to STD control objectives better than do health science textbooks. Health science textbooks may not contribute toward reducing STD incidence. Both types of textbooks present biomedical information without significant errors.
Frager and Kahn, 1988	US	Hearing health and protection	Elementary school. No information about grades.	School health textbooks	Identification of health information on hearing and assessment of its usefulness to prevent hearing loss.	More content regarding the signs and causes for hearing problems was identified than recommendations for avoiding hearing problems. Hearing health mobilizing information is lacking.
Beyer *et al.*, 1996	US	Gender representation	Junior high and high school. No information about grades.	History, mathematics, science, and reading	Examination of gender inequity in written textbooks.	Illustrations showed greater female representation. Greater male representation included that related to drug use, sexual exploitation, sexual desire, and homosexuality. Greater female representation included that related to body image, diseases of the reproductive organs, and hygiene.
Baysac *et al.*, 2004	US	Oral cancer	Grades 1-12 in elementary, junior high, and high school.	Health education	Evaluation of quality, completeness, and accuracy of oral cancer information.	Current school health textbooks do not provide adequate information about oral cancer prevention and early detection. To achieve Healthy People 2010 objectives, correct and adequate information about risk factors and examinations for oral cancer are needed.
Gavidia Catalán, 2003	Spain	All health information	Elementary, junior high, and high school. No information about grades.	All subjects	Identification of 1) presence or absence of education for health, 2) inclusion of health-related topics, 3) degree of health covered, 4) inclusion in the subject or dealt with on a transversal basis, 5) methodological aspects.	Sixty-three percent of the texts analyzed included topics on health education. Most topics were related to hygiene and eating. Health-related concepts most often dealt with are those of being disease-free and in a state of well-being. Current school textbooks are not sufficient either as a point of reference or as an adequate resource.
Barrio Cantalejo *et al.*, 2008	Spain	All health information	Elementary and high school. No information about grades.	No information about subjects.	Identification of 1) health priorities defined by health organizations, 2) messages on health, 3) extent to which these messages fit the priorities established.	The priorities most frequently covered in the textbooks were diet, physical exercise, and the impact of environmental contamination. The health messages contained in school textbooks are not well adapted to the priorities defined by health organizations.

Abbreviations: STD, sexually transmitted diseases; STI, sexually transmitted infection.

(to be continued)

Table 1. Results of reviews by target country, school grade level, subjects, and methodology (*continued*)

Author, year	Target country	Specific health topics	School level and grades	Subjects of texts	Analytical methods	Findings
de Irala *et al.*, 2008	Spain	Sexuality, human reproduction, and STIs	14-15-year-olds in secondary school	Biology	Evaluation of the extent to which textbooks on sexuality and human reproduction promote healthy reproductive lifestyles as well as avoidance of risk behavior among adolescent students.	All textbooks presented inaccurate information and incomplete perception of sexuality or risky behavior. On average, 12.6 incorrect messages were identified in each textbook. Eleven of 12 textbooks examined provided misleading statements on condom use for contraception and STI prevention and on family planning methods. The textbooks were neither appropriate nor sufficiently comprehensive for adolescent education on issues of sexuality. Results suggest a need for alternative textbooks based on better scientific evidence. Teenage sexual activities described in the textbooks are not supported by epidemiological data from the Spanish National Institute of Statistics.
Succi *et al.*, 2005	Brazil	Vaccines	Grade 1-8 in elementary school	Science and biology	Evaluation of content of textbooks with regard to concepts and information on vaccination.	Despite Ministry of Education recommendations, 34% of elementary-level textbooks did not include the subject of vaccination. More than half of the textbooks with content on vaccines presented some erroneous information on vaccination, errors in vaccination schedules, out-of-date information, omission of content, or inadequate illustrations.
Baron, 1990	Canada	Nutrition	Grade 1-6 in elementary school	Language, arts, and mathematics	Detection of nutrition messages in words and pictures.	A large proportion of references were to sugar-rich foods. Unintended information may influence nutritional habits of children.
Granados -Cosme *et al.*, 2007	Mexico	HIV/AIDS prevention	Grade 5-6 in elementary and 1-3 grade in junior high school	Natural science, biology, civics, and ethics education	Clarification of social actors' positions and interests and their influence on the content of textbooks.	Those actors whose beliefs are based on tradition and are contrary to modernization oppose the inclusion of topics on sexuality and HIV/AIDS in the school curriculum. The deficiencies and decline in HIV/AIDS prevention education were caused by actions from opposition groups.
Eichholzer -Helbling *et al.*, 1984	Switzer-land	Nutrition	Grade 1-4 in elementary school	Reading, arithmetic, and language	Examination of contents regarding nutrition in the textbooks.	Educational information regarding nutrition can be found in all textbooks, but it was not adjusted to today's perceptions.
Reiss, 1998	UK	Sexuality	14-15-year-olds in high school	Biology and science	Analysis of health topics related to human sexuality in school science textbooks.	Some science textbooks are sensitively written, comprehensive, and helpful. Others fail to tackle personal issues dealing with menstruation, ignore lesbian and gay issues, and either omit or fail to deal adequately with cultural issues in spite of the regulations of the UK Government's own Circular.

