

Knowledge and Prevention Behavior on Scrub Typhus Among Akha People, Chiang Rai Province, Thailand: A Pilot Study

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ABSTRACT

Introduction: Scrub typhus is a significant life-threatening infectious disease caused by *Orientia tsutsugamushi*. The Akha people in Chiang Rai, Thailand, who are living in an endemic area, are particularly at risk due to limited access to healthcare, language barriers, lower educational levels, and uncertain legal status. The study aimed to assess the knowledge of scrub typhus and prevention behavior among Akha people in Mae Fah Luang District, Chiang Rai Province, Thailand.

Methods: A pilot cross-sectional study was conducted between August and September 2022 among Akha individuals aged 40 and above residing in Mae Fah Luang District, Chiang Rai Province, Thailand. Data were gathered using a three-part questionnaire: part I, general information; part II, knowledge about scrub typhus disease; and part III, scrub typhus prevention practices. The questionnaire achieved content validity scores over 0.6, and Cronbach's alpha coefficient of validity test at 0.75. Descriptive statistics were used to present the findings.

Results: A total of 80 participants working in agriculture (100.0%) had a gross family income of ≤5,000 baht per month, more than half could not speak Thai (72.5%), almost all of them could not read Thai (96.3%) and writing Thai (95.0%). All of them did not know about scrub typhus disease (100.0%), reported that they never got sick with scrub typhus (100.0%), and had never received information about scrub typhus disease (98.8%). The scrub typhus knowledge was low (96.3%), while scrub typhus prevention practices were good (42.5%) to a very good level (33.8%).

Conclusion: Akha people living in the pandemic area have a low knowledge level of scrub typhus, and their prevention practices levels are relatively good to very good. Public health interventions to improve Akha people's knowledge and preventive practices on scrub typhus disease should be implemented.

Keywords: Scrub Typhus, Knowledge, Prevention behavior, Akha people

Introduction

Scrub typhus is an infectious disease caused by a Gram-negative bacterium called *Orientia tsutsugamushi* and transmitted by chigger mites [1]. Since World War II (WW-II), the disease has posed a significant and life-threatening public health issue, impacting over one billion individuals globally [1]. Moreover, over one million people in Asia are currently susceptible to catching the disease [1]. Scrub typhus has a broad geographic distribution, particularly in the Asia-Pacific area, encompassing countries such as Korea, Japan, China, Taiwan, India, Indonesia, Thailand, Sri Lanka, and the Philippines. Additionally, it was

discovered that scrub typhus is the leading cause of fever among non-malaria patients [2]. Individuals can contract scrub typhus by entering high-risk regions and being bitten by chigger mites that carry the *Orientia tsutsugamushi* bacteria.

Typical symptoms comprise fever, shivering, headache, nausea, vomiting, and muscle soreness. In severe cases, individuals may experience complications such as pneumonia, respiratory failure, shock, kidney failure, meningitis and/or encephalitis, myocarditis, and even death [3, 4]. Older patients and individuals residing in locations experiencing an outbreak have a higher fatality rate [5]. Scrub typhus infection is more likely to

occur in individuals who are impoverished, work outdoors or in forests, and live in a house located near pastures, vegetable gardens, or ditches. Individuals who fail to use protective clothing, expose their skin while working, rest directly on mud or grass, sit directly on the floor without using a mat, and wear the same clothes from work the following day are at a higher risk [6-11]. Individuals afflicted with scrub typhus and needing medical treatment can impose a heightened financial burden on their families [5].

