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Evaluation of Leptospirosis Risk Reduction Project in Northeast Thailand

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Evaluation of Leptospirosis Risk Reduction Project in Northeast Thailand

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Abstract

Evaluation of Leptospirosis Risk Reduction Project in Northeast Thailand

By: Kayoko Shioda

Background: The number of leptospirosis has been considerably increasing in these decades in Thailand, and 90% were reported from the northeast region. Therefore, a project was launched to reduce the risk of leptospirosis by providing villagers with basic knowledge of the disease and personal protective equipment in northeast Thailand.

Objective: This study aims to evaluate the efficacy of the intervention by assessing villagers' improvement of knowledge, attitudes, and practices regarding control of leptospirosis using a questionnaire.

Methods: One thousand randomly recruited villagers in South Korn Buri Subdistrict in Nakornratchsrima Province received the intervention and answered the questionnaire before and three months after the education campaign delivered by the trained village health volunteers. Two hundred and fifty randomly selected villagers in Bantoom subdistrict in Khon Kaen Province answered the same questionnaire twice without receiving any intervention. Paired t tests were performed to compare the scores of knowledge, attitudes, and practices before and after the intervention. Multiple linear regression (MLR) models were created whose outcomes were the score changes of knowledge, attitudes, and practices, and the primary exposure was the presence of intervention.

Results: In the intervention group, the score of knowledge (score range: 0 to 22) increased by 0.94 points (95%CI: 0.73 to 1.15), and the score of practices (score range: 0 to 48) increased by 1.81 points (95%CI: 1.41 to 2.21) after the intervention, on average (both $p<.0001$). The score of attitudes (score range: 0 to 10 for field workers, 0 to 6 for non-field workers) increased by 0.27 (95%CI: 0.14 to 0.40, $p<.0001$) among field workers, but did not change among non-field workers. According to the MLR models, receiving the intervention had positive associations with the improvement of knowledge, attitudes, and practices among both field workers and non-field workers, after adjusting for potential confounders, except the attitudes among non-field workers.

Discussion: This study demonstrated that the intervention with narrow budget and limited human resources could improve villagers' knowledge, attitudes, and practices regarding prevention of leptospirosis. It could be a model to control preventable infectious diseases at a community level, which could be easily applied to other regions in Thailand.

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CHAPTER I

BACKGROUND

AND

LITERATURE REVIEW

1-1. BACKGROUND AND DESCRIPTION OF THE PROJECT

Leptospirosis is a globally spreading infectious disease found in humans, animals, and the environment (1). *Leptospira sp*, the causal bacteria, are transmitted from the urine of infected animals through the compromised skin or mucosal membranes of humans, and cause various symptoms: an influenza-like illness, renal failure, jaundice, hemorrhage, and death. In Thailand, the number of cases has been increasing significantly in last two decades. Before 1980, there were only 10 to 20 cases per year, but in 2000, 14,285 cases were reported, and since then there have been about 5,000 cases every year (2). Though leptospirosis is easily preventable, many people have suffered from the disease due to a lack of knowledge about the disease, such as sources of infection, transmission routes, and risk behaviors.

Based on this fact, the World Health Organization (WHO) Country Office for Thailand launched a project to prevent and control leptospirosis in Thailand through two principle measures: educating villagers about the disease and distributing personal protective equipment such as boots and gloves. Because 90% of leptospirosis cases have been reported in northeast Thailand in the last two decades, an area in the Northeast region (South Korn Buri Subdistrict in Nakornratchsrima Province) was chosen as a study site for the project (3).

The core part of this intervention was the education program for villagers that provided them with basic knowledge of the disease so that they reduce their exposures to *Leptospira* bacteria. A total of 113 village health volunteers (VHVs) played a key role in the education program. They participated in a one-day workshop

organized by provincial government officers, physicians at local hospitals, staff from Chulalongkorn University, and the WHO staff. Through this workshop, the VHVs learned a basic knowledge of leptospirosis as well as how to educate neighbors using an information booklet. The booklet was seven pages long, and it had only pictures on one side, and corresponding text on the other side.

The first page of the booklet was about the basic characteristics of leptospirosis, such as how it looks under microscope, how it enters the human body, and carriers of leptospires. The second page described where leptospires exist. The third page explained major routes of entry of leptospires: cuts/scratches or macerated skin, and soft tissues such as conjunctiva, nasal mucosa, oral mucosa, and vaginal mucosa. The fourth page introduced various risk behaviors including: (a) wading barefoot; (b) being in contaminated water for more than six hours even without wounds; (c) swallowing contaminated water; (d) opening eyes in contaminated water; (e) drinking or eating contaminated fruits and vegetables; and (f) leaving foods without a cover. The fifth page was about symptoms of leptospirosis patients, including high fever, headache, muscle ache around thigh and calf, red eyes, palatal exanthema, hematemesis, and dyspnea. The sixth page described preventive behaviors, such as (a) avoiding swimming or fishing in water that has been drunk by cows and buffalos, or in places that are full of rats; (b) avoiding wading barefoot, especially when injured on the arm, leg, feet or any part of the body; (c) avoiding walking barefoot in fields or animal barns; (d) wearing boots, gloves, and clothes that can fully cover the body when working in fields; (e) taking shower immediately with soap after wading in water; wearing gloves when you slaughter animals; (f) avoiding

eating uncooked meat or uncooked vegetables without thoroughly washing; and (g) avoiding swallowing water or opening eyes in dirty water. The last page explained that some patients get infected but show no symptoms due to the amount and type of bacteria that infected their body, and their immunity and health condition. After the workshop, the VHVs visited their neighbors, explained basic knowledge of leptospirosis using this booklet, and raised villagers' awareness of the need for risk reduction measures against leptospirosis.

In addition to the education program, boots and gloves were distributed to rice field farmers to achieve risk reduction, because they usually needed to go to big cities to purchase boots and gloves, which had discouraged them from buying and using them in fields. Farmers were targeted because 71.5 to 83.9% of leptospirosis patients in this area were farmers and the leptospires enter human body via contaminated water in rice fields (2).

These interventions were implemented in August, because it has been known as a high morbidity month of leptospirosis. August is a rice planting season, and rats like to eat seeds which are found under the ground at the base of rice seedlings. Therefore, water in rice fields is likely contaminated with the urine of rats, which increases risk of infection in this season if farmers do not wear boots and gloves.

To evaluate the efficacy of the project, villagers were asked to answer a self-administrated questionnaire both before and after the interventions. The improvement of villager's knowledge, attitudes, and practices regarding leptospirosis control were assessed based on their answers to these questionnaires. The ultimate

goal of this intervention was to establish a model of local infectious disease prevention with a narrow budget and limited human resources that could be easily applied to other regions in Thailand.

1-2. STUDY SITE

1-2-1. Thailand

Thailand, officially the Kingdom of Thailand, is a Southeast Asian country located at the center of the Indochina Peninsula (Figure 1-1). Thailand shares borders with Myanmar, Laos, Cambodia, and Malaysia. The total area of Thailand is approximately 514,000 km^2, making it the third largest country in Southeast Asia and the 51st largest country in the world (4). The country has 75 provinces, and its capital is Bangkok. The country is divided into four regions: North, Northeast, Central, and South. The Central region has very fertile land and includes Bangkok and 33 provinces, while the Northeast is the poorest and most arid area comprising 20 provinces. The North region has nine provinces and is covered with mountains and fertile valleys. The South region has 14 provinces, and is comprised primarily of a peninsula covered with rainforest (5).

Thailand has three seasons: cool (November to February), hot (March to May), and rainy (June to October) (2). The minimum and maximum temperatures are 20 C and 37 C, on average (2). The average precipitation in Thailand is approximately

1,700 mm or 252 billion m^3 per year; however, the North and the Northeast regions have less than eighty rainy days in each year (2).

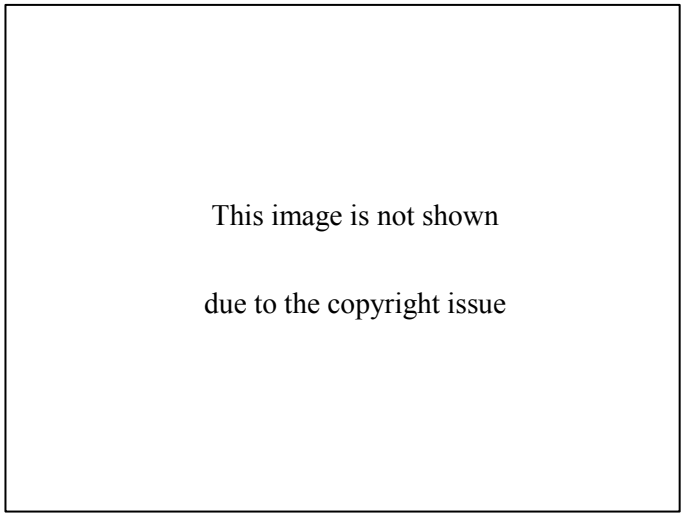
The decennial census in 2010 showed the total population of Thailand was 66,785,001 (up from 65,559,487 in 2005) (6). The sex ratio at birth (males per 100 females) was 106.7 in 2005-2006. The official language is Thai. Approximately 95% of Thai people are Buddhist. With regard to economy, Thailand has been rapidly growing over the past decades, and is now categorized as an upper middle income country by the World Bank. The Gross Domestic Product (GDP) in 2012 was 366.0 billion, while the annual GDP growth was 7.8% (2010), 0.1% (2011), 6.5% (2012), and 3.2% (2013) (6). On the other hand, 13.2% of the population lived below the national poverty line in 2011. Life expectancy at birth has been increasing in recent decades, and was 74 years in 2011(6).

With regard to the education system, the 1999 National Education Act (NEA) and the 2002-2016 National Education Plan proposed to raise compulsory education from six to nine years (7). The percentage of primary school enrollment was 97% in 2009, and disparity among income levels has diminished since 1994 (7). Regarding infrastructure, 95% of the rural population has access to an improved drinking water source, such as piped water on the premises (6).

Thailand's health care infrastructure has recently experienced decentralization, and the provinces and districts have gained authority for providing health services (8). According to a WHO report, the Bangkok Metropolis has five medical school hospitals, 29 general hospitals, 19 specialized hospitals/institutions, five 10-bed community hospitals, and 61 public health centers (8). At the provincial

level, there are 70 general hospitals, which cover all provincial areas, and 57 hospitals supported by various agencies of the Ministry of Defense. At the district level, 725 community hospitals cover 91.2% of all districts. There are also two extended outpatient departments or hospital outlets and 214 municipal health centers. At the subdistrict level, 9,765 health centers cover all subdistricts. At the village level, there are 311 community health posts, 66,223 rural community primary health care centers, and 3,108 urban community primary health care centers.

Figure 1-1. Map of Thailand



Source: maps.com

1-2-2. Nakornratchsrima Province and South Korn Buri Subdistrict

Nakornratchsrima Province, which is the largest province in Thailand (20,494 km^2), is one of twenty provinces in northeast Thailand (Figure 1-2A). It is often called by its nickname, Korat. It is 259 km (161 miles) from Bangkok. The total population is 2,525,975 in 2010 (9). Rice farming is a major occupation, and 472,689

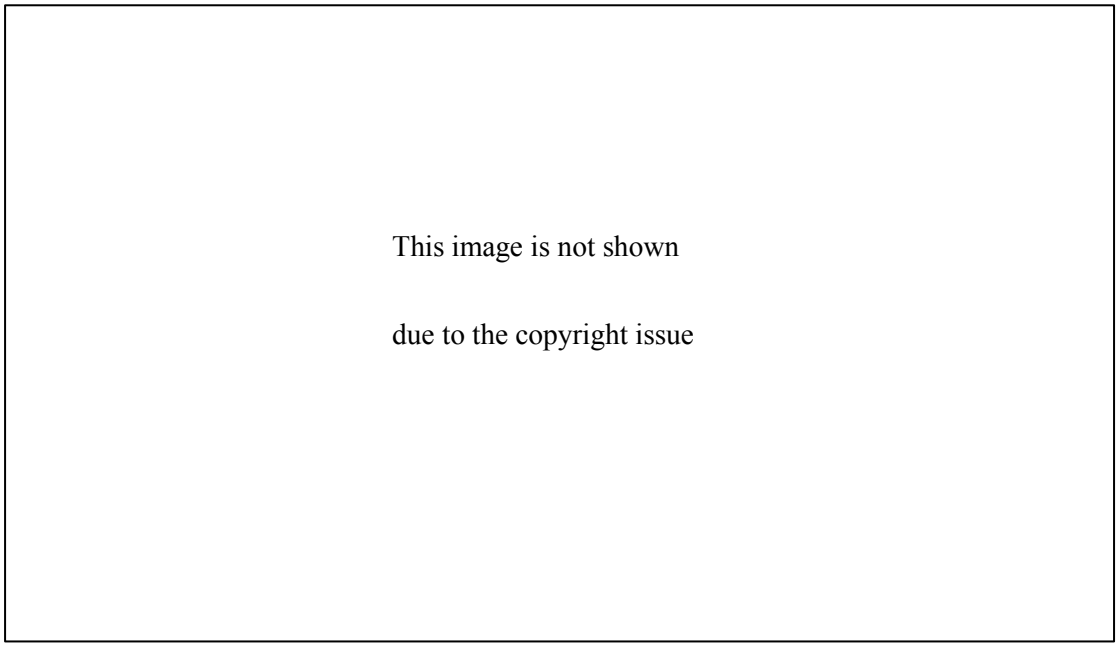
(30.2%) people were farm workers and fishery workers out of 1,562,827 employed persons whose age was 15 years or older in 2012 (10). The average annual precipitation is 1,028.1 mm, and the number of days which have more than 0.1 mm of rainfall is 107.9 days per year, on average (11).

This province has 32 districts that are further divided into 263 subdistricts and 3743 villages. The leptospirosis prevention project was implemented in one of 12 subdistricts in Korn Buri District − South Korn Buri Subdistrict (Figure 1-2B). Korn Buri District has 17 primary health care centers and 53 villages.

Figure 1-2. Map of Nakornratchsrima Province and Korn Buri District

A: Location of Nakornratchsrima Province

B: Location of Korn Buri District in Nakornratchsrima Province



Source:
http://www.watisan.com/wizContent.asp?wizConID=664&txtmMenu_ID=148
http://www.geocities.ws/sigdivs/mapkorat1.html

1-3. LEPTOSPIROSIS

1-3-1. Microbiology of Leptospirosis

Leptospirosis is a globally spreading infectious disease caused by bacteria called leptospires. It is a zoonosis disease first discussed in the literature by a German physician, Adolf Weil in 1886 (1). The most severe form of leptospirosis is called Weil's disease. Leptospires were discovered by Inada, Ido, Hoki, and Ito in Japan in the second decade of the 20th century (12).

Leptospires are corkscrew-shaped bacteria in the order Spirochaetales, family Leptospiraceae, genus *Leptospira*. Dark-field microscopy is the best method to observe leptospires, which can be distinguished from other spirochaetes due to the presence of end hooks (1, 13). Leptospires can be either pathogenic or saprophytic, and there are more than 200 pathogenic serovars, which can be classified into 25 serogroups (1, 13). Pathogenic leptospires can be found in the renal tubules of certain mammals in nature. Saprophytic leptospires are maintained in wet or humid environment, such as surface waters, moist soil, and tap water. These two types of leptospires can be distinguished by several laboratory techniques based on culture conditions and on antigenic and genetic properties (1).

1-3-2. Clinical Features, Diagnosis, and Treatment of Leptospirosis

The clinical manifestations of leptospirosis vary greatly and are often non-specific, which makes diagnosis difficult and morbidity unclear. According to the WHO and the International Leptospirosis Society (ILS), the symptoms of

leptospirosis can be categorized into four groups: (i) a mild, influenza-like illness; (ii) Weil's syndrome characterized by jaundice, renal failure, hemorrhage and myocarditis with arrhythmias; (iii) meningitis/meningoencephalitis; and (iv) pulmonary hemorrhage with respiratory failure (1).

Because the symptoms of leptospirosis are often non-specific, it has been underreported due to confusion with other diseases, such as dengue fever and other hemorrhagic fevers. Destruction of the endothelial lining of small blood vessels causes symptoms, but the mechanisms are not well known (1, 13). Leptospirosis is a preventable disease but can be fatal without treatment due to renal failure, cardiopulmonary failure, and widespread hemorrhage. Infected patients usually develop symptoms in five to 14 days, with a range of two to 30 days (1). Antibodies are usually produced seven days after the onset of disease, but it can take up to 10 days or more. Serovar-specific antibodies can prevent reinfection with the same serovar if the titer of antibodies is high enough.

The laboratory tests, such as detecting antibodies, culturing bacteria from blood, urine or tissues, or demonstrating the presence of leptospires using antibodies labeled with fluorescent markers, are used for diagnostic confirmation (1). The optimal treatment for leptospirosis is antibiotics, such as penicillin, amoxicillin, ampicillin, doxycycline, or erythromycin (14). It is most effective if it is initiated during an early phase of the disease.

1-3-3. Leptospirosis among Animals

Various mammals can be infected by leptospirosis, and can be sources of human infection. The most important natural reservoirs are rodents (rats, mice) and domestic animals (cattle, pigs, dogs, etc.), though reptiles and amphibians may also be carriers (1). Leptospires can be maintained in natural hosts without causing any symptoms, and natural hosts excrete leptospires in their urine for a long time or their lifespan (13). Clinical symptoms of leptospirosis among animals are also highly variable; symptoms can be asymptomatic, acute, subacute, and chronic. Therefore, diagnosis is difficult, and laboratory confirmation is required.

1-3-4. Transmission Routes of Leptospirosis

The most important source of leptospirosis infection is the urine of infected animals (1). The urine contaminates moist soil, nesting or foraging areas, farmyard floors, and sources of drinking water. Humans contract the disease by direct or indirect contact with the urine of infected animals or the contaminated environment. Drinking contaminated water, eating contaminated food, handling infected animal tissues, and inhaling droplets of urine are other possible routes of transmission. Leptospires can be found not only in aborted or stillborn calves but also in normal fetuses and vaginal excretion after calving.

Skin is the major route of entry of leptospires. Leptospires enter the body of humans and animals via abrasions or cuts in the skin (1). Even if humans do not have any wounds, just being in contaminated water for more than six hours increases the risk of infection. Intact mucous membranes (nose, mouth, eyes) are also the entry of

infection. Person-to-person transmission of leptospirosis rarely occurs (1, 13). Infection through sexual intercourse, transplacental transmission from mother to fetus, and infection through breast feeding are possible modes of human-to-human transmission. The urine and blood of patients could be considered as a source of infection. Leptospires can circulate in patients' blood only for short time, while they can be shed in urine for longer periods (1).

1-3-5. Prevention and Control of Leptospirosis

The measures of prevention of leptospirosis include (a) controlling the reservoir; (b) reducing infection in animal reservoir populations; (c) avoiding contact with animal urine and contaminated environment; (d) using appropriate protective equipment (gloves and boots) in water; and (e) cleaning human habitations (1). Vaccines for humans are available in some countries and vaccines for animals, such as dogs, are available in almost everywhere (1). Disinfectants and desiccation are utilized to clean small areas, such as floors in homes, but large areas cannot be disinfected.

At the population level, a surveillance system is essential to control leptospirosis. For example, reporting cases of leptospirosis immediately, identifying animal reservoirs in a particular area, and checking the environment for leptospires are important measures. It is critical to establish efficient real-time reporting systems through each level, such as district, province, region, and national levels. Strong networks between laboratories and community diagnostic services are also essential.

Education of residents and health care providers about leptospirosis is also useful to reduce the risk of infection.

In Thailand, leptospirosis has been a reportable disease under the National Passive Surveillance system since 1972 (2). Their clinical case definition of leptospirosis has followed the WHO standard. A standard case report form has been used for collecting information of patients, and has been reported to the Ministry of Public Health (MOPH) of Thailand. However, the previous survey found that physicians said the case definition and the care report system were difficult for them to follow (3).

1-3-6. Epidemiology of Leptospirosis in the World

Leptospirosis has been reported globally, but the high risk areas are tropical and subtropical areas that have high annual precipitation. The precise morbidity of leptospirosis is not known due to the difficulty of diagnosis confirmation and lack of awareness, and it varies depending on location (15). The reported number of human cases ranges from 0.1-1 per 100,000 per year in temperate climates to 10-1000 per 100,000 per year in the humid tropics (1). Case-fatality rates are also unclear; they have been reported to range from <5% to 30%, varying, again, in different parts of the world (1, 15).