Abbreviations: STDs, sexually transmitted diseases; STI, sexually transmitted infection.

social ideology on the content of HIV/AIDS education (*10*), another identified gender representation and examined gender inequity in textbook descriptions (*14*).

As the objective basis of analyses, 4 studies cited the country's national health policies or recommendations as a standard, and compared them with the content of health information in the textbooks. The 4 studies cited Healthy People 2010 in the United States, health priorities defined by health organizations or authorities in Spain, or recommendations of the Ministry of Education in Brazil. Other studies had no standards by which to evaluate the contents.

3.5. *Findings*

To summarize the quality of the school textbooks examined in findings, we chose the amount, the accuracy, and the currency of the health information on target health topics. We showed the results using the "+" symbol in Table 2. Of 14 studies reviewed, 11 reported that the school textbooks examined provided insufficient content or lacked information regarding the target topics; 5 studies reported that the health information in textbooks included inaccuracies or false information; and 5 studies reported that the health information was not current or was out-of-date and needed revision. In total, the authors of 13 of the 14 studies indicated that the textbooks they examined needed further improvement or revision.

In comparisons of the contents with national health policies or priorities, 4 studies cited the target country's health policy or Ministry of Health/ Education recommendations as standards. For example, they cited Healthy People 2010 objectives (*20*), the guidelines of Ministry of Education (MEC) (*11*), the UK Government's own Circular, the Local Government Act, and the Education Act (*15*), 24 priorities defined by the World Health Organization, the European Union, the Spanish Ministry of Health and Consumer Affairs, and the Spanish Society of Public Healthcare Administration (*4*).

4. Discussion

Content analysis of school textbooks often focused on sexuality/reproductive health and STDs; 4 out of 14 studies focused on these topics. These topics are important because unintended pregnancy is one of the main reasons why female students drop out of school (*21,22*). Furthermore, young people are particularly vulnerable to HIV infection: 15-24-year-olds account for 50% of new cases worldwide (*23*). They must be provided with essential skills and information before they become sexually active (*24*). The authors of these studies examined textbooks used in elementary and junior high schools (targeting 14-15-year-old students).

Although sex education is known to be difficult to deliver in school settings (*25*), previous studies have reported that school children in many countries identify textbooks or school as their primary source of health information (*26-29*). The importance of information delivered in school settings has also been demonstrated by its long-term impact on healthy behaviors (*30,31*). Thus, the contents of school textbooks require regular revision to provide students with accurate health information regarding sexuality, STDs, and reproductive health.