The national surveillance data of Thailand between 2003 and 2018 showed that there were a total of 103,345 reported cases of scrub typhus during this period [10]. Between the years 2022 and 2023, there were 14,723 reported cases of scrub typhus [12, 13]. The morbidity rate had a significant increase from 4.71 per 100,000 population in 2005 [10] to 12.8 per 100,000 population in 2023 [13]. The northern region had the greatest morbidity rate, with 32.2 per 100,000 population, followed by the northeastern region, with a rate of 14.6 per 100,000 population. The provinces of Mae Hong Son, Nan, Chiang Rai, Tak, and Chaiyaphum had the highest rates of morbidity for scrub typhus [14], with Chiang Rai province ranking fourth in terms of scrub typhus morbidity rate in Thailand [10]. In 2023, Chiang Rai province recorded a total of 1,259 cases of scrub typhus, with a morbidity rate of 96.9 per 100,000 population. This placed Chiang Rai Province as the second highest in the northern region, following Mae Hong Sorn Province [13]. A study carried out in Chiang Rai Prachanukroh Hospital, located in Chiang Rai Province, specifically examined the occurrence of scrub typhus in pediatric patients, it was found that 89.0 % of cases involved individuals from ethnic groupings; 65 % were identified as belonging to the Akha ethnic group, with the Lahu ethnic group being the second most common [15].

Mae Fah Luang District in Chiang Rai Province has the largest number of recorded cases, followed by Mae Suai and Mueang Chiang Rai Districts [10]. The disease surveillance reports from Mae Fah Luang District indicated a significant increase in the morbidity rate [16]. In 2010, the rate was 5.2 per 100,000 population, but in 2019, it rose to 774.4 per 100,000 population [16]. Further analysis of patients admitted to Mae Fah Luang District Hospital revealed that a large proportion of scrub typhus patients belonged to the Akha people, constituting 43.4%. This was eight times higher than the proportion of scrub typhus patients in the Thai population [16]. This group possesses their own distinct language, distinctive cultural identity, and specific health beliefs. Additionally, they frequently dress in short clothes [17], which exposes them to the risk of scrub typhus infection. They face other constraints, such as their citizenship status, language obstacles, limited educational opportunities, and difficulties accessing medical treatment [18]. Especially for individuals without citizenship, they are restricted to

specific places for healthcare services [19]. This study aimed to assess the knowledge and preventive behaviors concerning scrub typhus among the Akha people in Mae Fah Luang District, Chiang Rai Province.

Methods

This was a pilot cross-sectional study. The study received approval from the Mae Fah Luang University Ethics Committee on Human Research, with approval number AW 7742(1)/1257, as well as the Oxford Tropical Research Ethics Committee (OxTREC), with approval number 549-22. Additionally, permission was obtained from the Chiang Rai Provincial Health Office and community leaders in the study area. The data was gathered through a self-administered questionnaire between August 25 and September 21, 2022. The study sites, consisting of Huai Phung village in Mae Salong Nai Sub-district and San Mueang Ko village in Thoet Thai Sub-district, Mae Fah Luang District, were purposefully selected because they were endemic areas with a high number of reported scrub typhus cases in Mae Fah Luang District, Chiang Rai Province, Thailand.

The study participants were selected using a simple random sampling method from the population residing at the study sites. The sample size was not determined in this study as it was a pilot cross-sectional study [20]. The inclusion criteria comprised Akha individuals, encompassing both men and women aged 40 years and above, who were residing in Mae Fah Luang District, Chiang Rai Province, Thailand. The participants were chosen based on a literature evaluation, which showed that this age group is particularly susceptible to scrub typhus infection and lives in an area with a high number of recorded scrub typhus cases.

Furthermore, the participants were required to be engaged in agricultural activities and consent to participate in this study. The researcher recruited participants for the project with the help of village leaders from both sites and people who met the criteria. Researchers met them at the village meeting points based on participants' convenience and preference. The researcher provided a comprehensive explanation of the study's objectives, procedures, and data collection methods to the selected sample group. Adequate time was allocated to the participants for reviewing the information and raising any questions they may have. Subsequently, individuals willing to participate in the research endeavor gave their written consent to participate. The individuals were then instructed to complete a self-administered questionnaire. In cases where participants were unable to comprehend the Thai language or complete the questionnaire independently, the assistance of public health officials, community leaders, and village health volunteers was sought. These individuals were trained about the questionnaire before assisting participants; they facilitated the translation of

the questionnaire from Thai to the Akha language and provided support to participants in completing the questionnaire. The pilot study involved a total of 80 participants.