Occupation and recreational activities are known to be associated with the risk of infection. Veterinarians, military personnel, meat workers, sewage workers, garbage collectors, and cattle, rice, and sugarcane farmers are high risk occupation

groups (1). In terms of recreational activities, swimmers, white water rafters, triathletes, and adventure athletes have high risk of infection (2, 14, 16, 17).

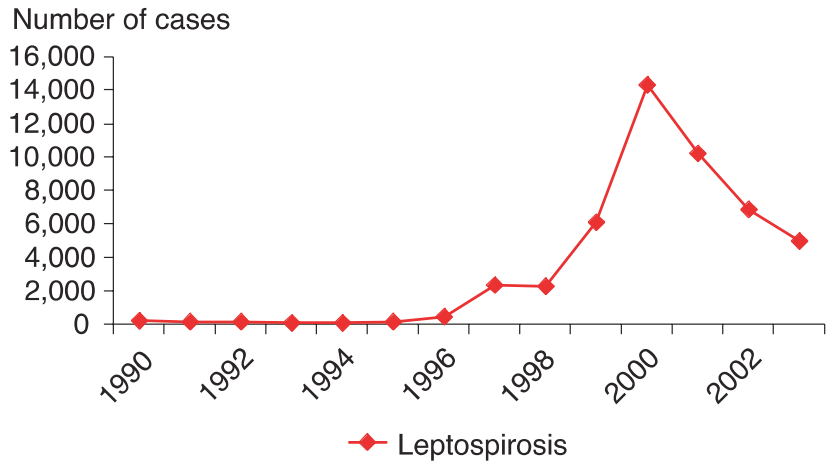
1-3-7. Epidemiology of Leptospirosis in Thailand

In Thailand, the number of incident cases of leptospirosis has been increasing since leptospirosis was registered as a reportable communicable disease under the National Passive Surveillance system in 1972. In the decade after 1972, the annual number of reported cases was only 10 to 20. However, from 1982 to 1994, the number ranged from 55 to 272 cases each year, equal to 0.3 cases per 100,000 population on average (2, 18, 19). These numbers were considered underreported because diagnosis confirmation required laboratory tests that were not available everywhere. Also, the awareness of the disease was low among physicians.

From 1995 to 2003, the number began to increase dramatically, peaking in 2000 in Thailand. A flood in Nakornratchsrima Province in 1996 is thought to be a trigger of this epidemic, and it spread over 16 out of 20 provinces in northeast Thailand in the next year. By 1999, leptospirosis was observed in 85% of the provinces (2, 20). Data on the number of cases reported in Thailand between 1995 and 2003 were as follows: 143 (1995); 398 (1996); 2,331 (1997); 6,080 (1999); 14,285 (2000); 10,217 (2001); 6,864 (2002); and 4,958 (2003) (19). Since 2003, the number of incidence cases in Thailand has remained stable at 4,944 (2010); 4261 (2011); and 4,130 (2012) (19). Although most of the cases could be attributed to several outbreaks, some of the increased cases might be because of the improved

diagnostic capabilities and increased awareness of leptospirosis among healthcare providers.

Figure 1-3. Reported Cases of Leptospirosis by Year in Thailand from 1990 to 2003 (2)



Source: Disease notification report. Ministry of Public Health, Thailand.

The seasonal fluctuation of leptospirosis in Thailand was detected by analysis of data between 1996 and 2002 (2). Most of the cases were observed from June to December, with the peak appearing from September to October when it rains heavily. Regarding the location, the Northeast region has seen high morbidity of leptospirosis; approximately 90% of cases were reported from the provinces in the Northeast region. The morbidity rate in this region exceeded 50 per 100,000 population in 2000 (21).

The most common occupation among patients in Thailand is farming (71.5 to 83.9%), followed by police officer, student, and soldier (2, 13). Monks are also a high risk population because they rarely wear shoes. Case fatality rates in Thailand

were around 10% until 1994 and have decreased since then, becoming less than 5% [4.4% (1999); 2.7% (2000); 1.7% (2001); 1.4% (2002); and 1.7% (2003)] (2). The age group with the highest morbidity in Thailand is 25 - 54 years, representing around 80% of all cases. Leptospirosis has also been reported in all other age groups, except in children less than 5 years old. The morbidity of leptospirosis in Thailand has also been associated with gender; cases were predominantly males from 1995 to 2003 with the range of 3:1 to 9:1 (18, 19). This trend has been gradually decreasing.

1-4. VILLAGE HEALTH VOLUNTEERS

In 1978, the Alma Ata Declaration on Health for All advocated the importance of community health workers in promoting equitable access to primary health care. Since then, community health workers have played an integral role in health care delivery system in many countries, especially in low-income areas and underserved communities. To provide primary health care, they act as a mediator between community residents and health care professionals, and support community participation in health care by reaching out into their communities (5). The great efficacy of these workers in achieving community involvement in health care has been reported in various countries, including Southeast Asian countries (8, 22).

In Thailand, the system of community health workers, commonly called village health volunteers (VHVs), was first implemented almost forty years ago (8). Since then, the number of trained VHVs has increased, with 750,000 workers in 2007

covering every village with at least one VHV (8). VHVs have contributed to saving villagers' time and travel costs to clinics, resulting in more people being served. Each VHV takes care of five to 15 households, on average. This system has been markedly successful in Thailand because it has been well integrated with Thai cultural ideals of volunteerism and supporting community members.

Community health workers are responsible for both formal health care services and socially oriented tasks, and their roles vary depending on their communities' needs. In Thailand, VHVs have been working on health promotion by distributing information on diseases and the primary health care system. In general, VHVs participate in workshops to acquire basic knowledge of health issues, receive training on disease prevention, and provide education to their neighbors (5). In addition, VHVs work on surveillance projects; since 2004, VHVs have been involved in a nationwide surveillance program for avian influenza, and have played peripheral roles that strongly link to communities (8). They have been required to report cases through telephone and radio wireless systems at health centers. Their responsibilities also include assessing community needs, conducting village specific activities, and providing underweight children with supplementary foods.

In Korn Buri District in Nakornratchsrima Province, if a need for VHVs arises, the district government informs 17 primary health care sectors. These primary health care sectors then contact the heads of the 12 subdistricts. These officials communicate with the heads of the villages and recruit VHVs registered in each village.

Because community health workers work closely with community residents, they need to have trust, respect, rapport, and understanding from their community (5, 23). Community health workers also need to have a strong spirit of volunteerism, because local governments are generally unable to pay them more than a minimal stipend. In Nakornratchsrima Province, the provincial government pays VHVs only 600 Thai Baht (18.6 United States Dollar) per month. Requirements for VHVs in Thailand include basic literacy skills, experience working in the community, residence in an area that is easily accessible to villagers, regular attendance at community development programs, and being otherwise employed (5). Also, government officers and village heads cannot be VHVs, but have the authority to elect VHVs in their village. In large cities, political issues sometimes influence these elections, because a selected VHV may gain strong authority over residents.

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CHAPTER II

PILOT STUDY

2-1. STUDY OBJECTIVES

The aim of this pilot study was to assess the quality of a questionnaire evaluating respondents' knowledge and practices regarding leptospirosis based on 113 village health volunteers' answers, and revise the questionnaire before distribution to 1,250 villagers.

2-2. METHODOLOGY

2-2-1. Questionnaire and Measured Characteristics

A paper-based, self-administered questionnaire designed to assess respondents' knowledge and practices regarding the prevention of leptospirosis was developed by Dr. Anek Mungaomklang, a local clinic physician in Korn Buri District and several Nakornratchsrima provincial government officers (Appendix 2-A). The questions were primarily multiple-choice questions and, on average, the survey took 10-20 minutes to complete.

The questionnaire encompassed three sections: (1) respondents' general and health history information, (2) knowledge of leptospirosis, and (3) practices regarding prevention of leptospirosis. The first section of the questionnaire collected data regarding respondents' history of infection and relevant demographic information, such as age, sex, level of education, occupation, and animals kept at their home. In addition, this section identified if participants had received information of

leptospirosis and participant preferred information tools, if leptospirosis information was given. Personal identifiers such as names, postal addresses, and telephone numbers, were not collected in this questionnaire.

The second section was composed of questions surrounding leptospirosis knowledge such as causes, sources, modes of transmission, clinical symptoms, natural reservoirs, risk behaviors, and measures of prevention. Surveys were scored with one point if a correct statement was chosen and no points were awarded if the respondent chose incorrectly or did not respond to a question.

The final section centered on practices regarding prevention of leptospirosis; thus, respondents were questioned how often they engaged in various preventive behaviors and risk behaviors on a daily basis. Respondents were given a scale consisting of the options "every time," "almost every time," "seldom," or "never," as answers. For preventive behaviors (question 1, 2, 3, 4, 6, 7, 8, and 10), three points were given to those who answered "every time," two points for "almost every time," one point for "seldom," and zero points for "never." For risk behaviors (question 5 and 9), the responses were scored conversely: three points for those who answered "never," two points for "seldom," one point for "almost every time," and zero points for "every time." For both statements, no points were given to those who selected more than one choice and those who did not answer the question. The outcome variables, total scores of knowledge and practices, were calculated by summing the total number of points. Higher values indicate better knowledge and practices.

2-2-2. Study Design

Before distributing the questionnaire to 1,250 villagers, we tested its performance with a smaller population − 113 village health volunteers (VHVs). In June 2013, the Nakornratchsrima provincial government recruited 113 registered VHVs to this project through phone calls and home visit. On July 2nd, 2013, these VHVs participated in a one-day workshop at a local temple in South Korn Buri Subdistrict in Nakornratchsrima Province (Appendix 2-B). The workshop was organized by the provincial government, Chulalongkorn University, and the WHO Country Office for Thailand. The purpose of this workshop was to provide the VHVs with basic knowledge of leptospirosis and train them in methods to educate neighbors about leptospirosis using an information booklet created by Dr. Mungaomklang and provincial government officers.

The questionnaire was distributed to the VHVs at the time of workshop registration. The VHVs completed surveys before lectures given by Thai public health officers. If a VHV had limited literacy skills, staff from Chulalongkorn University helped them read and complete the questionnaire. Participation of all respondents in this study was voluntary; but to increase a response rate volunteers were given bags, pens, and notebooks as incentive with survey completion. All data were collected anonymously. Prior to the questionnaire, each respondent was informed of the objectives of the project, and an informed consent was provided on the first page of the questionnaire.

2-2-3. Methods of Analysis

The answers for the questionnaire were entered into Microsoft Excel and imported to SAS 9.3 (Cary, NC). All analyses were completed using SAS 9.3. Descriptive statistics were calculated using the whole study population. The data were expressed as number, percentage, mean, and standard deviation.

2-3. RESULTS

2-3-1. Socio-demographic Characteristics of the VHVs

VHV socio-demographic characteristics are presented in Table 2-1. The mean and standard deviation of the VHVs' reported age were 43 and 8 years, respectively. The youngest VHV was 15 years old, and the oldest was 67 years old. Most of the VHVs were female. The major education level reported was primary school, followed by junior high school and high school. Three percent of respondents reported no education, and no VHVs reported an education level above high school. About half of the VHVs reported farming as the primary occupation while no VHVs reported working as an animal handler, fisherman, or government employee.

2-3-2. Major Sources of Information and Influential Information Tools for the VHVs

All 113 VHVs reported having received information about leptospirosis. The VHVs were asked to choose the top three information sources from which they had received information about leptospirosis. Three points were given to the major

information source, two points for the second major source, and one point for the third major source. The total point of each information medium was calculated as follows:

Total points = 3*(# of respondents who chose it as the first major information source)
+ 2*(# of respondents who chose it as the second major information source)
+ 1*(# of respondents who chose it as the third major information source)

As described in Table 2-2A, the most common source of information for the VHVs was public health officers (173 points), followed by workshops (113 points), then television (105 points). Even though posters about leptospirosis created by the WHO were placed in the villages (Appendix 2-C), only a few VHVs selected receiving information from a poster.

In addition, the VHVs selected the top three most influential information media that promoted their preventive behaviors. The points were calculated in the same way as above. As a result, the most influential information tools to VHVs were the public health officers (199 points), followed by television (122 points) and the workshop (110 points) (Table 2-2B).

2-3-3. Animals at the VHVs' Home

Eighty-seven VHVs (77%) reported having animals at their home when they answered this questionnaire. The most common animal reported was a dog, a known reservoir of leptospirosis, with almost two-thirds of the VHVs reporting dogs

at their home (Table 2-3). Poultry was the second most common animal, although it is not a reservoir of leptospirosis. More than one-thirds of the VHVs reported owning cats, which capable of carrying leptospires. There were only a few VHVs who possessed large animals, such as cows, buffalos, and pigs, which are all susceptible to leptospirosis.

2-3-4. History of Leptospirosis

Table 2-4 displays the history of leptospirosis among the VHVs and their family members. Less than five percent of the VHVs reported contracting leptospirosis at some point in their lives and five VHVs reported family members who had leptospirosis. Two VHVs reported a history of infection in both themselves and their family members.

2-3-5. Knowledge of Leptospirosis

Table 2-5A presents questions about knowledge of leptospirosis and its multiple choices as well as the distribution of the VHVs' answers. As mentioned above, the VHVs answered the questionnaire before workshop lectures; therefore, Table 2-5A reflects the VHVs' background knowledge of leptospirosis. This section consisted of ten questions, each with four answer choices. The correct choices are indicated by the check marks in Table 2-5A. The number missing in Table 2-5A includes both those participants who did not answer the question and those who chose more than one choice, as these respondents were not awarded points for their answers.

There were several limitations in this section that may have introduced bias. Although the instructions directed respondents to select one answer from four choices, some questions included more than one correct answer. For example, the first question asked about a mode of leptospirosis transmission in which all choices were correct. It has been known that skin is the major entry of leptospires, but other three modes can also transmit the disease. Blood transfusion rarely spread leptospirosis and has not been well studied, but the possibility is not zero. Breathing is also not a major mode of transmission, but inhalation of droplets of contaminated urine can cause leptospirosis. Transmission through sexual intercourse is also rare, but is possible. Question 3, 4, 8, and 9 also had multiple "correct" answers. All four choices of question 6 could also be correct; however, in this case, I gave one point to participants who selected a third choice "High fever + myalgia + red eye," because the question asked for a "specific" symptom of leptospirosis.

Another problem of this section was the exclusiveness of the choices. The four choices of Question 7 were obviously not mutually exclusive. For example, a choice "less than one week" clearly overlapped with the other choices: "less than two days" and "more than two days but less than one month." It is easy to imagine that these issues made respondents confused when answering the questionnaire.

The percentage of the VHVs who selected a correct answer in each question is shown in Table 2-5B. In all questions, the majority of the VHVs answered correctly. Especially, the percentages were very high for question 1 and 3. This is because all four choices were correct, and only those who did not respond or who selected multiple choices were not awarded points in these two questions. Even in the

question with the lowest correct response rate, which asked about a specific symptom of leptospirosis, only 22% of the VHVs chose a wrong choice.

A total score of up to 10 points was calculated for each VHV to determine knowledge regarding leptospirosis. The total score was categorized into three levels describing degree of knowledge: poor (0-5 points), moderate (6-8 points), and good (9-10 points). The distribution of the total score was strongly left-skewed (Figure 2-1). More than 80% of VHVs scored 9 or 10 points, while 2% of respondents scored less than 5 points (Table 2-5C).

2-3-6. Practices Regarding Prevention of Leptospirosis

Table 2-6A shows questions about practices regarding prevention of leptospirosis, its choices, and the distribution of the VHVs' answers. This section also had ten questions. The total score of each VHV ranged from 0 to 30, with categorization into three levels: poor (0-20 points), moderate (21-25 points), and good (26-30 points). The distribution of the total score of practices was also left-skewed, and almost one-third of the VHVs had established good practices to prevent leptospirosis (Table 2-6B and Figure 2-2).

However, there were several preventive behaviors that relatively many VHVs failed to perform and a risk behavior that comparatively more VHVs engaged in. For example, according to question 4, more than 10% of the VHVs seldomly or never burn/bury leftover food. Burning/burying leftover food is critical for leptospires because it prevents major carriers of the disease such as rats and mice from eating the leftover food at home. Also, more than 15% of VHVs performed some kind of

activity bare foot in water for more than six hours every time or almost every time, which also raises the possibility of contracting leptospirosis (question 9). Moreover, 23% of VHVs reported in question 10 either seldomly or never heating leftover food before consumption with the purpose of decreasing risk of infection through contaminated food. With regard to the risk behavior, more than 5% of the VHVs reported taking meat from cows or buffalos that died from unknown diseases every time or almost every time, a behavior which increases risk of infection (question 5).

2-4. DISCUSSION AND FUTURE DIRECTIONS

To test the quality of the questionnaire, the pilot study was conducted with 113 VHVs in South Korn Buri Subdistrict in Nakornratchsrima Province. This pilot study revealed that the majority of the VHVs who participated in the workshop already had good knowledge of leptospirosis even before the lectures. The mean total score of knowledge was 9, out of a total score of 10. Only 2% of the VHVs answered more than half of the questionnaire incorrectly. The VHVs' high scores may be explained by a higher interest in health issues than the general population; thus, they may have acquired sufficient knowledge about leptospirosis. However, it should be noted that the VHVs' background knowledge might be overestimated because of the following two limitations of the questionnaire.

First, question 1 and 3 had four answer choices that provided correct answers although the instructions asked respondents to select only one choice. Also,

question 4, 7, and 9 had three correct answers, and question 8 had two correct answers out of four choices. Only four questions (question 2, 5, 6, and 10) had a sole correct answer. Thus, the VHVs' health knowledge was artificially raised.

Second, the answers in several questions were very easy to guess even if respondents did not have thorough knowledge of leptospirosis. For example, in question 2, which asked respondents to choose a risk behavior of leptospirosis, three out of four choices were behaviors that are commonly regarded as positive: eat clean and fresh food, drink boiled water, and wear boots in water. These three positive statements were obviously not risk behaviors, and therefore, people who did not know about leptospirosis prevention might be able to guess a correct answer. If a question asks about risk behaviors, all four choices should have been negative statements so that participants need to use their knowledge of the disease to select a correct answer choice.

For these two reasons, it may be expected that the questionnaire failed to reflect respondents' true level of knowledge surrounding leptospirosis. Therefore, the questionnaire was revised so that all questions had a single correct answer in their choices. Also, only dichotomous yes/no questions were included so respondents were unable to guess correct answers based on answer choices.

Moreover, the section of knowledge experienced other type of limitations. First, the multiple choice answer format of question 6 was not mutually exclusive, which ultimately confused respondents. This issue would not be a cause for concern in the revised questionnaire, because all choices were changed to "yes," "no," and "don't know." Second, the questions in this section involved many technical terms,

such as “a mode of transmission,” “risk behaviors,” and “natural reservoirs.” The VHVs might be able to understand these words correctly, but general villagers may be less likely to understand them. To solve this issue, I wrote the questions in layman’s terms when I revised the questionnaire, and asked Dr. Supaporn, a professor at Chulalongkorn University, not to use technical jargon when translating the questionnaire to Thai. Finally, the choices in this section did not include a neutral statement, such as “don’t know.” Because villagers might not have enough information to choose either “yes” or “no” before the education campaign, the neutral choice would be helpful to assess villagers’ real knowledge. Thus, the choice “don’t know” was included in the revised questionnaire.

In addition, the VHVs’ total score of practices regarding prevention of leptospirosis was as high as that of knowledge. Only 4% of the VHVs gained less than two-thirds of the possible highest score, and 64% of respondents scored more than 25 out of 30 points. The high levels of practices may stem from an increased concern of disease prevention by the VHVs.

Among ten questions regarding practices, however, there were a few preventive behaviors that comparatively few VHVs did regularly. Most notably, preventive behaviors related to leftover food preparation were not common among the VHVs. Also, more than half of the VHVs were exposed to water more than six hours without personal protective equipment, such as boots. It has been known that being in rivers/canals/lakes for more than six hours increases the risk of leptospirosis even if people do not have any wounds and scars on their body. However, this behavior has been very common in Thailand, and the VHVs were no exception according to the

questionnaire. In terms of the quality of the section about practices, questions were well developed and non-technically written. The multiple choice questions were also clear; therefore, I used the original questions as much as possible in the revised questionnaire.