Three studies highlighted the over-representation of graphical information presenting sugar-rich food in the textbooks (*12,16,17*). The authors suggested the potential impact on school children of the over-representation of unhealthy eating behaviors. As

Table 2. Quality of the school textbooks examined

Author, year	Specific health topics	Quality		
		Insufficient information	Lack accuracy	Out-of-date information/ need revision
Tolan and Lounsbury, 1982	Mental health	+	+	+
D'Onofrio and Singer, 1983	Nutrition		+	
Kroger and Yarber, 1984	STD and sexuality	+		
Frager and Kahn, 1988	Hearing health and protection	+		+
Beyer *et al.*, 1996	Gender representation	+		
Baysac *et al.*, 2004	Oral cancer	+	+	
Gavidia Catalán, 2003	All health topics	+		
Barrio Cantalejo *et al.*, 2008	All health topics	+		
de Irala *et al.*, 2008	Sexuality, human reproduction, and STIs	+	+	+
Succi *et al.*, 2005	Vaccines	+	+	+
Baron, 1990	Nutrition			
Granados-Cosme *et al.*, 2007	HIV/AIDS prevention	+		
Eichholzer-Helbling *et al.*, 1984	Nutrition			+
Reiss, 1998	Sexuality	+		

+: include the comment shown at the top of the column.

unintended messages conveyed in textbooks may counteract efforts to promote healthy eating habits, those responsible for textbook selection should draw up health content guidelines.

In the 14 studies we reviewed, none focused on tobacco use, injury prevention, or alcohol/substance abuse, which have been emphasized as central to health education curricula in school settings (*32,33*). Our results also revealed that the researchers paid little attention to these topics in content analysis. However, educational interventions using various approaches including peer-education and linkage with supportive communities and policies have been intensively utilized in the school setting (*34-36*). Nonetheless, these studies emphasized the importance of comprehensive approaches and of basic curricula as principal components of health education.

The findings examined by the studies we reviewed were summarized as follows: most of the reviewed articles consistently reported insufficient health information provided by the textbooks. This tendency was particularly evident in the studies dealing with sexuality or STDs (*7,13,15*). However, 13 out of 14 studies reviewed also reported a wide range of variation among publishers in content insufficiency, inaccuracy, or out-of-date information.

In comparisons of content with national health policies or recommendations, only 4 studies cited the country's national health policy or recommendations as a standard. To evaluate the quality of school textbooks objectively, some standard of comparison is needed.

We also found that studies were mostly confined to developed nations: the target countries of 13 of the 14 studies were the U.S., Spain, Canada, Switzerland or the United Kingdom. This might be due to wider availability of textbooks in developed countries. However, 80% of the world's children live in developing countries where resources for textbook development are more likely to be limited than in developed countries (*37,38*). School textbooks used in developing countries also need to be examined with a view to improving the contents of health information.

To regularly and reliably provide sufficient and accurate health information in school textbooks to school children, we need to assess the adequacy of all school textbooks, whether they are used in developed or in developing countries.

5. Conclusion

In conclusion, this study showed that health-related content analysis of school textbooks is done mostly in Spain and the United States and most frequently examines content related to sexuality, STDs, and nutrition. The quality of the content is sometimes inappropriate and requires improvement.

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付録Ⅱ．教科書における健康に関する記述（ネパールの事例）

Subject	Grade	Page	Topic	Description
My Science, Health and Physical Education	1st	52	Basic Hygiene	**Cleanliness of My Body** 1-Clean mouth 2-Clean nose 3-Brush teeth 4- Comb hair 5- Take bath 6-Cut nails **Health Message** "Let's keep our teeth clean. Let's prevent toothache." **Clean House and School** 1- Always clean your house and house yard. 2- Don't throw wastes near house haphazardly. Don't defecate haphazardly. 3- Don't throw wastes around school area. 4- Keep school area clean. **Health Message** "Let's throw wastes at specific pits. Let's keep the school clean." **I Am Careful** 1- Hands get cut in door 2- Falling down from trees 3- Falling down from desks 4- Hand burn by hot objects 5- Cut by glass pieces 6- Electric shock **Health Message** "Let's not play with fire, electricity and sharp objects. Let's prevent injuries."
		55		
		62		
My Science, Health and Physical Education	2nd	42	Basic Hygiene	**Body Cleanliness** Our body is made up of different organs. We must keep these organs clean. To keep our body clean, we need to do several things. We must take bath daily. After bathing, body should be wiped with clean towel.