Examining textbooks, concepts, theories, and literature gathered from national and international research studies was used to produce a self-administered questionnaire that served as the study instrument. It originated in the Thai language. It was investigated by three experts with qualifications in content validity, and following feedback, enhancements were made to the content. The questionnaire was tested with 30 Akha individuals with proficiency in reading, and writing in Thai. The Cronbach's alpha coefficient was 0.75, meeting the acceptable threshold. The questionnaire comprises three parts, as outlined: Part I: general information, was a closed-ended questionnaire. Participants selected a response and completed a questionnaire consisting of 12 questions, which included sex, age, and education level. The ability to speak Thai, ability to read Thai, ability to write Thai, main occupation, gross family income per month, knowing scrub typhus disease, receiving information about scrub typhus, channel of receiving the scrub typhus information, and experience of being sick with scrub typhus. The participants were asked to answer truthfully.

Part II was asked about scrub typhus knowledge, consisting of a multiple-choice question with 12 questions, including, What is the vector of scrub typhus disease? Which animal does the vector usually feed on? What is the name of scrub typhus in Thai? How is scrub typhus transmitted to people? After being bitten by a vector, how many days does a patient usually have symptoms? What habitat is not associated with scrub typhus? What are the signs and symptoms indicating that you have scrub typhus? Which medicine is used to treat scrub typhus? Which occupation has the highest risk for scrub typhus? How can you prevent catching scrub typhus? Which of the following is not recommended? Which of the following is correct regarding the management of scrub typhus?

The smallest cumulative score is zero, while the maximum cumulative score is 12 scores. The scrub typhus knowledge level is categorized into three levels, with scores below 60.0% (less than 7 points) considered a low knowledge level. Individuals possessing a moderate level of knowledge attain scores within the range of 60.0% to 79.0% (7 to 9 points), while those possessing a high level of knowledge achieve scores of 80.0% or higher (10 points and above). The rating criteria are derived from Bloom's Principles 1971 [21].

Part III was asked about scrub typhus prevention practices for 7 questions, including wearing long-sleeved shirts, long pants, and boots while out in the rice field or garden. Mow the grass and clean around the house when the grass is overgrown, or there is

garbage around the house. Apply anti-insect bite lotion when going out into the forest or agricultural areas. Spray pesticides on the ground and shrubs around the house when entering the rainy season or there are many bushes around the house. Separate clothes every time individual comes back from working outdoors or in agriculture from the clothes that are worn every day at home. Changing clothes, take a shower with soap immediately after leaving the garden, farm, or forest, and bring a mat to lay down while sleeping during lunch break when going out to the farm or in the forest. This part is a 4-level rating scale: practice every time, practice almost every time, practice sometimes, and do not practice; each level is assigned a score ranging from 4 to 1, respectively. This study classified the levels of prevention practice into the following categories: Scoring between 7 and 12 points indicates a poor of prevention practice. A score ranging between 13 and 17 points indicates a moderate prevention practice. A score between 18 and 22 points indicates a good of prevention practice, whereas a score between 23 and 28 points indicates a very good prevention practice [22].

Statistical Analysis

The data was cleaned and entered into the computer using an Excel spreadsheet. The IBM SPSS statistics program, version 29, was utilized to conduct the data analysis. A number of descriptive statistics, including frequency and percentage measures, were utilized to analyze the general information, the scrub typhus knowledge, and scrub typhus prevention practices.

Results

General information

The participants consisted of 80 individuals, with 73.8% being female, 38.8% between the ages of 60 and 69 years (means 62 years old), and 96.3% being illiterate. The entire sample, constituting 100.0%, was engaged in agriculture. Approximately 62.5% reported gross family income of less than or equal to 5,000 baht per month (means 5,999 baht per month). A significant majority, 72.5%, lacked proficiency in speaking Thai. Moreover, 96.3% of the participants lacked proficiency in reading Thai, and 95.0% lacked proficiency in writing Thai. All 100.0% did not know about scrub typhus disease, had never experienced the illness with scrub typhus disease before, and 98.8% had never received information about scrub typhus (Table 1).