In conclusion, this pilot study clarified several points in the questionnaire that could be improved in order to obtain more meaningful results in the implementation study. Also, the major source of information and the influential information media for the VHVs were identified by the questionnaire, which would be useful for future interventions.

Table 2-1. Socio-demographic Characteristics of the Village Health Volunteers who Participated in the Workshop in South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Socio-demographic characteristics	n	%	Mean	S.D.
Age				
Less than 31 years	7	6	43.2	8.2
31 - 40 years	34	30		
41 - 50 years	52	46		
50 - 70 years	19	17		
Missing	1	1		
Gender				
Male	10	9		
Female	103	91		
Education				
No education	3	3		
Primary School	76	67		
Junior High School	22	19		
High School	11	10		
Diploma	1	1		
Bachelor's degree	0	0		
Higher than Bachelor's degree	0	0		
Primary Occupation				
Farming	53	47		
Orchard	2	2		
Plantation	29	26		
Other kinds of general employee	18	16		
Trader	5	4		
Others	4	4		
Missing	2	2		

Table 2-2A. Major Sources of Information on Leptospirosis Chosen by the Village Health Volunteers in South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013

Information tools	Total points
Public health officer	173
Workshop	113
Television	105
Community organization	59
Radio	40
Broadcast tower	32
Poster	19

Table 2-2B. Most Influential Sources of Information for the Village Health Volunteers in South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013

Information tools	Total points
Public health officer	199
Television	122
Workshop	110
Community organization	60
Radio	52
Broadcast tower	47
Poster	18
Others	1

Table 2-3. Animals Owned by the Village Health Volunteers in South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Animals	n	%	Animals	n	%
Cows			**Poultry**		
Yes	2	2	Yes	47	42
No	111	98	No	66	58
Missing	0	0	Missing	0	0
Buffalos			**Dogs**		
Yes	1	1	Yes	72	64
No	112	99	No	40	35
Missing	0	0	Missing	1	1
Pigs			**Cats**		
Yes	4	3	Yes	41	36
No	109	97	No	71	63
Missing	0	0	Missing	1	1

Table 2-4. History of Leptospirosis of the Village Health Volunteers and Their Family Members in South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

History of infection	Number	Percentage
VHVs		
Yes	5	4
No	106	94
Missing	2	2
VHVs' family members		
Yes	5	4
No	107	95
Missing	1	1

Table 2-5A. Village Health Volunteers' Answers to the Questions Regarding Knowledge of Leptospirosis, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Questions and Choices	n	%
Q1. Which of the following is a mode of transmission?		
Blood transfusion ✓	5	4
Breathing ✓	0	0
Sexual transmission✓	0	0
Skin ✓	106	94
Missing[*1]	2	2
Q2. Which of the following is a risk behavior of leptospirosis infection?		
Walk in moisture animal habitat without wearing shoes ✓	102	90
Eat clean and fresh vegetables	0	0
Drink boiled water	1	1
Wear boots in water	8	7
Missing[*1]	2	2
Q3. Which of the following is a risk environmental condition at home?		
Water jars without a cover ✓	6	5
Animal barns outside of a house ✓	14	12
Rice jars without a cover ✓	1	1
Dirty messy house ✓	90	80
Missing[*1]	2	2
Q4. Which of the following is a measure of prevention?		
Have a shower right after working in rice fields ✓	35	31
Wear boots during working in rice fields ✓	72	64
Wear gloves during working in rice fields ✓	1	1
Eat raw food or half-cooked food	1	1
Missing[*1]	4	3
Q5. Which of the following is the cause of leptospirosis?		
Agricultural chemicals	8	7
Food	0	0
Virus	12	11
Bacteria ✓	89	79
Missing [*1]	4	3
Q6. Which of the following is a specific symptom of leptospirosis?		
High fever + chill	7	6
Chill + severe headache	2	2
High fever + myalgia + red eye ✓	93	82
Headache + paralysis	8	7
Missing [*1]	3	3

Table 2-5A. (Continued) Village Health Volunteers' Answers to the Questions Regarding Knowledge of Leptospirosis, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Questions and Choices	n	%
Q7. How long does it take to develop symptoms after contacting source of leptospirosis?		
< 2 days	11	10
2 days - 1 month ✓	59	52
< 1 week ✓	28	25
1 week - 1 month ✓	15	13
Missing [*1]	0	0
Q8. Which of the following is a natural reservoir of leptospires?		
Fly, fruit fly	1	1
Bird, chicken, duck	7	6
Mouse, rat, cow, dog ✓	105	93
Cat ✓	0	0
Missing [*1]	0	0
Q9. Which of the following is a risk behavior of leptospirosis?		
Open eyes in dirty water and drink dirty water ✓	31	27
Walk without shoes in dry area ✓	76	67
Wear sandals in dry area ✓	2	2
Eat clean and fresh vegetables	0	0
Missing [*1]	4	4
Q10. Which of the following is a measure of prevention and control of leptospirosis?		
Graze livestock	5	4
Sprinkle water around a house	4	4
Raise livestock in a backyard	6	5
Clean dirty houses ✓	94	83
Missing [*1]	4	4

[*1] Missing includes both who did not answer the question and who chose more than one choice.

✓ indicates correct answers in each question.

Table 2-5B. Percentage of the Village Health Volunteers Who Answered Correctly to the Questions Regarding Knowledge of Leptospirosis, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

	%
Question 1	98
Question 2	90
Question 3	98
Question 4	95
Question 5	78
Question 6	82
Question 7	90
Question 8	92
Question 9	94
Question 10	83
Average	90

Table 2-5C. Distribution of the Village Health Volunteers' Total Score of Knowledge, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Level of Knowledge	Number	Percentage	Mean	S.D.
Poor: 0-5	2	2	2.0	0.0
Moderate: 6-8	18	16	6.9	0.9
Good: 9-10	93	82	9.6	0.5
Total	113	100	9.0	1.5

Figure 2-1. Distibution of the Level of Knowlege among the Village Health Volunteers, South Korn Buri Subdistrict, Thailand, July 2013 (N=113)

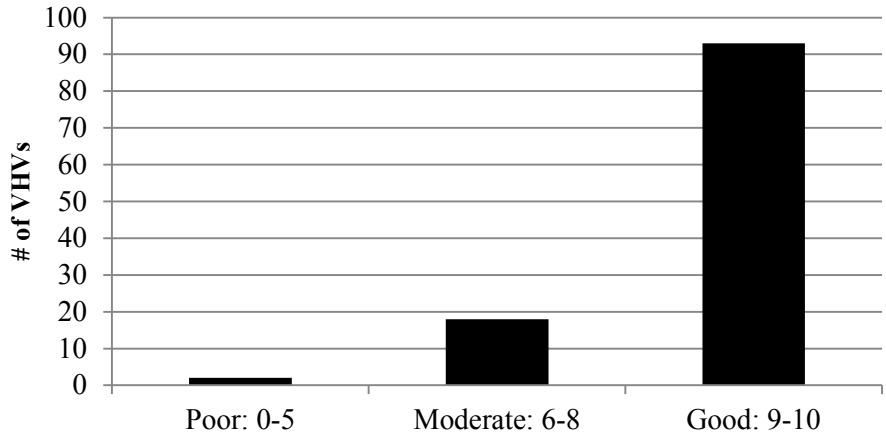


Table 2-6A. Village Health Volunteers' Answers to the Questions Regarding Practices of Leptospirosis, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Questions and Choices	n	%
Q1. Check wounds on feet before going into water		
Every time	86	76
Almost every time	14	12
Seldom	6	5
Never	6	5
Missing[*1]	1	1
Q2. Have a shower or bath with soap after going into water or walking around wet area		
Every time	90	80
Almost every time	16	14
Seldom	5	4
Never	1	1
Missing[*1]	1	1
Q3. Keep food with a cover		
Every time	101	89
Almost every time	9	8
Seldom	1	1
Never	0	0
Missing[*1]	2	2
Q4. Burn or bury garbage or leftover food		
Every time	75	66
Almost every time	25	22
Seldom	10	9
Never	2	2
Missing[*1]	1	1
Q5. Take meat from cows or buffalos which died from unknown disease		
Every time	5	4
Almost every time	2	2
Seldom	9	8
Never	94	83
Missing[*1]	3	3
Q6. Clean dirty houses		
Every time	85	75
Almost every time	27	24
Seldom	1	1
Never	0	0
Missing[*1]	0	0

Table 2-6A. (Continued) Village Health Volunteers' Answers to the Questions Regarding Practices of Leptospirosis, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

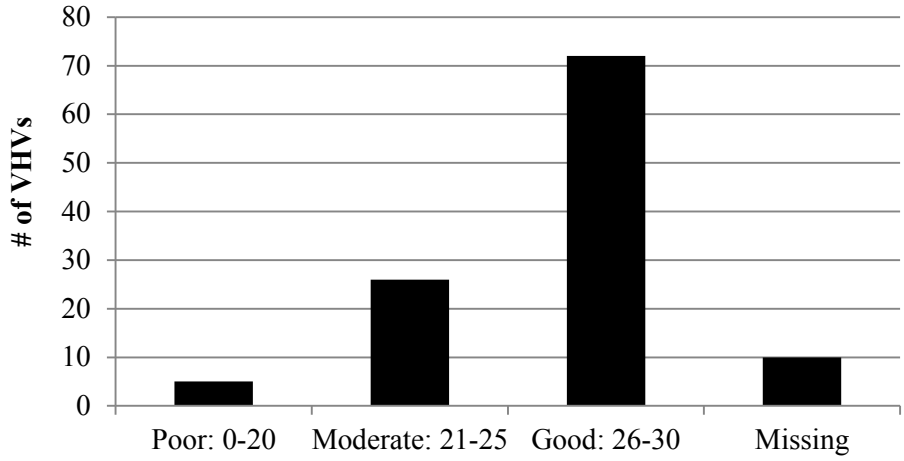
Questions and Choices	n	%
Q7. Participate in community-level campaigns and activities		
Every time	84	74
Almost every time	21	19
Seldom	5	4
Never	0	0
Missing[*1]	3	3
Q8. Wear boots in water		
Every time	92	81
Almost every time	15	13
Seldom	2	2
Never	1	1
Missing[*1]	3	3
Q9. Be in water for more than 6 hours with bare feet		
Every time	12	11
Almost every time	6	5
Seldom	42	37
Never	51	45
Missing[*1]	2	2
Q10. Heat leftover food before eating it again		
Every time	68	60
Almost every time	18	16
Seldom	24	21
Never	2	2
Missing[*1]	1	1

[*1] Missing includes both who did not answer the question and who chose more than one choices.

Table 2-6B. Distribution of the Village Health Volunteers' Total Score of Practices, South Korn Buri Subdistrict in Nakornratchsrima Province, Thailand, July 2013 (N=113)

Level of Practice	Number	Percentage	Mean	S.D.
Poor: 0-20	5	4	17.6	3.0
Moderate: 21-25	26	23	23.4	1.2
Good: 26-30	72	64	28.0	1.3
Missing	10	9	.	.
Total	113	100	26.3	3.1

Figure 2-2. Distribution of the Level of Practices among the Village Helath Volunteers, South Korn Buri Sibdistrict, Thailand, July 2013 (N=133)



Appendix 2-A. Original Questionnaire Evaluating Respondents' Knowledge and Practices Regarding Leptospirosis

Questionnaire

Knowledge, Attitude and Practice of Leptospirosis in Nakornrachasima Province

Explanation

This questionnaire is the part of implementation of a capacity development project for prevention and control of leptospirosis for village health volunteers and team leaders in Nakornrachasima Province.
Please answer all questions honestly.
This questionnaire is divided into the following three parts.

Part 1: General information
Part 2: Knowledge of prevention and control of leptospirosis
Part3: Practices of prevention and control of leptospirosis

The information from this questionnaire will be analyzed to plan implementation of prevention and control of leptospirosis. All information is confidential and will be used only for this project, and will never harm you.
Thank you so much for answering this questionnaire.

Sincerely,

Project responsible team

Part 1: General Information

Gender ( ) Female ( ) Male

Age _____ years old

The level of education
( ) No education
( ) Primary school
( ) Junior high school
( ) High school
( ) Diploma
( ) Bachelor's degree
( ) Higher than bachelor's degree

Primary occupation
( ) Farmer (How many times of cropping per year?: _____)
( ) Orchard (What kind of?: _____)
( ) Plantation (What kind of?: _____)
( ) Animal handler (What kind of?: _____)
( ) Fishing & selling
( ) Other kinds of general employee (What kind of?: _____)
( ) Merchant, trader (What kind of?: _____)
( ) Government employee
( ) Other _____

Secondary occupation _____

Have you ever been infected by leptospirosis?
( ) Yes: if so, when was the last time of infection? _____
( ) No

Have any of your family members ever been infected by leptospirosis?
( ) Yes ( ) No

Have you ever received information on leptospirosis? If yes, what were the sources of information?
(Choose the top 3)
( ) Television
( ) Radio
( ) Community organizations
( ) Posters and leaflets
( ) Public health officers
( ) Community announcement, news publication
( ) Meetings, workshops
( ) Other _____

What are the influential communication tools which promote your preventive behaviors? (Choose the top 3)

( ) Television
( ) Radio
( ) Community organizations
( ) Posters and leaflets
( ) Public health officers
( ) Community announcement, news publication
( ) Meetings, workshops
( ) Other _____

Do you have animals at your home?

( ) Yes ( ) No Cows (number: _____)
( ) Yes ( ) No Buffalos (number: _____)
( ) Yes ( ) No Pigs (number: _____)
( ) Yes ( ) No Poultry (what kind of:_____) (number: _____)
( ) Yes ( ) No Dogs (number: _____)
( ) Yes ( ) No Cats (number: _____)
Others (what kind of:_____) (number: _____)

Part 2: Knowledge of Prevention and Control of Leptospirosis

(Instruction: Mark X for your answer. Choose only one choice)

Which of the following is a mode of transmission?
A: Blood transfusion
B: Breathing
C: Sexual transmission
D: Skin

Which of the following is a risk behavior of leptospirosis infection?
A: Walk in moisture animal habitat without wearing shoes
B: Eat clean and fresh vegetables
C: Drink boiled water
D: Wear boots in water

Which of the following is a risky home environment?
A: Water jars without a cover
B: Animal barns outside of a house
C: Rice bins with a cover
D: Dirty and messy houses

Which of the following is a measure of prevention?
A: Have a shower right after working in rice fields
B: Wear boots during working in rice fields
C: Wear gloves during working in rice fields
D: Eat raw food or half-cooked food

Which of the following is the cause of leptospirosis?
A: Agricultural chemicals
B: Food
C: Virus
D: Bacteria

Which of the following is a specific symptom of leptospirosis?
A: High fever + chill
B: Chill + severe headache
C: High fever + myalgia + red eye
D: Headache + paralysis

How long does it take to develop symptoms after contacting source of leptospirosis?
A: Less than two days
B: More than two days but less than one month
C: Less than one week
D: More than one week but less than one month

Which of the following is a natural reservoir of leptospires?
A: Fly, small fly
B: Bird, chicken, duck
C: Mouse, rat, cow, dog
D: Cat

Which of the following is a risk behavior of leptospirosis?
A: Open eyes in dirty water and drink dirty water
B: Walk without shoes in dry area
C: Wear sandals in dry area
D: Eat clean and fresh vegetables

Which of the following is a measure of prevention and control of leptospirosis?
A: Graze livestock
B: Sprinkle water around a house
C: Raise livestock in a backyard
D: Clean dirty houses

Part 3: Practices Regarding Prevention of Leptospirosis

Please mark X in the blank that matches a frequency of your behavior in the usual life.

Practice behaviors	**Frequency**			
	Every time	Almost every time	Seldom	Never
1. Check wounds on feet before going into water				
2. Have a shower or bath with soap after going into water or walking around wet area				
3. Keep food with a cover				
4. Burn or bury garbage or leftover food				
5. Take meat from cows or buffalos which died from unknown disease				
6. Clean dirty houses				
7. Participate in community-level campaigns and activities				
8. Wear boots in water				
9. Be in water for more than 6 hours with bare feet				
10. Heat leftover food before eating it again				

Any comments or suggestions:

_____

Thank you for answering this questionnaire.

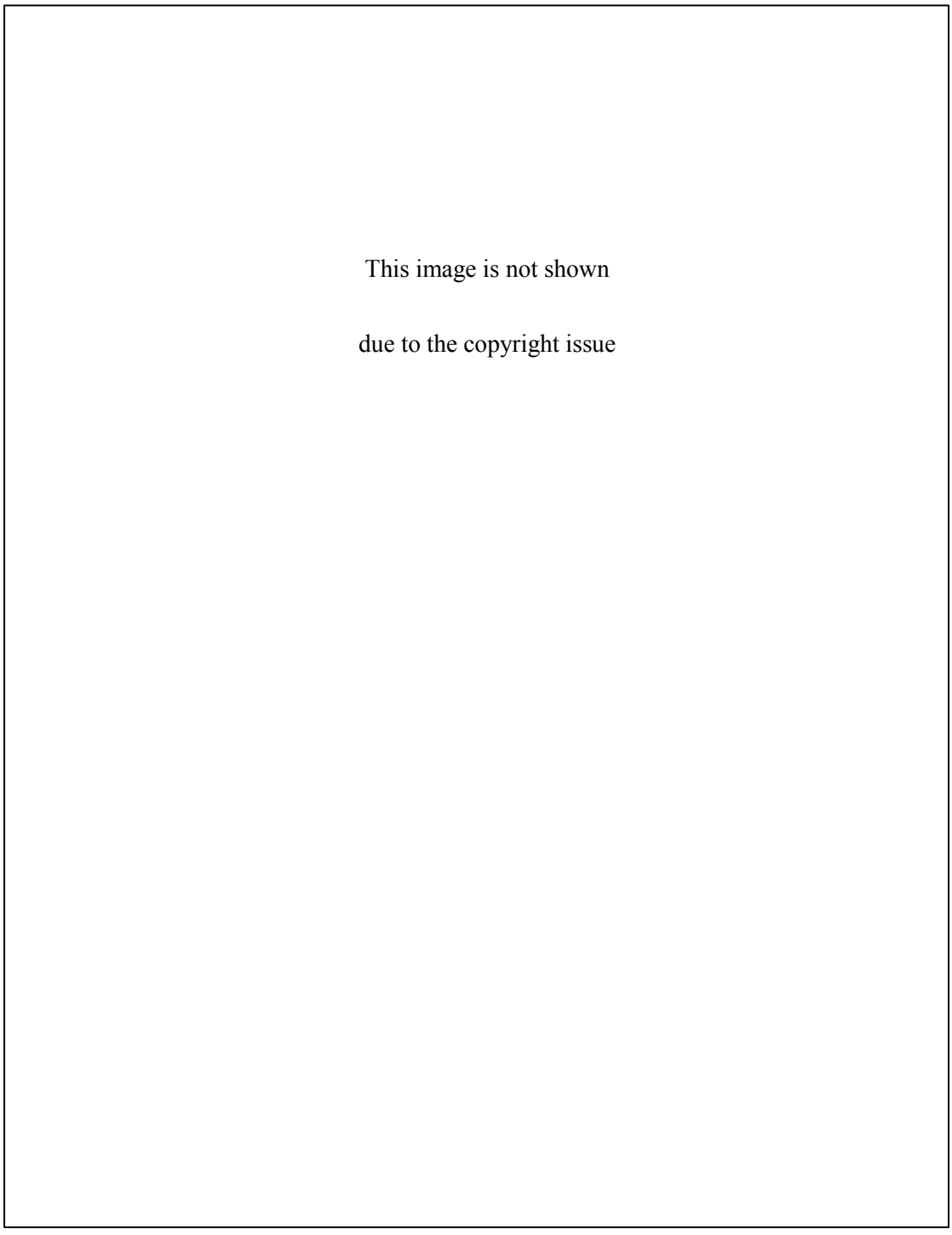
Sincerely,

Project responsible team

Appendix 2-B. Program of the One-day Workshop on Surveillance and Risk Reduction of Leptospirosis in a Community of Nakornratchsrima Province (July 2nd, 2013)

Time	**Activities**	**By**
08.00-08.30	- Registration - Conduct a questionnaire survey in VHP participants	Korn Buri Tai Team
08.30-09.00	Opening Remark	Korn Buri Tai Mayor
09.00-09.30	Review on Leptospirosis disease	Dr. Anek Mungaomklang
09.30-10.00	Leptospirosis prevention and control	Dr.Kiat Ruksakul
10.00-10.30	Photograph	All
10.15-10.30	Coffee/tea break	
10.30-11.30	Focus group discussion on Leptospirosis case scenario: participants will be divided to 8 groups	Nakornratchsrima provincial health office's team
11.30-12.00	Presentation of each group	
12.00-12.30	Wrap up of morning session	Dr. Anek Mungaomklang
12.30-13.30	Lunch	
13.30-14.00	Lecture on "How to improve your communication skills?" for 32 core VHVs	Local lecturer
14.00-15.00	Communication training in 32 core VHVs	Nakornratchsrima provincial health office's team
15.00-15.30	Coffee/tea break	
15.30-16.00	Planning of field works	Dr.Kiat Ruksakul
16.00-16.30	- Discussion - Conclusion - Closing	Dr. Anek Mungaomklang Dr.Kiat Ruksakul

Appendix 2-C. Poster of Leptospirosis (English Version)



CHAPTER III

IMPLEMENTATION STUDY

3-1. STUDY OBJECTIVES

The primary aim of the implementation study was to evaluate the efficacy of an intervention that aimed to reduce risk of leptospirosis by improving villagers' knowledge, attitudes, and practices regarding control of leptospirosis in South Korn Buri Subdistrict in Nakornratchsrima Province in Thailand using a revised questionnaire. The secondary aim was to identify bivariate associations with the improvement of villagers' knowledge, attitudes, and practices, and their demographic characteristics and health information. The ultimate goal was to create a model to control preventable infectious diseases, including leptospirosis, at a community level with a narrow budget and limited human resources for future interventions in Thailand.