				Hair should be combed with clean comb. Nail should be cut with nail cutters. Never bite nails. After taking food, always brush your teeth. While brushing your teeth, brush must be moved up and down and even inside. Face, eye and nose should be cleaned with clean water. While bathing or washing hand/feet, make sure that the slippery foam of the soap goes out.
My Science, Health and Physical Education	2nd	45	Health Message	"Before taking food/meal, let's wash our hands with soap and water or ash and water. After eating, let's brush our teeth. After taking sweets, let's gargle our mouth. Let's take regular bath. Let's clean our eyes with clean water every morning and evening."
My Science, Health and Physical Education	2nd	46	Basic Hygiene	**House Cleaning** Always be clean and tidy. Your study room or bed room should always be clean. Wall and ceilings of house must always be clean. Dust and dirt which get stuck on doors and windows must be wiped with clean clothes. House yard must always be cleaned or swept with the help of brush. Dirt, dust and garbage should be collected in a garbage box (container). Paper, plastics and solid wastes must be collected in separate boxes. Decomposable (organic) wastes can be collected in a pit and later on can be made compost. Plastic and solid wastes can be reused. While going to toilet, wear slippers. After using toilet, water should be poured in. After urination and defecation, hand must be washed with soap or ash water. Taps should be kept clean after you take bath, wash your hands and feet and after doing other works. There should be a proper drainage system for tap water and kitchen water.
My Science, Health and Physical Education	2nd	47	Basic Hygiene	**Health Message** "Let's throw garbage at specific pits. Let's clean our house and school. Let's keep water source clean. Let's use toilet for defecation."
My Science, Health and Physical Education	2nd	50-51	Basic Hygiene	**My Foods** Vegetables should be properly cleaned before cooking. Food must be clean and fresh.
My Science, Health and Physical Education	2nd	52	Basic Hygiene	**Drinking Water** We all need water. Without water, we can't survive. Drinking water must be safe. Clean water without germs is called safe water. We must always store water in clean pots with their lids closed. Water must be made safe either by boiling or filtering. Due to safe water drinking, stomach and skin also become healthy. Therefore,

				always make habit of drinking clean germ free water.
My Science, Health and Physical Education	2nd	56	Injury Prevention	We live in house. It provides us safety. If we are not careful, accidents /injuries can occur inside our house also. Sometimes, it may be fatal. We daily go to school. We play and eat together with friends. Accidents may occur due to friend's carelessness or naughty behaviors.
My Science, Health and Physical Education	3rd	99-101	Injury Prevention	There are many causes of accidents. Most accidents occur while walking on streets, getting in and out of bus, using sharp objects. Accidents may also occur from other causes. Certain accidents occur due to their own carelessness. There is also a danger of having road accidents in urban areas. In urban areas, the number of vehicles and people is increasing day by day. We can avoid accidents by following traffic rules. If we apply safety measures, accidents can be prevented. In rural areas, while coming and going to school, students have to walk through forests, rivers and hill paths. If they do not walk carefully, they may fall down or may get wounded. Accidents may occur falling down from trees. If an accident or injury occurs, doctor or health institution must be made available immediately. To avoid further complications of the injured person, primary treatment must be done. Primary treatment means the immediate service provided to an injured person until he or she reaches to hospital or health institution. Such services can be provided by person who has primary treatment-related skills. Primary treatment of major injury can be done by cleaning the injury/wound with dettol (antiseptic) or clean water and bandaging it. In case of major wounds/injuries, avoid bleeding and immediately take to hospital or health institution. Through primary treatment, we can save injured person's life. It would be useful to gain knowledge and skills regarding primary treatment.
My Science, Health and Physical Education	3rd	81-82	Basic Hygiene	**Clean House, Neighbor and Community** Clean house is a good house and everybody likes it. If everybody's house is clean, its neighbor as well as community will be clean. Clean community will have clean environment. In house and community with clean environment, there is less chances of getting communicable diseases. For healthy life, healthy environment is needed. When we throw household wastes/garbage haphazardly, our house and community will be polluted. In stagnant water, mosquitoes and disease germs will multiply and increase. To keep house clean, wastes/garbages