Table 1 General Information

General information	n	%
Sex		
Male	21	26.2
Female	59	73.8
Age (year)*		
40 – 49	11	13.8
50 – 59	21	26.3

General information	n	%
60 – 69	31	38.8
70 and above	17	21.1
Education		
Illiterate	77	96.3
Primary school	2	2.5
Secondary school	1	1.2
Main occupation		
Farmer	80	100.0
Gross family income (baht/month)**		
≤ 5,000	50	62.5
5,001 – 10,000	22	27.5
≥ 10,001	8	10.0
Proficiency in speaking Thai		
Fluent	5	6.2
Fair	17	21.3
No proficiency	58	72.5
Proficiency in reading Thai		
Fair	3	3.7
No proficiency	77	96.3
Proficiency in writing Thai		
Fair	4	5.0
No proficiency	76	95.0
Knowing scrub typhus disease		
Don't know	80	100.0
Experience of being sick with scrub typhus		
Never	80	100.0
Receiving information about scrub typhus		
Yes	1***	1.2
No	79	98.8

* Age means 62 years old

** Gross income means 5,999 baht per month

*** Had received information about scrub typhus from a public health officer

Scrub typhus knowledge

There was a high proportion of incorrect responses in the knowledge category. The top three items that were answered correctly and ranked highest were as follows: 47.5% of participants provided accurate responses regarding methods for preventing scrub typhus disease, followed by 46.3% correctly answered questions related to the appropriate management of scrub typhus disease. Additionally, 35% accurately identified the occupation with the highest risk for scrub typhus. As for the misinformation about scrub typhus, the top three questions with incorrect responses included 96.2% answered incorrectly regarding the scrub typhus disease vector, and an equivalent percentage of 96.2% provided incorrect answers about the Thai name of scrub typhus disease. Furthermore,

95% provided incorrect responses about places of residence that were not related to scrub typhus, and 93.8% answered incorrectly about the transmission of scrub typhus to humans. The analysis of the knowledge level regarding scrub typhus among the participants revealed that the majority, 96.3%, had a low level of knowledge, 3.7% had a moderate level, and none of them had a high level of scrub typhus knowledge (Table 2).

Table 2 Scrub typhus knowledge level

Knowledge	n	%
High	0	0.0
Moderate	3	3.7
Low	77	96.3

Scrub typhus prevention practices

Upon examining the frequency of scrub typhus prevention practices among the participants, it was found that the participants had prevention practices that they always practiced: 85% were wearing long-sleeved shirts, long pants, and boots while out in the rice field or garden; this was closely followed by 77.5% separating clothes every time they came back from working outdoors or agriculture from the clothes that worn every day at home; and the last two practices were 70.0% equally: Mow the grasses and clean around the house when the grass is overgrown or have garbage around the house and changing clothes, take a shower with soap immediately after leaving the garden, farm, or forest.

Regarding preventive practices that are practiced often, 15.0% of participants mow the grass and clean around the house when the grass is overgrown or has garbage around the house, and 12.6% change clothes and take a shower with soap immediately after leaving the garden, farm, or forest. The preventive practices that were practiced sometimes included 18.8% spraying pesticides on the ground and shrubs around the house when entering the rainy season, or there are many bushes around the house, followed by 15.0% mowing the grasses and cleaning around the house when the grass is overgrown or having garbage around the house. The prevention practices that they never practiced at all, including 70.0% were applying anti-insect bite lotion when going out into the forest or agricultural areas, followed by 63.7% bringing a mat to lay while sleeping during lunch break when going out to farm or go into the forest. The last practice, 56.2%, was spraying pesticides on the ground and shrubs around the house when entering the rainy season or when there are many bushes around the house.