3-2. RESEARCH HYPOTHESES

The research hypotheses of this implementation study included:

1. The villagers' scores of knowledge/attitudes/practices regarding leptospirosis control would be improved after the door-to-door education by the village health volunteers (VHVs) compared to same-village pre-education surveys, and the improvement would be significantly different from the score difference between the initial survey and the follow-up time point survey among the control group that did not receive any intervention.
2. Villagers' higher knowledge of leptospirosis would be associated with their better attitudes toward control of leptospirosis before the intervention.
3. Villagers' higher knowledge of leptospirosis would be associated with their better practices regarding control of leptospirosis before the intervention.
4. Villagers' better attitudes toward control of leptospirosis would be associated with their better practices regarding control of leptospirosis before the intervention.
5. The improvement of knowledge would be higher among villagers with lower education.
6. The improvement of practices would be higher among women than men.

3-3. METHODOLOGY

3-3-1. Questionnaire and Measured Characteristics

To evaluate the intervention of leptospirosis control, the original questionnaire was revised based on the findings from the pilot study with 113 VHVs as described in Chapter II, and a new questionnaire was developed (Appendix 3-A). It was a paper-based self-administered questionnaire, as was the original questionnaire. It was designed to assess respondents' knowledge, attitudes, and practices regarding prevention of leptospirosis. Most questions were multiple-choice questions, and the survey was 6-page long. The VHVs and the local government staff distributed the questionnaire to villagers in person, and it took respondents 15 - 25 minutes to complete.

The questionnaire was composed of four sections: (1) respondents' demographic and health history information, (2) knowledge of leptospirosis, (3) attitudes toward prevention of leptospirosis, and (4) practices regarding prevention of leptospirosis. In the first section, respondents provided information of the history of infection and relevant demographic information, including age, sex, level of education, occupation, level of income, and what animals they had at their home. Participants were also asked if they had received information of leptospirosis and what sources of general health information they preferred.

The section on knowledge of leptospirosis had 16 questions, all of which were multiple-choice questions with three choices: yes, no, and don't know. The neutral choice "don't know" was included in this section of the revised questionnaire,

because we did not want to force respondents to choose either yes or no when they were not sure about answers, and adding this choice was believed to better measure villagers' true level of knowledge. Scores were calculated for each villager as follows: If participants selected a correct choice, they got one point for that question. In contrast, if respondents selected a wrong answer or the neutral choice "don't know," they did not get a point for that question. Also, no point was given to those who did not circle any choice. A total score of knowledge was calculated by adding each point, and the possible highest score was 22.

In the third section, respondents were asked about their attitudes toward prevention of leptospirosis. This section had ten questions that were further divided into two subsections. The first six questions were asked of all respondents, and the other were asked only of field workers such as farmers, orchard workers, plantation workers, animal handlers, and fishermen. The intent of the second subsection was to learn thoughts of field workers regarding preventive measures while they work in fields. In this section, all items had a dichotomous answer set: "agree" and "disagree." A neutral choice was not included in this section to learn villagers' attitudes clearly. Also, to make the questionnaire as simple as possible, this section did not use moderate choices such as "somewhat agree" and "somewhat disagree." A point was given if respondents circled "agree" for questions describing desired beliefs and attitudes. In contrast, for undesired beliefs and attitudes, respondents who selected "disagree" received a point. There were no attitudes favoring undesired behaviors. A total score of attitudes was also calculated by summing each point. The possible highest score among non-field workers was 6, and 10 for field workers.

The last section was about practices regarding prevention of leptospirosis. It was composed of 16 questions that asked how frequently villagers performed various preventive measures in their usual days. The scale with four choices were used in this section to evaluate frequency of villagers' behaviors: every time, almost every time, seldom, and never. Three points were given to those who answered "every time," two points for "almost every time," one point for "seldom," and zero points for "never." Respondents did not get any points if they circled more than one choice or did not choose any choice. A total score of practices was calculated as same as previous sections, and 48 was the possible highest score.

To evaluate improvement of respondents' knowledge, attitudes, and practices, villagers answered the same questionnaire twice: once before the education campaign, and a second time three months after the campaign. At the 3-month follow up, respondents skipped the first section about the general information, and answered other three sections. Identifiers, such as names, postal address, and telephone numbers, were not collected in this questionnaire. Instead, ID numbers were randomly provided to respondents so that our research team could match their answers when we followed them up after the intervention. Villagers did not have to remember their ID numbers, but the VHVs and the local government staff, who distributed the questionnaire to the villagers in person, matched an ID number with each villager. It was not possible for those who entered and analyzed data to identify respondents using these numbers.

Every respondent was informed about the objectives of the project, and was notified of how the data would be used. An informed consent was shown on the first

page of the questionnaire, and the consent was verbally collected from each participant (Appendix 3-A). The study protocol was inspected by Emory University's Institutional Review Board (IRB), and it has been determined that this analysis of study data does not require IRB review (Appendix 3-B).

3-3-2. Study Design

This implementation study was a prospective cohort study. Everyone who took the baseline survey in August was successfully offered the followed-up survey in November, and no one who did not take the baseline survey was allowed to participate in the follow-up survey. Total sample size of this study was 1,250. All participants were 15 or older and younger than 80 years of age. Sampling was executed by Dr. Mungaomklang's team and the Nakornratchsrima provincial government using a simple random sampling method in June 2013. The team used existing administrative lists of residents in the study sites. Villagers were randomly recruited without regard to household, so it was possible that multiple people were recruited from one family.

The study population was categorized into three groups: the intervention group 1, the intervention group 2, and the control group. The choice of which groups were intervention and which was control was purposive. For the intervention group 1, seven hundred villagers living in South Korn Buri Subdistrict were randomly selected using the list of residents. The project team called selected villagers by phone or visited their home to recruit them into the study. In August 2013, the villagers in this group were provided with the door-to-door education by the trained VHVs and

personal protective equipment at a low price in their villages. Before these interventions, all villagers answered the revised questionnaire. The VHVs and provincial government staff brought the questionnaire to villagers' home, collected it after they answered, and sent it to the provincial government office. All participants were followed up about three months later, which was in the middle of November, and answered the same questionnaire except the first section about the general information.

In the intervention group 2, three hundred villagers were randomly recruited from South Korn Buri Subdistrict, the same subdistrict as the intervention group 1, by the same sampling measure. In addition to the education program and the distribution of personal protective equipment, villagers in this group also took blood tests (microscopic agglutination tests: MAT) to detect antibody against leptospires. On August 1st, 2013, which was before the interventions, recruited villagers visited a public school in South Korn Buri Subdistrict to get blood collection and answer the questionnaire. Eight nurses from clinics in South Korn Buri Subdistrict collected blood from villagers, and blood samples were tested for antibody against leptospires. On that day, even though all 300 villagers were asked to visit the school, only 178 villagers actually came to participate in the pre-intervention program. Therefore, provincial government staff and nurses visited the rest of the villagers' homes to collect their blood and ask them to answer the questionnaire. After collecting all blood samples and the questionnaires, which was in the middle of August, the trained VHVs visited their home to provide the same education program, and cheap personal protective equipment was also distributed in their villages. In November, all 300

participants were followed up and took the same blood test and answered the same questionnaire again, except the first section. Study staff informed villagers of the results of their blood tests and provided an explanation of how to interpret the data. Because of privacy issues, the serology data were not analyzed for the program evaluation.

For the control group, 250 people were randomly recruited using a list of residents from a different subdistrict, Bantoom Subdistrict in Khon Kaen Province, which is also located in northeast Thailand. Villagers in the control group neither received the education program nor the distribution of personal protective equipment, but they answered the same questionnaire twice at the same time, in August and November 2013.

3-3-3. Methods of Analysis

The two answers from each respondent were matched using the ID number. There was no loss to follow-up in the dataset. The data were entered into Microsoft Excel and imported to SAS 9.3 (Cary, NC). All data analysis was performed with SAS 9.3. The significant level was set at $\alpha = 0.05$ for the statistical analyses.

To evaluate improvements of knowledge, attitudes, and practices quantitatively, three continuous outcomes were calculated by subtracting each villager's pre-intervention total scores of knowledge, attitudes, and practices from their corresponding post-intervention scores. Higher values of these outcomes represented more improvement in villagers' knowledge, attitudes, and practices. The significance of the difference between the scores before and after the intervention was

assessed using paired t tests in all three groups. The normality of the improvement scores was assessed based on the histograms, and no violation was observed.

Bivariate analysis between the improvement of knowledge, attitudes, and practices and other variables was performed using simple linear regression (SLR) models, independent t test, and one-way analysis of variance (ANOVA). Normality assumptions of SLR models were examined using skewness and kurtosis values (values between -1 and 1 were considered to be normally distributed). Linearity assumptions of SLR models were tested using residual plots of each model fitted. Independence of observations was assumed to be true based on the sampling method. Based on these examinations, no assumption violation of SLR models was observed for three outcomes.

To examine the effect of the intervention on the outcomes − the improvement of villagers' knowledge, attitudes, and practices − multiple linear regression (MLR) models were fit. The primary exposure was the presence of intervention which was the dichotomous variable: 1 for 700 villagers in the intervention group 1 and 300 villagers in the intervention group 2, and 0 for 250 villagers in the control group. Variables that were associated in the bivariate analysis with the improvement of knowledge, attitudes, and practices were eligible for inclusion in MLR models ($p < 0.05$). Two-way interactions between intervention group and potential confounders were also included in the models.

Then, variance inflation factors (VIF) were measured to examine multicolinearity of the MLR models. If there were variables whose VIFs exceeded 10, an interaction term with the highest VIF was dropped from the model at a time until

all VIFs became less than 10. Next, interaction assessment of the MLR models was performed. A two-way interaction term was dropped from the model at a time if a p value was greater than 0.05.

The key assumptions of MLR models were then checked: (1) normality, (2) linearity, (3) homoscedasticity, and (4) independence. Based on normal quintile plots and histograms of residuals, violation of normality of outcomes and residuals was not found. No gross violation of linearity between the predictors and the outcomes was observed in partial plots for outcomes. There was no violation of homoscedasticity based on residual plots. Independence was assumed to be satisfied because the study population was selected randomly. Also, Cooks values, the leverage values, and Jacknife residuals were examined to determine if there were influential outliers in the final model. There were observations that could be considered to be outliers, but all observations were retained in the models because all values were plausible.

After those tests, stratified MLR models were built for each outcome: one model was fit for field workers and one was fit for non-field workers, and the significance of the effect of intervention was assessed. Stratified modeling was conducted because the field workers were asked additional questions in the section about attitudes, so that the improvement scores for field workers and non-field workers were not directly comparable.

3-4. RESULTS

3-4-1. Socio-demographic Characteristics of the Villagers

Table 3-1 presents the distribution of socio-demographic characteristics of the villagers for three groups: the intervention group 1, the intervention group 2, and the control group. These results were recorded before the intervention in August, and all participants were successfully followed up in November.

The mean of the villagers' age were 49.1 in the intervention group 1 and 47.3 years in the intervention group 2. The control group had younger population compared to the two intervention groups where the mean of the age was 43.6 years ($p<.0001$). In all three groups, the number of men was higher than the number of women, and the sex ratios were significantly different across the groups ($p=0.02$). It might indicate that randomly selected villagers did not answer the questionnaire by themselves, but they asked someone else in their household to answer the questionnaire. For example, if a mother was selected, she might ask her husband to answer the questionnaire as a representative of her household, which reflects a culture in Thailand. Although the study staff may have known about this phenomenon, they may have not realized the importance of having the selected individual to answer. Consequently, they may have accepted the form if the questionnaire was filled in, regardless of who filled it in.

With regard to the level of education, villagers in the control group were more highly educated compared to the intervention groups ($p<.0001$). There was no villager who did not get any education in the control group, whereas about 3% of the

villagers in the intervention groups had never gone to school. In addition, the percentage of villagers who had diploma, bachelor's degree or more was almost 30% in the control group, but it was less than 2% in the intervention groups. The major level of education in the control group was the secondary school which 30% of the villagers completed, whereas it was the primary school in the intervention groups which almost 80% of the villagers completed.

Also, the distribution of the level of income differed between the intervention groups and the control group ($p<.0001$). More than half of the villagers in the intervention groups earned 3,001 to 6,000 Thai Baht (about 93 to 186 United States Dollar: USD), and only about 6% of them earned more than 10,000 Thai Baht (about 310 USD) per month. In contrast, the level of income relatively evenly distributed in the control group, and almost 20% of the villagers' monthly income exceeded 10,000 Thai Baht.

The distribution of the primary occupation was also different between the intervention groups and the control group ($p<.0001$). Even though the major occupation was farming in all three groups, the percentage was about 40% in the control group, while it was more than 60% in the intervention groups. Government employees were quite rare in the intervention groups, but made up about 20% of the control group. About 17% of the villagers in the intervention groups worked in plantations, but none of the villagers in the control group did. Orchard workers, animal handlers, and fishermen were rare in all three groups.

In summary, Table 3-1 shows that the villagers in the control group were younger, highly educated, and well-paid compared to the two intervention groups, and

the distribution of the occupation was significantly different between the intervention groups and the control group.

3-4-2. Animals at the Villagers' Home

The percentage of the villagers who kept animals at their home in the control group was less than the intervention groups; 70% of the intervention group 1 and 64% of the intervention group 2 reported possessing animals, while only 56% of the villagers in the control group had animals at their home (p=0.0002). In all three groups, the most frequently named animals were dogs − known carriers of leptospires (Table 3-2). Large animals, such as cows, buffalos, and pigs, were rare in all three groups.

3-4-3. Major Sources of Information and Influential Information Tools for the Villagers

In all three groups, more than 95% of the villagers answered that they had received information about leptospirosis before the intervention. In the questionnaire, the villagers were asked to select the top three information sources from which they had received information about leptospirosis. Three points were given to the major information source, two points for the second major source, and one point for the third major source. The total points for each information medium were calculated as follows:

Total point = 3*(# of respondents who chose it as the first major information source)

+ 2*(# of respondents who chose it as the second major information source)

+ 1*(# of respondents who chose it as the third major information source)

For this question, there were 25 and six missing data in the intervention group 1 and the control group, respectively. As described in Table 3-3A, the VHV program was the most major information source for the villagers in the intervention groups. In contrast, television was the first major information medium followed by the VHV program in the control group.

In addition, the villagers selected the top three most influential information media that encourage them to engage in preventive behaviors. There were no missing values for this question. The points were calculated in the same way as above. The ranking of the influential information tools is shown in Table 3-3B. Television got the highest point in the intervention group 1 and the control group, while the VHV program was the top in the intervention group 2.

3-4-4. History of Leptospirosis

The villagers reported the history of leptospirosis among themselves and their family members. This result did not take into account whether the diagnosis was confirmed by the laboratory test, and medical records were not reviewed. It relied on villagers' memory. About 4% of the villagers had the history of infection in the both intervention groups, while only 2% of the villagers had leptospirosis in the control group ($p=0.2$). The percentages of the villagers whose family members got

leptospirosis were 3% in the intervention group 1, 5% in the intervention group 2, and 2% in the control group (p=0.7).

3-4-5. Knowledge of Leptospirosis

Table 3-4 presents 16 questions about knowledge of leptospirosis and its multiple choices as well as the distribution of villagers' answers both before and three months after the education program in all three groups. The correct choices are indicated by the check marks in Table 3-4.

Examinations of each group individually revealed the different trends. In the intervention group 1, there were no missing observations either before or after the education program. On average, 74% of the villagers answered correctly before the intervention. Notably, there were three questions that more than 90% of the villagers answered correctly even before the education program: question 2, 14, and 16-3. On the other hand, there were two questions where the percentage of the villagers who answered correctly was less than 50% before the intervention: question 10 and 12. The percentages were also relatively low for question 16-6 and 16-7 (59% and 52%, respectively). After the education campaign, 78% of the villagers answered correctly, on average. There were 12 questions where the correct response rates increased by 5% or more after the education (question 1, 3, 4, 5, 10, 11, 12, 15, 16-2, 16-5, 16-6, and 16-7). However, there were also two questions where the corresponding rates decreased by 5% or more (question 7 and 13).

The intervention group 2 did not have missing observations before the education program; however, each of question 6, 7, 13, and 14 had one observation

coded incorrectly after the education. These observations were from two villagers (ID 2-217 and 2-218), which were dropped from further analysis. On average, 76% of the villagers answered correctly before the intervention. As observed in the intervention group 1, more than 90% of the villagers answered correctly to question 2, 14, and 16-3 before the education. In addition, 93% of the villagers in the intervention group 2 answered correctly to question 16-1. This group had three questions where the correct response rates were less than 50% before the education campaign: question 11, 16-6, and 16-7. After the education, more than 80% of the villagers answered correctly, on average. There were nine questions where the corresponding rates increased by 5% or more after the education (question 1, 3, 6, 8, 9, 11, 16-5, 16-6, and 16-7). However, there were two questions where the corresponding rates decreased by 5% or more (question 10 and 16-1).

With regard to the control group, there were no missing observations in August, but there were three observations coded incorrectly in question 5, 6, and 7 in November. These values were all from one person, ID 3-189, who was excluded from further analysis. When the villagers answered the questionnaire for the first time in August, 64% of them answered correctly. There was no question where the correct response rate exceeded 90%. On the other hand, there were six questions where less than half of the villagers answered correctly: question 10, 11, 13, 16-5, 16-6, and 16-7. In November, the same 250 villagers answered the same questionnaire without receiving any intervention. The average percentage of the villagers who answered correctly decreased from 64% to 55% when they were followed up. There were 18 questions where the correct response rates decreased by 5% or more (question 1 − 9,

12, 14, 15,16-1, 16-2, 16-4, 16-5, 16-6, and 16-7). Table 3-4 tells a detailed story behind this decline. The decrease in correct responses was associated with a larger number of villagers who chose the neutral choice "don't know" increased in November compared to August. On the other hand, there were three questions where the correct response rates increased by 5% or more (question 10, 13, and 16-3).

In total, it appeared that questions 10 and 11 were difficult for the villagers, which asked about a relationship between leptospirosis and rainy season and a risk of eating raw meat. Although the correct response rate for question 11 improved by more than 5% after the education in both intervention groups, it was still 30% in the group 1 and 37% in the group 2. For question 10, the rate also increased by 7% in the intervention group 1, while it decreased by 5% in the intervention group 2. Also, the correct response rates for question 16, which asked about carriers of leptospires, were also relatively low. Especially, it appeared the villagers did not have an improvement in understanding that dogs could be carriers.

Next, the total score of up to 22 points was calculated for each villager before and after the education campaign to assess their knowledge quantitatively (Table 3-7 and Figure 3-1). The paired t-test was performed to compare the total score of knowledge before and after the education, as shown in Table 3-7. The average total scores significantly increased from 16.3 to 17.2 and from 16.8 to 17.8 in the intervention group 1 and 2, respectively (both $p<.0001$). On the other hand, the mean score was decreased by more than two points when the villagers in the control group were followed up ($p<.0001$).

3-4-6. Attitudes toward Prevention of Leptospirosis

Table 3-5 presents 10 questions about attitudes toward leptospirosis and the multiple choices, as well as the distribution of villagers' answers both before the education program and at the 3-month follow up. The choices describing desired attitudes are indicated by the check marks in Table 3-5. Field workers answered all 10 questions, but non-field workers answered only the first six questions. The first six statements described good attitudes, and the last four statements expressed undesired attitudes toward prevention of leptospirosis. Therefore, respondents had good attitudes if they selected "agree" for the first six questions and "disagree" for the last four questions.

First, each group was examined individually. In the intervention group 1, there was one value before the education and five values after the education coded incorrectly. These were from three villagers (ID 1-157, 1-409, 1-593) who were not involved in the further analysis. More than 90% of the villagers agreed with the first six statements describing desired attitudes toward prevention of leptospirosis even before the intervention. Among 615 field workers in the intervention group 1, 65 ~ 71% of them disagreed with the last four questions describing undesired attitudes, which indicated majority of the field workers had good attitudes even before the education. There were three questions where the preferable response rates increased by 5% or more after the intervention: question 7, 8, and 9. There was no question whose preferable response rate decreased by 5% or more.

The intervention group 2, all values were coded correctly before the education, but five values were coded incorrectly after the education. They were from

two villagers (ID 2-288 and 2-284), and they were not included in the further analysis. The overall trend of the villagers in the intervention group 2 before the education was very similar to the intervention group 1. There were two questions whose preferable response rates increased by 5% or more after the education campaign: question 4 and 8. No corresponding rate decreased by 5% or more in any question in this group.

In the control group, 59 values were coed incorrectly before the education. These values came from 21 villagers who were excluded from further analysis. There was no observation coded incorrectly after the education program. The control group also had similar results for the first six positive statements where more than 85% of them showed good attitudes when they were first contacted in August. However, for the next four questions, 97 field workers in the control group showed worse attitudes than field workers in the intervention groups in August. More than half of them said wearing gloves during working in fields made them feel annoyed. Also, about half of them answered wearing gloves made them feel unskillful, and wearing personal protective equipment in fields did not help them reduce the risk of getting leptospirosis. When they were followed up in November, the preferable response rates increased by 5% or more in three questions: question 2, 3, and 5. In contrast, the corresponding rates decreased by 13 ~ 20% in the last five questions.

Next, the total score of attitudes toward prevention of leptospirosis was calculated for field workers and non-field workers separately (Table 3-7 and Figure 3-1). To compare the total scores before and after the intervention, the paired t-test was conducted (Table 3-7). The total scores were significantly improved by 0.31 points among the field workers in the intervention group 1 ($p<.0001$), while it got

significantly worsened by 0.59 points among the field workers in the control group (p=0.02). There was no significant difference among field workers in the intervention group 1. Among non-field workers, no significant difference was observed in all three groups.

3-4-7. Practices Regarding Prevention of Leptospirosis

Table 3-6 displays 16 questions about practices regarding prevention of leptospirosis, its multiple choices, and the distribution of villagers' answers both before and after the intervention for all three groups. Respondents had established good practices if they choose "every time" or "almost every time." In this section, no missing values were found both before and after the education in all three groups.

Each group was again examined separately. In the intervention group 1, more than 80% of the villagers chose either "every time" or "almost every time" for 12 questions even before the intervention. For the rest four questions (7, 8, 9, and 10), the percentages of the villagers who selected "every time" or "almost every time" were about 54 ~ 67%. These questions asked about rodent elimination at home, campaign participation, personal protective equipment use during cooking rat meat, and wearing gloves in rice fields. After the education, the corresponding percentage increased by 5% in question 7, 5% in question 8, 1% in question 9, and 9% in question 10; however the percentages were still low compared to other questions even after the improvement. There were seven questions where the percentage of the villagers who selected either "every time" or "almost every time" increased by 5% or

more after the intervention (question 4-8, 10, and 16). There were no questions whose percentage decreased by 5% or more after the education.

In the intervention group 2, the same four questions (7, 8, 9, and 10) got low percentage of the villagers who selected “every time” or “almost every time” before the intervention. It was around 49 ~ 65%, while the percentages exceeded 80% in other 12 questions. For these four questions, the intervention worked very well and the corresponding percentages increased by 16 ~ 22%. These increases were much larger than what was observed among these four questions in the intervention group 1 (1 ~ 9%). As a result, all percentages exceeded 70% after the education campaign in the intervention group 2. There were five questions where the percentage of the villagers who selected either “every time” or “almost every time” increased by 5% or more after the intervention (question 7-10, and 13). There were no questions whose percentage decreased by 5% or more after the education.

When the villagers first answered the questionnaire, the control group had a similar distribution of frequency with the intervention groups. For most of the questions, more than 70 ~ 80% of the villagers chose “every time” or “almost every time,” while these percentages were low in question 8, 9, and 10. However, at the 3-month follow up, the result of the control group was notably different from the intervention groups. There was no question whose percentage decreased after the intervention in the intervention groups, but there were 12 questions where the percentages decreased by 5% or more in the control group. The biggest decline was -26% that was found in question 7. There was only one question where the percentage increased by more than 5% (question 6).

Next, the total score of practices regarding prevention of leptospirosis was calculated for each villager. The possible highest score was 48. Table 3-7 and Figure 3-1 show the distribution of the total scores before and after the intervention in each group. To compare the pre and post-education scores, the paired t-test was conducted (Table 3-7). The mean total scores increased by 1.7 and 2.1 points after the education in the intervention group 1 and 2, respectively (both $p<.0001$). In contrast, the mean total score decreased by 5.6 points in the control group ($p<.0001$).

3-4-8. Linear Associations among the Baseline Total Scores of Knowledge, Attitudes, and Practices

Bivariate associations between the baseline scores of knowledge, attitudes, and practices were evaluated in three groups, as summarized in Table 3-8. Mostly, three scores were significantly linearly related to each other, and all associations were positive. However, there was no significant association between the score of practices and the score of attitudes among non-field workers in all three groups (all $p>0.05$), and the score of attitudes and the score of knowledge among field workers in the control group ($p=0.2$). Overall, those who had higher knowledge, attitudes, or practices scored higher in the other two sections.

3-4-9. Bivariate Analyses between the Improvement of Knowledge, Attitudes, and Practices with Selected Demographic Variables

Bivariate associations between the improvement of knowledge, attitudes, and practices − which were the difference of the scores before and after the

interventions − with demographic variables were assessed (Table 3-9). As shown in Table 3-9A the improvement of knowledge was significantly associated with gender and the level of education in the intervention group 2. The improvement of knowledge was 1.0 point higher (95% confidence interval (CI): 0.1 to 1.9) among females than males. The score of knowledge among the villagers who graduated from junior high schools were less improved than the villagers who completed primary school or less (mean difference: -1.8; 95% CI: -3.0 to -0.5). No significant association was found in the other groups.

Regarding the improvement of attitudes among the field workers, no association was found in any of the three groups, except one association with the level of education in the control group (Table 3-9B). The improvement of attitudes among the field workers whose level of education was junior high school was 2.5 points lower (95% CI: 1.5 to 3.4) than the field workers whose level of education was primary school or less.

Among non-field workers, the improvement of attitudes was significantly related to the history of infection in the intervention group 2 (Table 3-9C). The improvement of attitudes among non-field workers with the history of infection was about two points higher than non-field workers without the history of infection (95%CI: 0.0 to 3.7). However, it should be noted that there was only one observation that had the history of infection in this group, and therefore, the difference in the intervention group 2 was based on one person. Also, significant associations between the improvement of attitudes and three demographic characteristics − the level of education, the level of income, and age, − were observed in the control group (Table

3-9C and Table 3-10). The improvement of attitudes among the non-field workers who completed more than high school was 1.2 points lower than non-field workers who completed primary school or less (95% CI: 0.5 to 2.0). The improvement of attitudes among the non-field workers who earned more than 3,000 Thai Baht was 1.4 points lower than non-field workers who earned less than 3,000 Thai Baht per month (95% CI: 0.9 to 1.9). In every ten-year increase in age among non-field workers, the expected improvement of attitudes decreases by 0.4 (standard error: 0.1), on average (p=0.001).

The villagers' improvement of practices was significantly associated with the history of infection, possession of animals, occupation, the level of education, and age in the control group (Table 3-9D and Table 3-10). The significant relationship with the possession of animals was also found in the intervention group 1 (Table 3-9D). A notably large mean difference of the improvement of practices was found in the comparison between the villagers with and without the history of infection in the control group (mean difference: 25.8; 95% CI: 14.6 to 36.9). It was because the villagers who did not have the history of infection failed to improve their practices, as the average score difference between before and after the intervention was -6.0; while the villagers who had the history of infection improved their scores by 19.8 points on average (Table 3-8D). The villagers who had animals improved their score of practices less than the villagers who did not have animals in the intervention group 1 and the control group. The villagers with high risk occupation increased their score of practices less than the villagers with non-high risk occupation. The score of practices decreased at the follow-up time among the villagers in all level of education in the

control group, but the decline was smaller among those who completed high school compared to those who completed primary school or less.

3-4-10. Multiple Linear Regression Models

To evaluate the effect of the intervention, the MLR models were created for three outcomes: the improvement of knowledge, attitudes, and practices regarding control of leptospirosis (Table 3-11). Because the possible highest total score of attitudes was different between field workers and non-field workers, regression analysis was performed separately for each occupation group.

For the improvement of knowledge among both field workers and non-field workers, gender, level of education, and baseline total scores of knowledge, attitudes, and practices were included in the MLR models as potential confounders based on the bivariate analysis (Table 3-9A). There was no significant two-way interaction between the presence of intervention and these potential confounders among both field workers and non-field workers. After controlling for these potential confounders, a significant positive association between the improvement of knowledge and the presence of intervention was observed. The MLR model suggested that the improvement of knowledge was 4.9 points higher (95% CI: 4.3 to 5.6) among the field workers who received the intervention than the field workers who did not receive any intervention ($p<.0001$). Among the non-field workers, the average difference was 3.8 points (95% CI: 2.5 to 5.0; $p<.0001$).

For the improvement of attitudes among the field workers, the MLR model included the level of education, the history of infection, and the baseline total scores

of knowledge, attitudes, and practices as potential confounders based on the result of bivariate analysis (Table 3-9B). No significant two-way interaction between them and the presence of intervention was observed. The final model found that the intervention had a significant positive effect on the improvement of attitudes among the field workers after controlling for the potential confounders. The improvement of attitudes was 1.3 points higher (95% CI: 1.0 to 1.6) among the field workers in the intervention group compared to the field workers in the control group ($p<.0001$). On the other hand, the effect of the intervention was not significant among the non-field workers after controlling for age, level of education, history of infection, and baseline scores of knowledge, attitudes, and practices ($p=0.2$).

For the improvement of practices, the potential confounders were age, history of infection, possession of animals, level of education, and baseline scores of knowledge, attitudes, and practices based on bivariate analysis (Table 3-9D and 3-10). Among the field workers, there was a significant two-way interaction between the presence of the intervention and the level of education ($p=0.03$). However, the result was not presented separately for each level of education in Table 3-11. Because all associations were positive and all p values were less than 0.0001, we decided to present an aggregated result in Table 3-11. After controlling for the potential confounders, the intervention had a significant positive effect on the improvement of practices among the field workers. The differences of the score improvement between the field workers in the intervention groups and the field workers in the control group were 11.1 points (95% CI: 9.6 to 12.6; $p<.0001$). Among the non-field workers, the effect of intervention was also significant. The score improvement was 7.8 points

higher (95% CI: 5.4 to 10.1) among the non-field workers in the intervention group than the non-field workers in the control group, after controlling for age, possession of animals, history of infection, level of education, and baseline scores of knowledge, attitudes, and practices ($p<.0001$).

3-5. DISCUSSION

According to the MRL models, receiving the intervention was associated with improves knowledge, attitudes, and practices regarding control of leptospirosis among villagers, after adjusting for potential confounders. The improvement of the scores of knowledge and practices were significantly higher among both field workers and non-field workers in the intervention groups compared to the control group. Regarding the improvement of attitudes, however, there was a significant difference of the improvement between the intervention group and the control group among the field workers, while no difference was found among the non-field workers. It may be attributed to the high baseline score of attitudes among the non-field workers, which was 5.6 out of 6.0 points. Overall, we concluded that the intervention successfully improved villagers' knowledge, attitudes, and practices regarding prevention of leptospirosis, and the improvement was maintained for three months after the intervention. Also, considering the assessment of two-way interactions with the presence of intervention and demographic characteristics, the intervention had a significant effect across all different demographic categories.

Nonetheless, several facts should be noted. There were several questions about knowledge whose correct response rates were considerably lower than other questions even after the intervention. Also, there were a few questions where the correct response rates decreased by 5% or more after the intervention. These questions were related to natural reservoirs of leptospires, the risk of eating raw meat, the risk of handling chemical fertilizers without gloves, and the risk of infection during the rainy season.

There were several possible reasons for the low correct response rates of these questions. First, there was an inconsistency between the questionnaire and the information booklet that the VHVs used when they educated villagers. Some questions − such as getting dog bites and handling chemical fertilizers − were not addressed in the information booklet. During the site visits, we noticed that many villagers thought chemical fertilizers might cause leptospirosis, but we could not include it in the booklet because they had been already printed out. However, we included related questions in the questionnaire, because we wanted to see if their attitudes toward chemical fertilizers were consistent across the subdistrict. Second, the villagers might become too careful about everything after the intervention, and therefore, they answered that non-risk behaviors increase the risk of infection. Third, the question about the rainy season might have been difficult for participants because of a slight difference in language between the information booklet and the survey. Using the information booklet, the VHVs told villagers that the risk of infection increases during the rainy season. However, the question 7 asked “Leptospirosis

occurs only during the rainy season." Thus, the question was not designed well to assess the effect of the education, and it might have confused the villagers.

Next, in the section of the practices regarding prevention of leptospirosis, there was no question whose percentage of villagers with desired behaviors decreased after the intervention; however, there were four questions (question 7, 8, 9, and 10) whose corresponding percentages were relatively low even after the intervention. These questions were about rodent elimination, campaign participation, personal protective equipment use during cooking rat meat, and wearing gloves in rice fields. These protective behaviors might not be practical in this area, and might not fit their life style. Thus, alternative practical actions should be considered to promote prevention of leptospirosis in this community.

Also, social desirability likely affected the villagers' answers in this study. According to the villagers' answers, large numbers of them used personal protective equipment when they worked in fields and walked in water both before and after the intervention. However, the project members from the local clinic and the provincial government office mentioned that only a few people actually used them regularly. The effect of social desirability became strong, because the questionnaires were collected by people whom villagers knew very well, such as the VHVs and the local government staff. If we could collect the questionnaires by mail, the result would be improved; however, the non-response rate would increase.

Another fact should be addressed when looking at the magnitude of the coefficient of the presence of intervention in the MLR models, which compared the improvement of knowledge, attitudes, and practices between the intervention group

and the control group. At the follow up three months after the initial contact, the mean total scores of knowledge, attitudes, and practices decreased in the control group, while they increased in the intervention groups. When looking at the distribution of villagers' answers closely, it was found that many people in the control group circled the neutral statement "don't know" in the questions regarding knowledge of leptospirosis when they were followed up in November. It might be because the villagers in the control group did not get any intervention, which resulted in lowering of motivation, and therefore, they did not complete the questionnaire in November with as much focus or effort as during the initial contact. Thus, the scores of the control group decreased significantly when they were followed up, mostly attributable to increased responses of "don't know." For this reason, the magnitude of the coefficient of the presence of intervention in the MLR models might not be informative. When looking at only the intervention group, the improvement of three outcomes was significant by pre-post comparison using the paired t test; however, the pre-post comparison can obtain internal validity only if the intervention was the sole reason that the scores after the intervention increased from the scores before the intervention. This assumption is usually not true, because the subjects are constantly exposed to dynamic environment and social interactions. Also, the pretest itself can change villagers' level of knowledge and improve their scores at the follow up. Therefore, the efficacy of the intervention should be evaluated based on the comparison with the control group. To make the control group comparable with the intervention group in our study, a placebo intervention should have been implemented in the control group, such as an education campaign about the other disease.

In addition, the exchangeability should be discussed when comparing the outcomes of the intervention groups and the control group. It should be considered that the distribution of the demographic characteristics was significantly different between the intervention groups and the control group. It might be attributed to the fact that the control group was sampled from the different province from the intervention groups, even though they were both from the Northeast region where leptospirosis endemic occurred. In future projects, it would be better to recruit a control group from the same province with an intervention group so that the control group would represent the distribution of demographic characteristics in the intervention group.

The unequal gender proportion is another limitation of this study. Females were underrepresented in all three groups even though participants were randomly recruited. It might be because women asked men in their households to answer the questionnaire instead of answering it by themselves, which might be attributed to Thai culture. It might affect the findings regarding villagers' practices, because females are predominantly in charge of household chores in Thailand. To get a study population representing gender distribution of a total population, VHVs are required to understand the importance of the sampling design, and ensuring each recruited person to answer the questionnaire by himself/herself.

Regarding the non-sampling errors, the study had very high response rate. All participants were followed up successfully in November, and most of the questions were answered in all three groups. In general, some participants cannot be followed up because of various reasons, such as they move, die, get sick, and simply

refuse to answer the questionnaire. The high response rate in our study might be because the VHVs and the government staff worked hard to get answers from the villagers. Because it was one of few projects funded by WHO in this area, the project members tried to obtain a desired result from this study so that they can get another funding in the future. Thus, it might be possible that they asked other people in a same household to fill in the questionnaire if a selected person was not able to do so. In contrast, the control group had 59 values coded incorrectly in the section of attitudes in the first contact, which were from 21 villagers. It might be because of the error that occurred when the data were entered into the excel sheet by the project members. It was likely to affect the assessment of villagers' attitudes in the control group.

With regard to the quality of the revised questionnaire, there were still some inadequacies. First, there were several questions that were not applicable to all respondents. For example, in the section regarding practices, question 6 was not applicable to those who did not have an animal barn, and question 10 was not applicable to non-field workers. In this area of Thailand, many villagers work in fields, even though their primary occupation is not farming, when they help their neighbors and relatives. However, even considering this fact, some villagers might find this question inapplicable to them, and therefore, it is not sure they selected "never" because they did not work in fields or because they did not wear gloves when they worked in fields. To solve this problem, a screening question needed to be inserted in advance of these questions. Second, some questions might be unclear for villagers. For instance, question 10 in the section of attitudes was a negative sentence

that said “wearing gloves or boots during working in rice fields, orchards, or plantations does not help us reduce the risk of getting leptospirosis” and its choices were “agree” and “disagree.” Given the low education level in the study sites, this question may have confused villagers, and they might not be able to choose a choice reflecting their true attitudes. Third, the questionnaire might be too long for some villagers considering their education level. Also, people in this area of Thailand were not familiar with a survey, and they were not willing to answer the long questionnaire. As discussed above, there were only a few missing observations in all three groups because the VHVs and provincial government staff encouraged them to answer all questions, but villagers might not spend enough time and focus when they answered the questionnaire.

On the other hand, the revised questionnaire had several strengths. Because it was developed based on the discussions with local professionals, the questions were locally tailored and successfully addressing cultural behaviors found in this area. The number of people eating rats has decreased in these decades, but it is still a common behavior in northeast Thailand, which is clearly one of the reasons of high morbidity rate in this area. Based on this fact, the questions evaluating this behavior, which were not included in the original questionnaire, were added in the revised one. The question asking about the chemical fertilizer was also included, because the site visits revealed many villagers in this area believed that chemical fertilizer was the cause of leptospirosis. Also, the revised questionnaire succeeded in evaluating villagers’ knowledge, attitudes, and practices surrounding current issues of leptospirosis in Thailand. As Thailand has suffered from a big outbreak of Dengue virus infection

these years, there were many villagers who confused leptospirosis with Dengue fever. Through the site visits, it was found that some villagers thought mosquito bites would cause leptospirosis, and therefore, the questions about mosquito bites were included in the revised questionnaire.