Upon evaluating the level of scrub typhus prevention practices among the participants, it was found that the majority, constituting 42.5%, were at a good level, followed by 33.8% at a very good level, 21.2% at a fair level, and 2.5 % at a poor level (Table 3).

Table 3 Scrub typhus prevention practices

Prevention practice	n	%
Very good	27	33.8
Good	34	42.5
Moderate	17	21.2
Poor	2	2.5

Discussion

The findings regarding knowledge about scrub typhus among the Akha people in Chiang Rai Province, Thailand. It highlighted significant gaps in understanding and awareness of disease, especially their vulnerability to infection. The result indicated that all participants were engaged in agriculture, which is regarded as a high-risk occupation for contracting scrub typhus infection [6, 10, 11, 23]. Surprisingly, none of the participants were knowledgeable about scrub typhus disease, and most had never received any information about it. This remark aligns with personal experiences in collaborating with the Akha communities, where it was observed that there is no specific term for scrub typhus disease in the Akha language. This finding is additionally supported by inquiries made with local public health authorities, which indicated that educational materials on scrub typhus are not typically supplied. The majority of participants were unable to speak, read, or write in Thai proficiently due to their illiteracy. These limitations may pose challenges in accessing information about scrub typhus, especially given that the resources accessible in Thailand are usually presented in the Thai language. In addition, a majority of participants reported a low gross family income, providing evidence that lower levels of education and income are associated with higher risks for scrub typhus infection [6, 8].

An assessment question evaluating knowledge of scrub typhus has uncovered significant patterns. Participants demonstrated the highest accuracy in questions related to prevention measures, the appropriate management of the disease, and identifying high-risk occupations. Regarding the knowledge about scrub typhus, there is no empirical evidence in past knowledge surveys, especially among the Akha people. Despite the fact that accuracy was at its highest point, less than half of the participants were able to deliver correct answers. Further analysis revealed that a majority of participants provided inaccurate responses regarding the disease vector, disease names in Thai, habitat association, and the transmission of scrub typhus to humans. It is crucial to identify these areas of misunderstanding, as having adequate knowledge enables participants to prevent or mitigate the risk of infection. Upon analyzing the participants' knowledge levels regarding scrub typhus disease, a majority of participants displayed a low level of knowledge. This emphasizes a significant gap in knowledge among the participants, specifically among the Akha people who encounter challenges in speaking in the Thai language

[24, 25]. Scrub typhus is a disease that can be life-threatening and fatal [2]. The lack of awareness and limited understanding about their disease certainly lead to delays in seeking medical treatment [26, 27].

This study offers significant insights into preventive measures practiced against scrub typhus among the Akha people in Chiang Rai Province, Thailand. The study classified behaviors based on their frequency, highlighting the most common preventive measures that they always practiced, including wearing long-sleeved shirts, long pants, and boots while out on the rice field or garden and separating work clothes from everyday clothes after coming back from agricultural work. These prevention practices can be linked to Thailand's tropical climate, particularly in the Chiang Rai Province area, where temperatures vary between 15 to 34 degrees Celsius. It is customary for farmers in the region to wear protective clothing to protect themselves from scratches and exposure to sunlight when they work in the field [28]. Furthermore, a majority of the local population engages in agricultural activities, which requires them to wear long-sleeve shirts and long pants as a preventive step against the chemicals for pesticide applications [29].