Although it has limitations, this intervention demonstrated that the public health project implemented with relatively small resource needs could make the significant change in villagers' knowledge, attitudes, and practices. The score differences before and after the intervention might seem small even though they were significant; however, given the fact that the education campaign was implemented only once, the intervention appeared to have a practical impact on villagers' improvement of knowledge, attitudes, and practices three months later. Especially, it should be noted that the villagers' scores of practices improved in most of the questions, while there were no questions where the villagers' scores worsened in the intervention group. Because this intervention was executed with simple and easy measures, it could be smoothly applied to other areas in Thailand. We hope this intervention could be a model protocol of infectious disease control at a community level in Thailand, and contribute to the risk reduction of not only leptospirosis but also other preventable infectious diseases.

Table 3-1. Socio-demographic Characteristics of the Villagers in Three Groups, Northeast Thailand, August 2013 (N=1,250)

Socio-demographic characteristics	Interv. 1[*1] (n=700)	Interv. 2[*2] (n=300)	Control (n=250)	P
Age				
18 - 30 years	48 (7%)	25 (8%)	34 (14%)	<.0001[*3]
31 - 40 years	102 (15%)	58 (19%)	72 (29%)	
41 - 50 years	249 (36%)	112 (37%)	75 (30%)	
51 - 60 years	175 (25%)	67 (22%)	57 (23%)	
61+ years	126 (18%)	38 (13%)	12 (5%)	
Gender				
Male	477 (68%)	186 (62%)	147 (59%)	0.02[*4]
Female	223 (32%)	114 (38%)	103 (41%)	
Education				
≤ Primary School	558 (80%)	241 (80%)	69 (28%)	<.0001[*3]
Junior High School	89 (13%)	40 (13%)	76 (30%)	
High School	42 (6%)	14 (5%)	34 (14%)	
> High school	11 (2%)	5 (2%)	71 (28%)	
Monthly income				
≤ 3,000 B	139 (20%)	48 (16%)	81 (32%)	<.0001[*3]
3,001 – 6,000 B	390 (56%)	175 (60%)	72 (29%)	
6,001 – 10,000 B	124 (18%)	51 (17%)	50 (20%)	
≥ 10,001 B	44 (6%)	19 (7%)	47 (19%)	
Occupation				
Farming	473 (68%)	183 (61%)	107 (43%)	<.0001[*3]
Orchard	10 (1%)	4 (1%)	8 (3%)	
Plantation	120 (17%)	50 (17%)	0 (0%)	
Animal handler	9 (1%)	5 (2%)	3 (1%)	
Fishery	5 (1%)	7 (2%)	0 (0%)	
Other general employee	53 (8%)	37 (12%)	59 (24%)	
Trader	15 (2%)	1 (0%)	8 (3%)	
Government employee	0 (0%)	2 (1%)	44 (18%)	
Others	10 (1%)	10 (3%)	21 (8%)	

*1: Intervention group 1

*2: Intervention group 2

*3: Calculated by ANOVA based on Tukye's method

*4: Calculated by Cochran-Mantel-Haenzel statistics

Table 3-2. Animals Owned by the Villagers, Northeast Thailand, August 2013 (N=1,250)

	Intervention 1 (n=700)	Intervention 2 (n=300)	Control (n=250)
Cows			
Yes	15 (2%)	6 (2%)	4 (2%)
No	685 (98%)	294 (98%)	246 (98%)
Buffalos			
Yes	17 (2%)	7 (2%)	0 (0%)
No	683 (98%)	293 (98%)	250 (100%)
Pigs			
Yes	44 (6%)	21 (7%)	9 (4%)
No	656 (94%)	279 (93%)	241 (96%)
Dogs			
Yes	478 (68%)	184 (61%)	132 (53%)
No	222 (32%)	116 (39%)	118 (47%)

Table 3-3A. Scores of the Major Information Media on Leptospirosis, Northeast Thailand, August 2013 (N=1,219)

Information tools	Intervention 1 (n=675)	Intervention 2 (n=300)	Control (n=244)
Television	982	396	**629**
Radio	411	253	107
VHVs	**1321**	**624**	336
Posters and leaflets	237	90	104
Public health officers	644	259	150
Broadcast towers	200	83	52
Meetings/workshops	232	93	29
Internet	8	2	33
Other	4	0	4

Table 3-3B. Scores of the Influential Information Media on Leptospirosis, Northeast Thailand, August 2013 (N=1,250)

Information tools	Intervention 1 (n=700)	Intervention 2 (n=300)	Control (n=250)
Television	**1321**	405	**611**
Radio	479	226	127
VHVs	1255	**620**	308
Posters and leaflets	177	76	111
Public health officers	512	220	201
Broadcast towers	319	125	35
Meetings/workshops	279	127	53
Internet	6	1	42
Other	4	0	0

Table 3-4. Villagers' Answers to the Questions Regarding Knowledge of Leptospirosis, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q1. Contacting with the urine of animals increases the risk of infection.						
Yes ✓	568 (81%)	623 (89%)	268 (89%)	281 (94%)	196 (78%)	170 (68%)
No	75 (11%)	35 (5%)	26 (9%)	9 (3%)	34 (14%)	26 (10%)
Don't know	57 (8%)	42 (6%)	6 (2%)	10 (3%)	20 (8%)	54 (22%)
Q2. Putting your scratched skin in to the water increases the risk of infection.						
Yes ✓	659 (94%)	675 (96%)	292 (97%)	295 (98%)	223 (89%)	120 (48%)
No	27 (4%)	17 (2%)	6 (2%)	5 (2%)	23 (9%)	79 (32%)
Don't know	14 (2%)	8 (1%)	2 (1%)	0 (0%)	4 (2%)	51 (20%)
Q3. Touching animal dead bodies when you have wounds on your hands increases the risk of infection.						
Yes ✓	524 (75%)	596 (85%)	246 (82%)	264 (88%)	191 (76%)	147 (59%)
No	100 (14%)	57 (8%)	37 (12%)	20 (7%)	40 (16%)	52 (21%)
Don't know	76 (11%)	47 (7%)	17 (6%)	16 (5%)	19 (8%)	51 (20%)
Q4. Eating contaminated food increases the risk of infection.						
Yes ✓	557 (80%)	595 (85%)	261 (87%)	264 (88%)	189 (76%)	153 (61%)
No	96 (14%)	65 (9%)	28 (9%)	14 (5%)	40 (16%)	54 (22%)
Don't know	47 (7%)	40 (6%)	11 (4%)	22 (7%)	21 (8%)	43 (17%)
Q5. Drinking contaminated water from uncovered water jar increases the risk of infection.						
Yes ✓	510 (73%)	561 (80%)	245 (82%)	259 (86%)	189 (76%)	150 (60%)
No	116 (17%)	83 (12%)	37 (12%)	24 (8%)	41 (16%)	55 (22%)
Don't know	74 (11%)	56 (8%)	18 (6%)	17 (6%)	20 (8%)	44 (18%)

Table 3-4. (Continued) Villagers' Answers to the Questions Regarding Knowledge of Leptospirosis, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q6. Mosquito bites and insect bites increase the risk of infection.						
Yes	40 (6%)	42 (6%)	36 (12%)	13 (4%)	34 (14%)	46 (18%)
No ✓	625 (89%)	616 (88%)	239 (80%)	269 (90%)	186 (74%)	156 (62%)
Don't know	35 (5%)	42 (6%)	25 (8%)	17 (6%)	30 (12%)	47 (19%)
Q7. Dog bites increase the risk of infection.						
Yes	105 (15%)	164 (23%)	48 (16%)	56 (19%)	51 (20%)	55 (22%)
No ✓	502 (72%)	440 (63%)	217 (72%)	221 (74%)	175 (70%)	153 (61%)
Don't know	93 (13%)	96 (14%)	35 (12%)	22 (7%)	24 (10%)	41 (16%)
Q8. Being in the same room with affected people increases the risk of infection.						
Yes	61 (9%)	102 (15%)	47 (16%)	35 (12%)	48 (19%)	58 (23%)
No ✓	562 (80%)	547 (78%)	227 (76%)	244 (81%)	182 (73%)	144 (58%)
Don't know	77 (11%)	51 (7%)	26 (9%)	21 (7%)	20 (8%)	48 (19%)
Q9. Shaking hands with affected people increases the risk of infection.						
Yes	56 (8%)	90 (13%)	44 (15%)	30 (10%)	29 (12%)	52 (21%)
No ✓	579 (83%)	559 (80%)	229 (76%)	248 (83%)	206 (82%)	150 (60%)
Don't know	65 (9%)	51 (7%)	27 (9%)	22 (7%)	15 (6%)	48 (19%)
Q10. Leptospirosis occurs only during rainy season.						
Yes	342 (49%)	281 (40%)	95 (32%)	101 (34%)	128 (51%)	51 (20%)
No ✓	314 (45%)	363 (52%)	190 (63%)	174 (58%)	99 (40%)	166 (66%)
Don't know	44 (6%)	56 (8%)	15 (5%)	25 (8%)	23 (9%)	33 (13%)

Table 3-4. (Continued) Villagers' Answers to the Questions Regarding Knowledge of Leptospirosis, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q11. Eating raw or half-cooked meat increases the risk of infection						
Yes ✓	152 (22%)	207 (30%)	73 (24%)	111 (37%)	66 (26%)	73 (29%)
No	469 (67%)	398 (57%)	208 (69%)	161 (54%)	169 (68%)	135 (54%)
Don't know	79 (11%)	95 (14%)	19 (6%)	28 (9%)	15 (6%)	42 (17%)
Q12. Walking in animal habitat with bare feet increases the risk of infection.						
Yes ✓	589 (84%)	626 (39%)	271 (90%)	279 (93%)	192 (77%)	143 (57%)
No	78 (11%)	54 (8%)	26 (9%)	17 (6%)	55 (22%)	68 (27%)
Don't know	33 (5%)	20 (3%)	3 (1%)	4 (1%)	3 (1%)	39 (16%)
Q13. Handling chemical fertilizer without gloves and masks increases the risk of infection.						
Yes	143 (20%)	210 (30%)	68 (23%)	88 (29%)	129 (52%)	52 (21%)
No ✓	440 (63%)	390 (56%)	180 (60%)	192 (64%)	94 (38%)	164 (66%)
Don't know	117 (17%)	100 (14%)	52 (17%)	19 (6%)	27 (11%)	34 (14%)
Q14. Working in the rice field with bare feet increases the risk of infection.						
Yes ✓	643 (92%)	665 (95%)	278 (93%)	292 (97%)	207 (83%)	178 (71%)
No	45 (6%)	25 (4%)	18 (6%)	7 (2%)	43 (17%)	45 (18%)
Don't know	12 (2%)	10 (1%)	4 (1%)	0 (0%)	0 (0%)	27 (11%)
Q15. Swimming in natural water source increases the risk of infection						
Yes ✓	468 (67%)	583 (83%)	254 (85%)	254 (85%)	160 (64%)	99 (40%)
No	153 (22%)	77 (11%)	38 (13%)	31 (10%)	62 (25%)	119 (48%)
Don't know	79 (11%)	40 (6%)	8 (3%)	15 (5%)	28 (11%)	32 (13%)

Table 3-4. (Continued) Villagers' Answers to the Questions Regarding Knowledge of Leptospirosis, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q16-1. Do flies have leptospires?						
Yes	47 (7%)	65 (9%)	5 (2%)	36 (12%)	15 (6%)	21 (8%)
No ✓	623 (89%)	616 (88%)	290 (97%)	261 (87%)	209 (84%)	176 (70%)
Don't know	30 (4%)	19 (3%)	5 (2%)	2 (1%)	26 (10%)	53 (21%)
Q16-2. Do birds have leptospires?						
Yes	122 (17%)	113 (16%)	67 (22%)	53 (18%)	23 (9%)	29 (12%)
No ✓	516 (74%)	552 (79%)	227 (76%)	239 (80%)	193 (77%)	164 (66%)
Don't know	62 (9%)	35 (5%)	6 (2%)	7 (2%)	34 (14%)	57 (23%)
Q16-3. Do mice and rats have leptospires?						
Yes ✓	666 (95%)	680 (97%)	295 (98%)	286 (96%)	213 (85%)	241 (96%)
No	26 (4%)	18 (3%)	5 (2%)	12 (4%)	34 (14%)	5 (2%)
Don't know	8 (1%)	2 (0%)	0 (0%)	1 (0%)	3 (1%)	4 (2%)
Q16-4. Do mosquitos have leptospires?						
Yes	47 (7%)	64 (9%)	26 (9%)	25 (8%)	39 (16%)	23 (9%)
No ✓	628 (90%)	617 (88%)	266 (89%)	271 (91%)	188 (75%)	172 (69%)
Don't know	25 (4%)	19 (3%)	8 (3%)	3 (1%)	23 (9%)	55 (22%)
Q16-5. Do cows and buffalos have leptospires?						
Yes ✓	523 (75%)	602 (96%)	222 (74%)	255 (85%)	74 (30%)	34 (14%)
No	128 (18%)	70 (10%)	76 (25%)	37 (12%)	160 (64%)	155 (62%)
Don't know	49 (7%)	28 (4%)	2 (1%)	7 (2%)	16 (6%)	61 (24%)
Q16-6. Do pigs have leptospires?						
Yes ✓	411 (59%)	506 (72%)	147 (49%)	220 (74%)	49 (20%)	29 (11%)
No	221 (32%)	157 (22%)	149 (50%)	64 (21%)	181 (72%)	165 (66%)
Don't know	68 (10%)	37 (5%)	4 (1%)	15 (5%)	20 (8%)	58 (23%)
Q16-7. Do dogs have leptospires?						
Yes ✓	365 (52%)	403 (58%)	117 (39%)	171 (57%)	63 (25%)	29 (12%)
No	239 (34%)	210 (30%)	157 (52%)	114 (38%)	167 (67%)	163 (65%)
Don't know	96 (14%)	87 (12%)	26 (9%)	14 (5%)	20 (8%)	58 (23%)

✓ indicates the correct answer to the question.

Table 3-5. Villagers' Answers to the Questions Regarding Attitudes Toward Prevention of Leptospirosis, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q1. I need to have the knowledge of leptospirosis.						
Agree ✓[*2]	692 (99%)	697 (100%)	297 (99%)	295 (99%)	238 (95%)	248 (99%)
Disagree	8 (1%)	3 (0%)	3 (1%)	4 (1%)	12 (5%)	2 (1%)
Q2. I need to make sure that my house is free from mice and rats.						
Agree ✓	633 (90%)	634 (91%)	276 (92%)	283 (95%)	216 (86%)	238 (95%)
Disagree	67 (10%)	66 (9%)	24 (8%)	16 (5%)	34 (14%)	12 (5%)
Q3. The dustbin in a house should be covered all the time.						
Agree ✓	676 (97%)	692 (99%)	294 (98%)	299 (100%)	230 (92%)	242 (97%)
Disagree	24 (3%)	8 (1%)	6 (2%)	1 (0%)	20 (8%)	8 (3%)
Q4. I am worried that I might get leptospirosis when I walk through flood.						
Agree ✓	652 (93%)	645 (92%)	258 (86%)	275 (92%)	212 (85%)	218 (87%)
Disagree	48 (7%)	55 (8%)	42 (14%)	25 (8%)	38 (15%)	32 (13%)
Q5. If I suspect that I might get leptospirosis, I will go to a clinic immediately.						
Agree ✓	673 (96%)	694 (99%)	297 (99%)	296 (99%)	223 (91%)	242 (97%)
Disagree	27 (4%)	6 (1%)	3 (1%)	4 (1%)	23 (9%)	8 (3%)
Q6. I am worried when my children swim in the canal/river when they have wounds or scratched skin because they might get leptospirosis.						
Agree ✓	636 (91%)	643 (92%)	261 (87%)	265 (89%)	220 (88%)	182 (73%)
Disagree	64 (9%)	57 (8%)	39 (13%)	34 (11%)	30 (12%)	68 (27%)
Q7. Wearing gloves during working in rice fields, orchards, or plantations makes me feel annoyed.[*1]						
Agree	209 (34%)	155 (25%)	74 (30%)	67 (27%)	58 (57%)	83 (70%)
Disagree ✓	408 (66%)	462 (75%)	175 (70%)	181 (73%)	44 (43%)	35 (30%)
Q8. Wearing gloves during working in rice fields, orchards, or plantations makes my work slower and makes me feel unskillful.[*1]						
Agree	215 (35%)	152 (25%)	86 (35%)	69 (28%)	49 (47%)	80 (68%)
Disagree ✓	402 (65%)	465 (75%)	163 (65%)	179 (72%)	56 (53%)	38 (32%)
Q9. Wearing boots during working in rice fields, orchards, or plantations makes my work slower and makes me feel unskillful.[*1]						
Agree	181 (29%)	130 (21%)	65 (26%)	63 (25%)	38 (36%)	65 (55%)
Disagree ✓	346 (71%)	487 (79%)	183 (74%)	185 (75%)	67 (64%)	53 (45%)
Q10. Wearing gloves or boots during working in rice fields, orchards, or plantations does NOT help us reduce the risk of getting leptospirosis.[*1]						
Agree	203 (33%)	218 (35%)	90 (36%)	99 (40%)	50 (48%)	80 (68%)
Disagree ✓	413 (67%)	398 (65%)	159 (64%)	148 (60%)	55 (52%)	38 (32%)

*1: Question 7 ~ 10 were only applicable to field workers (Intervention group 1: n=617; Intervention group 2: n=249; Control group: n=118); *2: ✓ indicates preferable attitudes.

Table 3-6. Villagers' Answers to the Questions Regarding Practices of Leptospirosis Control, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q1. I cover wounds before going into the water.						
Every time	453 (65%)	506 (72%)	251 (84%)	233 (78%)	173 (69%)	75 (30%)
Almost every time	153 (22%)	136 (19%)	40 (13%)	50 (17%)	56 (22%)	114 (46%)
Seldom	67 (10%)	43 (6%)	9 (3%)	11 (4%)	17 (7%)	45 (18%)
Never	27 (4%)	15 (2%)	0 (0%)	6 (2%)	4 (2%)	16 (6%)
Q2. I have a shower or bath with soap immediately after going into the water or walking around wet area.						
Every time	477 (68%)	515 (74%)	219 (73%)	231 (77%)	184 (74%)	63 (25%)
Almost every time	166 (24%)	155 (22%)	72 (24%)	68 (23%)	41 (16%)	130 (52%)
Seldom	53 (8%)	27 (4%)	9 (3%)	1 (0%)	25 (10%)	50 (20%)
Never	4 (1%)	3 (0%)	0 (0%)	0 (0%)	0 (0%)	7 (2%)
Q3. I keep food in a cabinet or keep food with a cover on.						
Every time	598 (85%)	606 (87%)	257 (86%)	255 (85%)	176 (70%)	99 (40%)
Almost every time	69 (10%)	83 (12%)	37 (12%)	42 (14%)	52 (21%)	117 (47%)
Seldom	27 (4%)	8 (1%)	6 (2%)	3 (1%)	14 (6%)	27 (11%)
Never	6 (1%)	3 (0%)	0 (0%)	0 (0%)	8 (3%)	7 (3%)
Q4. I burn or bury leftover food.						
Every time	405 (58%)	430 (61%)	165 (55%)	202 (67%)	119 (48%)	41 (16%)
Almost every time	201 (29%)	215 (31%)	111 (37%)	78 (26%)	78 (31%)	129 (52%)
Seldom	73 (10%)	46 (7%)	22 (7%)	18 (6%)	28 (11%)	69 (28%)
Never	21 (3%)	9 (1%)	2 (1%)	2 (1%)	25 (10%)	11 (4%)
Q5. I clean my place when it is messy.						
Every time	451 (64%)	474 (68%)	203 (68%)	221 (74%)	124 (50%)	69 (28%)
Almost every time	205 (29%)	208 (30%)	90 (30%)	68 (23%)	94 (38%)	122 (49%)
Seldom	33 (5%)	17 (2%)	7 (2%)	11 (4%)	32 (13%)	48 (19%)
Never	11 (2%)	1 (0%)	0 (0%)	0 (0%)	0 (0%)	11 (4%)
Q6. I clean an animal barn with gloves and boots.						
Every time	433 (62%)	462 (66%)	180 (60%)	210 (70%)	100 (40%)	102 (41%)
Almost every time	132 (19%)	152 (22%)	91 (30%)	69 (23%)	76 (30%)	94 (38%)
Seldom	75 (11%)	45 (6%)	16 (5%)	13 (4%)	47 (19%)	42 (17%)
Never	60 (9%)	41 (6%)	13 (4%)	8 (3%)	27 (11%)	12 (5%)

Table 3-6. (Continued) Villagers' Answers to the Questions Regarding Practices of Leptospirosis Control, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q7. I eliminate rats and mice by catching them by hands or using drugs and traps.						
Every time	241 (34%)	279 (40%)	75 (25%)	132 (44%)	94 (38%)	25 (10%)
Almost every time	230 (33%)	233 (32%)	119 (40%)	112 (37%)	86 (34%)	90 (36%)
Seldom	204 (29%)	177 (25%)	95 (32%)	47 (16%)	59 (24%)	123 (49%)
Never	25 (4%)	21 (3%)	11 (4%)	9 (3%)	11 (4%)	12 (5%)
Q8. I participate in community-level campaigns and activities for prevention of leptospirosis.						
Every time	250 (36%)	273 (39%)	92 (31%)	157 (52%)	91 (36%)	23 (9%)
Almost every time	140 (20%)	151 (22%)	77 (26%)	68 (23%)	57 (23%)	111 (44%)
Seldom	180 (26%)	178 (25%)	79 (26%)	51 (17%)	73 (29%)	61 (24%)
Never	130 (19%)	21 (3%)	52 (17%)	24 (8%)	29 (12%)	55 (22%)
Q9. I use personal protective equipment when I cook rat meat.						
Every time	243 (36%)	251 (36%)	133 (44%)	149 (50%)	92 (37%)	27 (9%)
Almost every time	139 (20%)	150 (21%)	51 (17%)	83 (28%)	57 (23%)	99 (40%)
Seldom	154 (16%)	172 (25%)	72 (24%)	47 (16%)	38 (15%)	46 (18%)
Never	164 (19%)	127 (18%)	44 (15%)	21 (7%)	63 (25%)	78 (31%)
Q10. I wear gloves while I work in rice fields.						
Every time	244 (35%)	277 (40%)	99 (33%)	141 (47%)	88 (35%)	44 (18%)
Almost every time	135 (19%)	164 (23%)	47 (16%)	72 (24%)	78 (31%)	95 (38%)
Seldom	157 (22%)	118 (17%)	77 (26%)	30 (10%)	32 (13%)	64 (26%)
Never	164 (23%)	141 (20%)	77 (26%)	57 (19%)	52 (21%)	47 (19%)
Q11. I wash hands before eating food.						
Every time	572 (82%)	594 (85%)	273 (91%)	342 (81%)	154 (62%)	123 (49%)
Almost every time	84 (12%)	88 (13%)	18 (6%)	50 (17%)	64 (26%)	85 (34%)
Seldom	32 (6%)	11 (2%)	5 (2%)	4 (1%)	18 (7%)	33 (13%)
Never	12 (2%)	7 (1%)	4 (1%)	3 (1%)	14 (6%)	9 (4%)
Q12. I wash hands after touching animals.						
Every time	551 (79%)	588 (84%)	232 (77%)	248 (83%)	154 (62%)	78 (31%)
Almost every time	108 (15%)	97 (14%)	63 (21%)	45 (15%)	51 (20%)	104 (42%)
Seldom	33 (5%)	12 (2%)	2 (1%)	6 (2%)	34 (14%)	58 (23%)
Never	8 (1%)	3 (0%)	3 (1%)	1 (0%)	11 (4%)	10 (4%)

Table 3-6. (Continued) Villagers' Answers to the Questions Regarding Practices of Leptospirosis Control, Northeast Thailand, 2013

	Intervention 1 (n=700)		Intervention 2 (n=300)		Control (n=250)	
Questions and Choices	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**	**Pre-education**	**Post-education**
Q13. I heat leftover food before eating it again.						
Every time	489 (70%)	530 (76%)	209 (70%)	214 (71%)	142 (57%)	30 (12%)
Almost every time	142 (20%)	119 (17%)	51 (17%)	66 (22%)	69 (28%)	163 (65%)
Seldom	63 (9%)	49 (7%)	36 (12%)	19 (6%)	20 (8%)	48 (19%)
Never	6 (1%)	2 (0%)	4 (1%)	1 (0%)	19 (8%)	9 (4%)
Q14. I wash vegetables with clean water before eating.						
Every time	563 (80%)	583 (83%)	239 (80%)	238 (79%)	147 (59%)	119 (48%)
Almost every time	112 (16%)	111 (16%)	55 (18%)	57 (19%)	65 (26%)	97 (39%)
Seldom	21 (3%)	6 (1%)	3 (1%)	4 (1%)	27 (11%)	25 (10%)
Never	4 (1%)	0 (0%)	3 (1%)	1 (0%)	11 (4%)	9 (4%)
Q15. I put a cover on a water jar.						
Every time	562 (80%)	605 (86%)	224 (75%)	257 (86%)	164 (66%)	65 (26%)
Almost every time	100 (14%)	82 (12%)	64 (21%)	39 (13%)	66 (26%)	133 (53%)
Seldom	31 (4%)	13 (2%)	8 (3%)	1 (0%)	15 (6%)	40 (16%)
Never	7 (1%)	0 (0%)	4 (1%)	3 (1%)	5 (2%)	12 (5%)
Q16. I wear boots when I walk in water.						
Every time	495 (71%)	533 (76%)	233 (78%)	245 (82%)	133 (53%)	96 (38%)
Almost every time	135 (19%)	132 (19%)	56 (19%)	43 (14%)	71 (28%)	108 (43%)
Seldom	52 (7%)	25 (4%)	6 (2%)	5 (2%)	34 (14%)	39 (16%)
Never	18 (3%)	10 (1%)	5 (2%)	7 (2%)	12 (5%)	7 (3%)

Table 3-7. Distribution of Total Score of Knowledge, Attitudes, and Practices Regarding Leptospirosis Before and After the Education Program, Northeast Thailand, 2013

	n	Pre[*1] (s.d.[*4])	Post[*2] (s.d.[*4])	Mean difference	95% CI[*3]	p value
Knowledge: 0 ~ 22						
Intervention 1	700	16.3 (3.4)	17.2 (2.9)	0.85	(0.62 to 1.09)	<.0001
Intervention 2	298	16.8 (2.6)	17.8 (2.7)	1.11	(0.68 to 1.55)	<.0001
Control	249	14.2 (3.3)	12.0 (4.6)	-2.14	(-2.87 to -1.43)	<.0001
Attitudes (Field workers): 0 ~ 10						
Intervention 1	615	8.4 (1.7)	8.7 (1.7)	0.31	(0.17 to 0.45)	<.0001
Intervention 2	247	8.3 (1.9)	8.5 (1.5)	0.16	(-0.16 to 0.47)	0.3
Control	97	7.5 (1.7)	6.9 (1.5)	-0.59	(-1.06 to -0.12)	0.02
Attitudes (Non-field workers): 0 ~ 6						
Intervention 1	77	5.6 (0.7)	5.6 (0.7)	0.03	(-0.10 to 0.15)	0.7
Intervention 2	50	5.6 (0.7)	5.8 (0.6)	0.18	(-0.08 to 0.44)	0.2
Control	132	5.4 (1.2)	5.4 (0.9)	0.08	(-0.18 to 0.33)	0.6
Practices: 0 ~ 48						
Intervention 1	700	38.3 (7.1)	40.0 (5.5)	1.66	(1.22 to 2.09)	<.0001
Intervention 2	300	39.3 (5.0)	41.4 (5.6)	2.10	(1.25 to 2.96)	<.0001
Control	250	36.2 (7.9)	30.5 (7.9)	-5.61	(-7.06 to -4.16)	<.0001

*1: The mean scores reported in August, which was before the intervention

*2: The mean scores reported in November, which was three months after the intervention

*3: 95% confidence interval for the mean difference

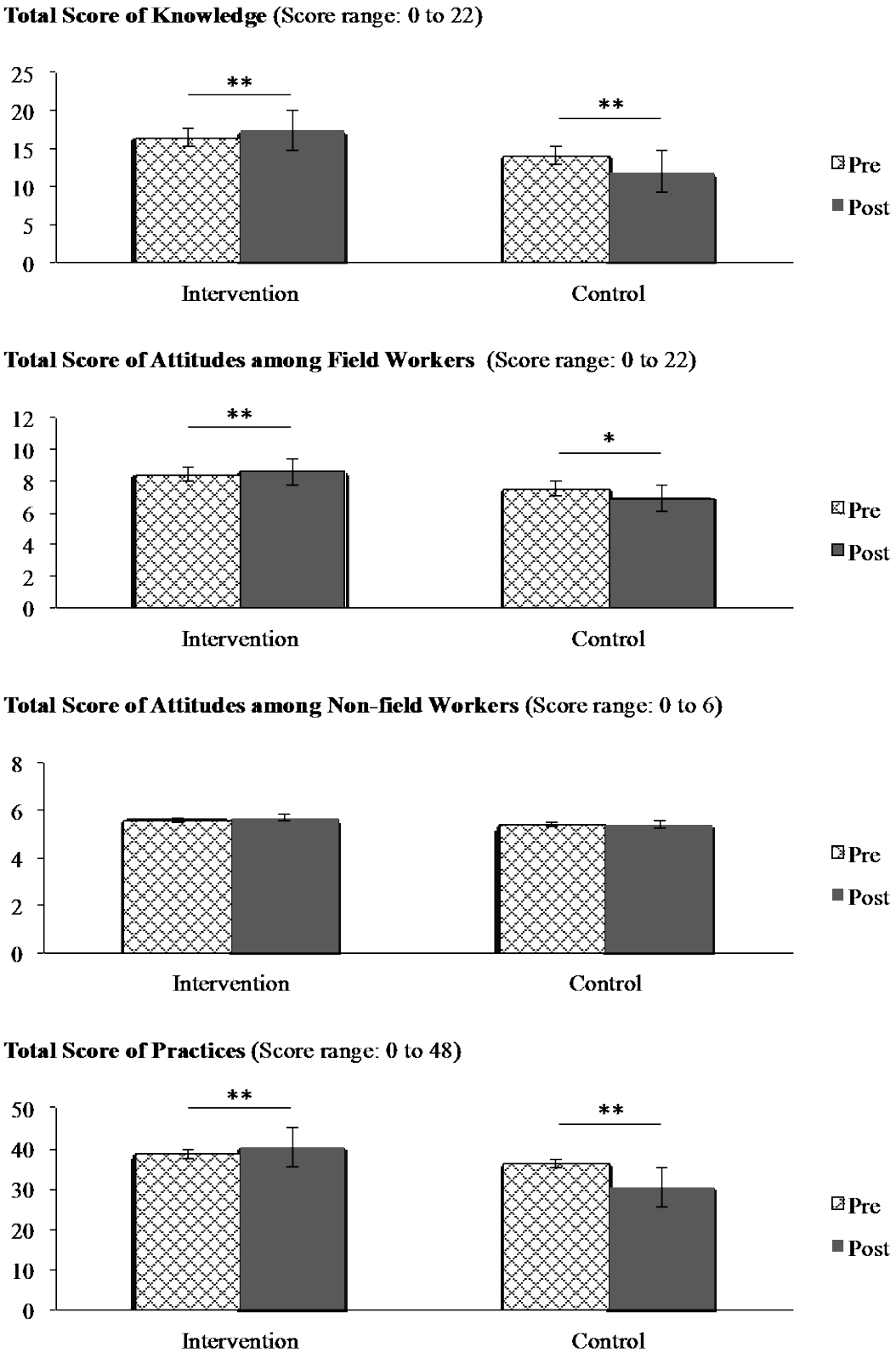
*4: Standard deviation of the mean scores

Table 3-8. Linear Associations between the Baseline Total Scores of Knowledge, Attitudes, and Practices, Northeast Thailand, August 2013

Dependent	Independent	Group	n	Intercept estimate (se[*1])	Slope estimate (se[*1])	p-value for test of slope	R-square
Attitudes (Field workers)	Knowledge	Intervention 1	615	6.16 (0.34)	0.13 (0.02)	<.0001	0.07
		Intervention 2	247	5.11 (0.74)	0.19 (0.04)	<.0001	0.07
		Control	97	8.37 (0.80)	-0.07 (0.05)	0.2	0.01
Attitudes (Non-field workers)	Knowledge	Intervention 1	77	4.48 (3.09)	1.94 (0.55)	0.0007	0.14
		Intervention 2	50	6.93 (2.60)	1.70 (0.46)	0.0006	0.22
		Control	132	11.01 (1.38)	0.55 (0.25)	0.03	0.04
Practices	Knowledge	Intervention 1	700	28.00 (1.26)	0.63 (0.08)	<.0001	0.09
		Intervention 2	298	33.68 (1.84)	0.33 (0.11)	0.002	0.03
		Control	249	29.27 (2.19)	0.49 (0.15)	0.001	0.04
Practices	Attitudes (Field workers)	Intervention 1	615	30.16 (1.40)	1.00 (0.16)	<.0001	0.06
		Intervention 2	247	32.58 (1.44)	0.80 (0.17)	<.0001	0.08
		Control	97	26.94 (2.81)	1.59 (0.38)	<.0001	0.13
Practices	Attitudes (Non-field workers)	Intervention 1	77	35.08 (5.65)	0.38 (1.00)	0.7	0.00
		Intervention 2	50	35.54 (4.41)	0.74 (0.78)	0.3	0.02
		Control	132	33.13 (3.04)	0.19 (0.55)	0.7	0.00

[*1] se = standard error

Figure 3-1. Distribution of the Total Scores of Knowledge, Attitudes, and Practices Before and After the Education Program, Northeast Thailand, 2013



Statistical significance in difference between scores before and after the intervention is indicated as symbols located at the top of columns; *, $p < 0.05$; **, $p < 0.0001$

Table 3-9A. Association between Distribution of Villagers' Improvement of Knowledge and Selected Categorical Variables, Northeast Thailand, 2013

Characteristics		n	Mean	S.D.	Mean Difference (95% CI)
Gender					
Intervention 1	Male	477	0.8	3.0	0.1 (-0.3 to 0.7)
	Female	223	0.9	3.6	
Intervention 2	Male	184	0.7	4.0	**1.0 (0.1 to 1.9)**
	Female	114	1.7	3.6	
Control	Male	147	-2.5	5.5	1.0 (-0.5 to 2.4)
	Female	102	-1.6	6.0	
History of Infection					
Intervention 1	(+)	27	0.8	2.9	(0.01 (-1.1 to 1.3)
	(-)	672	0.9	3.2	
Intervention 2	(+)	13	2.1	3.1	-1.0 (-3.2 to 1.1)
	(-)	282	1.1	3.9	
Control	(+)	4	-6.3	5.1	4.2 (-1.5 to 9.9)
	(-)	245	-2.1	5.7	
Animals					
Intervention 1	(+)	490	0.9	3.3	-0.1 (-0.6 to 0.4)
	(-)	210	0.8	3.1	
Intervention 2	(+)	191	1.1	3.8	0.2 (-0.7 to 1.1)
	(-)	107	1.2	3.8	
Control	(+)	139	-2.4	5.9	0.5 (-0.9 to 2.0)
	(-)	110	-1.9	5.6	
Occupation					
Intervention 1	High risk	617	0.9	3.3	-0.1 (-0.8 to 0.5)
	Non-high risk	78	0.7	2.7	
Intervention 2	High risk	247	1.1	3.8	0.3 (-0.8 to 1.5)
	Non-high risk	50	1.4	4.0	
Control	High risk	118	-2.5	6.0	0.7 (-0.7 to 2.1)
	Non-high risk	131	-1.8	5.5	

Table 3-9A. (Continued) Association between Distribution of Villagers' Improvement of Knowledge and Selected Categorical Variables, Northeast Thailand, 2013

Characteristics		n	Mean	S.D.	Mean Difference (95% CI)
Level of Education					
Intervention 1	≤ Primary	558	0.8	3.3	Ref
	Junior high	89	1.3	3.1	0.5 (-0.2 to 1.2)
	High	42	0.7	2.9	-0.1 (-1.1 to 0.9)
	> High	11	0.6	3.5	-0.2 (-2.1 to 1.8)
Intervention 2	≤ Primary	240	1.4	3.8	Ref
	Junior high	39	-0.4	4.0	**-1.8 (-3.0 to -0.5)**
	High	14	1.3	3.1	-0.1 (-2.1 to 1.9)
	> High	5	-0.8	2.2	-2.2 (-5.5 to 1.1)
Control	≤ Primary	69	-1.6	5.8	Ref
	Junior high	76	-2.7	5.2	-1.1 (-3.0 to 0.7)
	High	34	-0.5	7.1	1.1 (-1.2 to 3.4)
	> High	71	-3.0	5.4	-1.4 (-3.3 to 0.5)
Level of Income					
Intervention 1	≤ 3,000	139	1.0	4.1	Ref
	3,001–6,000	390	0.7	3.0	-0.3 (-0.9 to 0.3)
	6,001–10,000	124	1.3	3.0	0.3 (-0.5 to 1.1)
	≥ 10,001	44	0.9	2.5	-0.1 (-1.2 to 1.0)
Intervention 2	≤ 3,000	48	1.1	4.3	Ref
	3,001–6,000	174	0.9	3.6	-0.2 (-1.4 to 1.0)
	6,001–10,000	51	1.2	3.7	0.1 (-1.4 to 1.6)
	≥ 10,001	19	2.7	4.8	1.6 (-0.4 to 3.6)
Control	≤ 3,000	81	-1.1	5.5	Ref
	3,001–6,000	72	-2.7	5.7	-1.6 (-3.4 to 0.2)
	6,001–10,000	50	-2.7	5.6	-1.6 (-3.6 to 0.4)
	≥ 10,001	46	-2.6	6.3	-1.5 (-3.6 to 0.6)

Table 3-9B. Association between Distribution of Field Workers' Improvement of Attitude and Selected Categorical Variables, Northeast Thailand, 2013

Characteristics		n	Mean	S.D.	Mean Difference (95% CI)
Gender					
Intervention 1	Male	414	0.3	1.7	-0.0 (-0.3 to 0.3)
	Female	201	0.3	1.9	
Intervention 2	Male	156	-0.1	2.5	0.6 (-0.0 to 1.3)
	Female	91	0.6	2.5	
Control	Male	54	-0.7	2.2	0.2 (-0.7 to 1.2)
	Female	43	-0.5	2.5	
History of Infection					
Intervention 1	(+)	25	-0.1	1.7	0.4 (-0.3 to 1.1)
	(-)	589	0.3	1.7	
Intervention 2	(+)	12	0.4	2.1	-0.3 (-1.7 to 1.2)
	(-)	232	0.1	2.5	
Control	(+)	0	–	–	–
	(-)	97	–	–	
Animals					
Intervention 1	(+)	434	0.2	1.6	0.3 (-0.1 to 0.6)
	(-)	181	0.5	2.0	
Intervention 2	(+)	160	0.3	2.6	-0.5 (-1.1 to 0.2)
	(-)	87	-0.1	2.3	
Control	(+)	68	-0.6	2.2	-0.0 (-1.1 to 1.0)
	(-)	29	-0.6	2.7	
Level of Education					
Intervention 1	≤ Primary	493	0.3	1.8	Ref
	Junior high	71	0.3	1.7	0.0 (-0.4 to 0.5)
	High	40	0.5	1.3	0.2 (-0.3 to 0.8)
	> High	11	-0.1	1.8	-0.4 (-1.4 to 0.7)
Intervention 2	≤ Primary	207	0.3	2.5	Ref
	Junior high	29	-0.6	2.4	-0.9 (-1.9 to 0.0)
	High	9	-0.8	1.8	-1.1 (-2.8 to 0.5)
	> High	2	-3.5	0.7	-3.8 (-7.3 to -0.4)
Control	≤ Primary	51	0.1	2.3	Ref
	Junior high	26	-2.4	1.8	**-2.5 (-3.4 to -1.5)**
	High	10	1.1	1.0	1.0 (-0.3 to 2.4)
	> High	10	-1.0	1.8	-1.1 (-2.4 to 0.3)
Level of Income					
Intervention 1	≤ 3,000	115	0.6	1.7	Ref
	3,001–6,000	348	0.3	1.7	-0.3 (-0.7 to -0.1)
	6,001–10,000	107	0.3	1.9	-0.3 (-0.8 to 0.2)
	≥ 10,001	42	0.1	1.5	-0.4 (-1.0 to 0.2)
Intervention 2	≤ 3,000	39	-0.3	2.1	Ref
	3,001–6,000	145	0.2	2.5	0.5 (-0.3 to 1.4)
	6,001–10,000	40	0.6	2.7	0.9 (-0.2 to 1.9)
	≥ 10,001	17	-1.0	2.7	-0.7 (-2.1 to 0.7)
Control	≤ 3,000	41	-1.0	2.3	Ref
	3,001–6,000	43	-0.2	2.5	0.7 (-0.2 to 1.7)
	6,001–10,000	13	-0.5	1.9	0.4 (-1.0 to 1.9)
	≥ 10,001	0	–	–	–

Table 3-9C. Association between Distribution of Non-Field Workers' Improvement of Attitude and Selected Categorical Variables, Northeast Thailand, 2013

Characteristics		n	Mean	S.D.	Mean Difference (95% CI)
Gender					
Intervention 1	Male	57	0.0	0.4	-0.0 (-0.4 to 0.4)
	Female	20	0.0	0.8	
Intervention 2	Male	28	0.0	0.9	0.4 (-0.1 to 0.9)
	Female	22	0.4	0.9	
Control	Male	83	0.1	1.4	-0.0 (-0.6 to 0.5)
	Female	49	0.1	1.6	
History of Infection					
Intervention 1	(+)	2	0.0	0.0	0.0 (-0.1 to 0.2)
	(-)	75	0.0	0.5	
Intervention 2	(+)	1	2.0	–	**-1.9 (-3.7 to -0.0)**
	(-)	48	0.1	0.9	
Control	(+)	4	-0.5	1.0	0.6 (-0.9 to 2.1)
	(-)	128	0.1	1.5	
Animals					
Intervention 1	(+)	51	-0.1	0.5	0.3 (-0.0 to 0.5)
	(-)	26	0.2	0.6	
Intervention 2	(+)	29	0.3	0.9	-0.3 (-0.8 to 0.2)
	(-)	21	0.0	0.9	
Control	(+)	58	0.0	1.5	0.1 (-0.4 to 0.6)
	(-)	74	0.1	1.5	
Level of Education					
Intervention 1	≤ Primary	57	0.0	0.6	Ref
	Junior high	18	0.0	0.5	-0.0 (-0.3 to 0.2)
	High	2	0.0	0.0	-0.0 (-0.8 to 0.7)
	> High	0	–	–	–
Intervention 2	≤ Primary	31	0.2	1.0	Ref
	Junior high	11	0.1	0.7	-0.1 (-0.7 to 0.5)
	High	5	0.4	0.9	0.2 (-0.6 to 1.1)
	> High	3	0.0	0.0	-0.2 (-1.3 to 0.9)
Control	≤ Primary	16	0.8	1.6	Ref
	Junior high	37	0.2	1.6	-0.6 (-1.4 to 0.2)
	High	21	0.9	2.0	0.2 (-0.7 to 1.1)
	> High	58	-0.5	0.9	**-1.2 (-2.0 to -0.5)**
Level of Income					
Intervention 1	≤ 3,000	22	0.0	0.6	Ref
	3,001–6,000	37	0.0	0.3	-0.0 (-0.3 to 0.3)
	6,001–10,000	16	0.0	0.9	-0.0 (-0.4 to 0.3)
	≥ 10,001	2	0.0	0.0	-0.0 (-0.8 to 0.7)
Intervention 2	≤ 3,000	9	0.2	1.2	Ref
	3,001–6,000	29	0.2	1.0	-0.0 (-0.7 to 0.6)
	6,001–10,000	10	0.0	0.0	-0.2 (-1.0 to 0.6)
	≥ 10,001	1	0.0	–	-0.2 (-2.0 to 1.6)
Control	≤ 3,000	36	1.1	1.7	Ref
	3,001–6,000	18	-0.6	0.9	**-1.7 (-2.4 to -0.9)**
	6,001–10,000	34	0.0	1.5	**-1.1 (-1.7 to -0.5)**
	≥ 10,001	44	-0.5	0.9	**-1.6 (-2.2 to -1.0)**

Table 3-9D. Association between Distribution of Villagers' Improvement of Practices and Selected Categorical Variables, Northeast Thailand, 2013

Characteristics		n	Mean	S.D.	Mean Difference (95% CI)
Gender					
Intervention 1	Male	447	1.6	5.9	0.2 (-0.7 to 1.2)
	Female	223	1.8	5.9	
Intervention 2	Male	186	2.0	7.3	0.2 (-1.5 to 2.0)
	Female	114	2.2	7.9	
Control	Male	147	-5.8	12.5	0.3 (-2.5 to 3.2)
	Female	103	-5.4	10.3	
History of Infection					
Intervention 1	(+)	27	0.5	4.1	1.2 (-0.5 to 2.9)
	(-)	672	1.7	5.9	
Intervention 2	(+)	13	3.1	6.5	-1.1 (-5.3 to 3.1)
	(-)	283	2.0	7.6	
Control	(+)	4	19.8	6.6	**-25.8 (-36.9 to -14.6)**
	(-)	246	-6.0	11.3	
Animals					
Intervention 1	(+)	490	1.3	5.5	**1.2 (0.2 to 2.2)**
	(-)	210	2.5	6.6	
Intervention 2	(+)	191	2.1	7.4	0.1 (-1.7 to 1.8)
	(-)	109	2.1	7.8	
Control	(+)	139	-7.7	10.4	**4.7 (1.8 to 7.7)**
	(-)	111	-3.0	12.6	
Occupation					
Intervention 1	High risk	617	1.8	6.0	-1.2 (-2.4 to 0.0)
	Non-high risk	78	0.6	4.9	
Intervention 2	High risk	249	2.4	7.6	-2.1 (-4.4 to 0.2)
	Non-high risk	50	0.3	6.9	
Control	High risk	118	-7.8	11.8	**4.2 (1.4 to 7.1)**
	Non-high risk	132	-3.6	11.2	

Table 3-9D. (Continued) Association between Distribution of Villagers' Improvement of Practices and Selected Categorical Variables, Northeast Thailand, 2013

Characteristics		n	Mean	S.D.	Mean Difference (95% CI)
Level of Education					
Intervention 1	≤ Primary	558	1.6	6.1	Ref
	Junior high	89	1.8	5.3	0.2 (-1.1 to 1.5)
	High	42	1.5	4.4	-0.1 (-2.0 to 1.7)
	> High	11	1.5	4.0	-0.1 (-3.6 to 3.4)
Intervention 2	≤ Primary	241	2.0	7.7	Ref
	Junior high	40	3.2	7.6	1.1 (-1.4 to 3.6)
	High	14	-0.2	5.5	-2.3 (-6.3 to 1.8)
	> High	5	3.0	4.7	1.0 (-5.7 to 7.6)
Control	≤ Primary	69	-7.0	11.5	Ref
	Junior high	76	-8.4	11.2	-1.4 (-5.1 to 2.3)
	High	34	-1.0	12.3	**6.0 (1.3 to 10.7)**
	> High	71	-3.5	11.1	3.4 (-0.3 to 7.2)
Level of Income					
Intervention 1	≤ 3,000	139	2.3	6.6	Ref
	3,001–6,000	390	1.6	6.0	-0.7 (-1.8 to 0.5)
	6,001–10,000	124	1.4	5.3	-0.9 (-2.4 to 0.5)
	≥ 10,001	44	0.6	2.7	-1.7 (-3.7 to 0.3)
Intervention 2	≤ 3,000	48	0.8	7.9	Ref
	3,001–6,000	175	2.1	7.5	1.2 (-1.2 to 3.6)
	6,001–10,000	51	3.3	7.4	2.4 (-0.5 to 5.4)
	≥ 10,001	19	3.6	7.5	2.7 (-1.2 to 6.7)
Control	≤ 3,000	81	-6.5	12.0	Ref
	3,001–6,000	72	-7.1	11.4	-0.5 (-4.2 to 3.1)
	6,001–10,000	50	-4.5	10.4	2.1 (-2.0 to 6.1)
	≥ 10,001	47	-3.0	12.5	3.6 (-0.6 to 7.7)

Table 3-10. Associations between Age and the Villagers' Improvement of Knowledge, Attitudes, and Practices, Northeast Thailand, 2013

		n	Intercept estimate (se[*1])	Estimate of Age (se[*1])	p-value for test of slope	R-square
Improvement of Knowledge	Intervention 1	700	0.7 (0.5)	0.00 (0.0)	0.8	0.00
	Intervention 2	298	-0.1 (1.0)	0.02 (0.0)	0.2	0.00
	Control	249	-1.7 (1.4)	-0.01 (0.0)	0.7	0.00
Improvement of Attitude (Field workers)	Intervention 1	615	0.7 (0.3)	-0.01 (0.0)	0.2	0.00
	Intervention 2	247	1.0 (0.7)	-0.02 (0.0)	0.2	0.01
	Control	97	0.2 (1.2)	-0.01 (0.0)	0.7	0.00
Improvement of Attitude (Non-field workers)	Intervention 1	77	-0.2 (0.2)	0.00 (0.0)	0.3	0.01
	Intervention 2	50	-0.3 (0.5)	0.01 (0.0)	0.3	0.02
	Control	132	1.6 (0.5)	-0.04 (0.0)	0.001	0.08
Improvement of Practice	Intervention 1	700	1.7 (0.9)	-0.00 (0.0)	1.0	0.00
	Intervention 2	300	3.5 (1.9)	-0.03 (0.0)	0.4	0.00
	Control	250	3.6 (2.9)	-0.21 (0.1)	0.0009	0.04

[*1] se = standard error

Table 3-11. Evaluation of the Effect of the Intervention on Villagers' Improvement of Knowledge, Attitudes, and Practices by the Multiple Linear Regression Analysis, Northeast Thailand, 2013

	n	Estimated mean difference (Intervention − Control)	95% CI	Percentage change	P
Improvement of Knowledge[*1]					
Field workers	957	4.9 [*4]	(4.3 to 5.6)	22%	<.0001
Non-field workers	258	3.8 [*5]	(2.5 to 5.0)	17%	<.0001
Improvement of Attitudes[*2]					
Field workers	957	1.3 [*6]	(1.0 to 1.6)	13%	<.0001
Non-field workers	258	0.2 [*7]	(-0.1 to 0.5)	3%	0.2
Improvement of Practices[*3]					
Field workers	957	11.1 [*8]	(9.6 to 12.6)	23%	<.0001
Non-field workers	258	7.7 [*9]	(5.4 to 10.0)	16%	<.0001

*1: The range of score of knowledge was from 0 to 22

*2: The range of score of attitudes was from 0 to 10 among field workers, and 0 to 6 among non-field workers

*3: The range of score of practices was from 0 to 48

*4: Adjusting for gender, level of education, and baseline scores of knowledge, attitudes, and practices

*5: Adjusting for gender, level of education, and baseline scores of knowledge, attitudes, and practices

*6: Adjusting for level of education, history of infection, and baseline scores of knowledge, attitudes, and practices

*7: Adjusting for age, level of education, level of income, history of infection, and baseline scores of knowledge and attitudes

*8: Adjusting for age, level of education, history of infection, possession of animals, and baseline scores of knowledge, attitudes, and practices

*9: Adjusting for age, level of education, history of infection, possession of animals, and baseline scores of knowledge and practices

Appendix 3-A. Revised questionnaire evaluating villagers' knowledge, attitudes, practices regarding leptospirosis

Number of questionnaire [ ] [ ] [ ] [ ]

Questionnaire

Knowledge, Attitude and Practice of Leptospirosis in Nakornrachasima Province

Instruction

1. This questionnaire is the part of implementation of capacity development project "Surveillance and Risk Reduction of Leptospirosis in a Community of Nakornrachasima province".
2. This is not an exam. Please answer all questions according to your real situation.
3. This questionnaire is divided into the following four parts.
   Part 1: General information
   Part 2: Knowledge regarding prevention and control of leptospirosis
   Part 3: Attitude regarding prevention and control of leptospirosis
   Part4: Practice regarding prevention and control of leptospirosis
4. The information from this questionnaire will be analyzed to plan implementation of prevention and control of leptospirosis. All information is confidential and nothing will harm you.
5. Thank you so much for answering this questionnaire. We sincerely appreciate your cooperation.

Sincerely,

Project responsible team

Part 1: General Information

(Instruction: Please check for your answer in appropriate blank.)

1. Gender ( ) 0. Female ( ) 1. Male

2. Age _____ years old

3. The level of education
   ( ) 0. No education
   ( ) 1. Primary school (6 years)
   ( ) 2. Secondary school (3 years)
   ( ) 3. High school (3 years)
   ( ) 4. Diploma (2 years)
   ( ) 5. Bachelor's degree (4 years)
   ( ) 6. Higher than bachelor's degree (ex. Master or Ph.D.)

4. What is your income per month (Bath)?
   ( ) 1. Less than 3,000 ( ) 2. 3,000 – 6,000
   ( ) 3. 6,001 – 10,000 ( ) 4. More than 10,000

5. Primary occupation
   ( ) 1. Farmer (How many times of cropping per year?: _____)
   ( ) 2. Orchard (What kind of?: _____)
   ( ) 3. Plantation (What kind of?: _____)
   ( ) 4. Animal handler (What kind of?: _____)
   ( ) 5. Fishing & selling
   ( ) 6.Other kinds of general employee (What kind of?: _____)
   ( ) 7. Merchant, trader (What kind of?: _____)
   ( ) 8. Government employee
   ( ) 9. Other _____

6. Secondary occupation _____

7. Were you ever affected by leptospirosis?
   ( ) 0. No
   ( ) 1. Yes: if so, when was the last time you got sick (year)? _____
   How did you get a diagnosis? _____

8. Were any of your family members ever affected by leptospirosis?
   ( ) 0. No ( ) 1. Yes, when was the last time you got sick (year)? _____

9. Do you wear boots while working in fields, such as rice field, orchard, and plantation?
   ( ) 0. No,
   because
   ( ) 01. I don't have them. ( ) 02. I don't like wearing them ( ) 03. It is uncomfortable
   ( ) 1 Yes

10. Did you ever receive information about leptospirosis?
    ( ) 0. No ( ) 1. Yes

11. If yes, from what source did you get information?
    (Please choose top three, and fill 1, 2, and 3 in the blank)
    ( ) 1. Television
    ( ) 2. Radio
    ( ) 3. Village health volunteers
    ( ) 4. Posters and leaflets
    ( ) 5. Public health officers
    ( ) 6. Broadcast tower
    ( ) 7. Meetings, workshops
    ( ) 8. Internet
    ( ) 9. Other _____

12. What is the most effective information source on your practice in leptospirosis prevention?
    (Please choose top three, and fill 1, 2, and 3 in the blank)
    ( ) 1. Television
    ( ) 2. Radio
    ( ) 3. Village health volunteers
    ( ) 4. Posters and leaflets
    ( ) 5. Public health officers
    ( ) 6. Broadcast tower
    ( ) 7. Meetings, workshops
    ( ) 8. Internet
    ( ) 9. Other _____

13. Livestock and pet animals at your home

Cows	( ) 0. No ( ) 1. Yes	number: _____animals
Buffalos	( ) 0. No ( ) 1. Yes	number: _____animals
Pigs	( ) 0. No ( ) 1. Yes	number: _____animals
Dogs	( ) 0. No ( ) 1. Yes	number: _____animals

Part 2: Knowledge Regarding Leptospirosis

(Instruction: Please mark X for your answer.)

Leptospirosis can be developed from…

	Yes	No	Don't know
1. Contacting with the urine of animals increases the risk of infection.			
2. Putting your scratched skin in to the water increases the risk of infection.			
3. Touching animal dead bodies when you have wounds on your hands increases the risk of infection.			
4. Eating contaminated food increases the risk of infection			
5. Drinking contaminated water from uncovered water jar increases the risk of infection.			
6. Mosquito bites and insect bites increase the risk of infection.			
7. Dog bites increase the risk of infection			
8. Being in the same room with affected people increases the risk of infection.			
9. Shaking hands with people increases the risk of infection.			
10. Leptospirosis occurs only during rainy season.			
11. Eating raw or half-cooked meat increases the risk of infection.			
12. Walking in moisture animal habitat with bare feet increases the risk of infection.			
13. Handling chemical fertilizer without gloves and mask increases the risk of infection.			
14. Working in the rice field with bare feet increases the risk of infection.			
15. Swimming in natural water source (ex. river and canal) increases the risk of infection.			

16. Please mention all animals or insects that carry leptospires.
(Please mark X in the blank for the answer that you think correct.)

	Yes	No	Don't know
1. Flies			
2. Birds, ducks, chickens			
3. Mice and rats			
4. Mosquitos			
5. Cows, buffalos			
6. Pigs			
7. Dogs			

Part 3: Attitude Regarding Prevention and Control of Leptospirosis

(Instruction: Please mark X in the blanks which match your opinion.)

	Agree	Disagree
1. I need to have the knowledge of leptospirosis.		
2. I need to make sure that my house is free from mice and rats.		
3. The dustbin in a house should be covered all the time.		
4. I am worried that I might get sick because of leptospirosis when I walk through flood.		
5. If I suspect that I might get leptospirosis, I will go to a clinic immediately.		
6. I am worried when my children swim in the canal/river when they have wounds or scratched skin because they might get leptospirosis.		
If you are a farmer, orchard, or plantation worker:		
7. Wearing gloves during working in rice fields, orchards and plantations makes me feel annoyed.		
8. Wearing gloves during working in rice fields, orchards and plantations makes my work slower and makes me feel unskillful.		
9. Wearing boots during working in rice fields, orchards and plantations makes my work slower and makes me feel unskillful.		
10. Wearing gloves or boots during working in the rice field, orchard or plantation does NOT help us reduce the risk of getting leptospirosis.		

Part 4: Practice of Prevention and Control of Leptospirosis

Please mark X in the blank that matches a frequency of your behavior in the usual life.

Practice behavior	Frequency			
	Every time	Almost every time	Seldom	Never
1. I cover wounds before going into the water.				
2. I have a shower or bath with soap immediately after going into the water or walking around wet area.				
3. I keep food in a cabinet or keep food with a cover on.				
4. I burn or bury leftover food.				
5. I clean my place when it is messy.				
6. I clean an animal barn with gloves and boots				
7. I eliminate rats and mice by catching them by hands, or using drugs and traps.				
8. I participate in community-level campaigns and activities for prevention of leptospirosis				
9. I use personal protective equipment when I coot rat meat.				
10. I wear gloves while I work in rice fields.				
11. I wash hands before eating food.				
12. I wash hands after touching animals.				
13. I heat leftover food before eating it again.				
14. I wash vegetables with clean water before eating.				
15. I put a cover on a water jar.				
16. I wear boots when walking in water.				

Any comments or suggestions are appreciated:

_____

Thank you for answering this questionnaire.

Sincerely,

Project responsible team

Appendix 3-B. Letter from Emory Institutional Review Board

EMORY UNIVERSITY | Institutional Review Board

March 6, 2014

Kayoko Shioda, DVM
Rollins School of Public Health
1518 Clifton Rd., NE, Atlanta, GA 30322

RE: Determination: No IRB Review Required
Title: *Risk Reduction of Leptospirosis in Northeast Thailand*
PI: Kayoko Shioda, DVM

Dear Dr. Shioda:

Thank you for requesting a determination from our office about the above-referenced project. Based on our review of the materials you provided, we have determined that it does not require IRB review because it does not meet the definition of "research" with human subjects or "clinical investigation" as set forth in Emory policies and procedures and federal rules, if applicable. Specifically, in this project, you will be conducting a quality improvement project in collaboration with the World Health Organization in Thailand to evaluate a leptospirosis control program.

Please note that this determination does not mean that you cannot publish the results. If you have questions about this issue, please contact me.

This determination could be affected by substantive changes in the study design, subject populations, or identifiability of data. If the project changes in any substantive way, please contact our office for clarification.

Thank you for consulting the IRB.

Sincerely,

Scott S. Katz, MS
Analyst Assistant

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