While following less frequent practices, the behaviors that they practice often include mowing the grasses and cleaning around the house when the grass is overgrown or has garbage around the house, changing clothes, and taking a shower with soap immediately after leaving the garden, farm, or forest. Among the behaviors that were sometimes practiced were spraying pesticides on the ground and shrubs around the house during the rainy season or when there were many bushes around the house, mowing the grass, and cleaning around the house when the grass was overgrown or had garbage around the house. Some practices, such as applying anti-insect bite lotion when going out into the forest or agricultural areas, bringing a mat to lay down while sleeping during lunch break when going out to farm or in the forest, and lastly, spraying pesticides on the ground and shrubs around the house when the rainy season or there are many bushes around the house, were never done at all by a majority of participants. This highlighted a critical gap between knowledge of preventive measures and their implementation. These low-frequency practices are particularly concerning as they are essential in reducing the risk of scrub typhus transmission [3, 6, 7, 9, 30]. The study revealed that although most of the participants demonstrated scrub typhus prevention practice levels at a good to very good level, they still accounted for less than half of the total number of participants. Previous studies on scrub typhus in Thailand have not provided any empirical evidence regarding practice behavior. However, a study conducted in Nepal revealed that participants had low adherence to preventive measures such as wearing closed footwear, using insect repellents, avoiding mite infection is important, using soap in a hot bath or

shower, using ground covers while sitting [31], and a study conducted in South Korea found that participants had limited awareness of the preventive measure such as wearing long sleeves, full-length pants, and boots helped to prevent scrub typhus disease [32]. Hence, it is crucial to continue promoting scrub typhus prevention measures practices, especially among the Akha people residing in regions with a high likelihood of infection.

An inherent limitation of this study was language proficiency among participants, as they lacked the ability to read or write Thai. This barrier poses a challenge for researchers in directly collecting data from participants. However, to overcome this challenge, the research team received cooperation from public health officials, community leaders, and village health volunteers to assist and play the role of facilitating communication by translating questionnaires from Thai to Akha language and assisting participants in responding to the questionnaire. For future research studies, researchers can consider applying various strategies to engage illiterate participants, such as utilizing participatory methods and bilingual workers, incorporating multimedia in research such as visual aids, involvement of family members, and cultural mediators' approaches [33-35]. These strategies could be able to help overcome communication barriers and ensure ethical engagement. Moreover, several factors contributed to the limitation of the study, including its exploratory nature, small sample size, time constraints faced by the researcher, the expedited timeline for conducting research on scrub typhus knowledge and prevention practices, challenges such as language barriers and limited human resources further complicated the research process, potentially impacting the reliability and validity of the study findings. Additionally, the study's participant age range was confined to individuals aged 40 years and above, posing a potential limitation on the generalizability of the results to other age groups at risk.

Conclusion

Within the geographic scope of the pandemic-affected region, the Akha people showed a significant deficit in awareness about scrub typhus despite their great commitment to preventive measures. The discrepancy between preventive behaviors and the limited knowledge of the specific infectious threat underscores the imperative for intensified efforts in information dissemination and educational interventions. While the observed levels of engagement in preventive measures are commendable, the persistent knowledge gap regarding scrub typhus necessitates targeted initiatives to fortify the community's understanding of the disease and its associated risks. The identified disparity highlights a critical juncture for public health authorities operating within the pandemic-stricken area. These findings can provide a significant framework for the development and improvement of

future health education programs, considering the necessity for a detailed and subtle approach. To bridge the current gaps in existing knowledge and preventive behaviors, especially in the study areas, it will be necessary to implement future campaign activities. One possible approach for public health officers to address the gaps and challenges identified is to create educational materials on scrub typhus disease in the Akha language, taking into account their culture and language. It would be beneficial to investigate the effectiveness of these materials in enhancing knowledge and promoting prevention practices. Performing extended research to evaluate the effects of educational initiatives over a long-term period of time. These factors will aid in comprehending the extent to which knowledge is retained and how it is effectively applied to long-term preventive behaviors. Public health officers can promote a more comprehensive understanding of scrub typhus within the Akha population by the community involvement method, such as engaging the Akha community network to promote health education programs such as training village health volunteers and community leaders to teach villagers about scrub typhus diseases and its prevention. Therefore, the potential utility of these findings extends beyond mere awareness, presenting an opportunity to cultivate a more informed and resilient community capable of effectively mitigating the risks associated with infectious diseases amidst a pandemic backdrop.

Competing Interests

The investigators have no potential conflicts of interest.

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References

- [1] Douglas RG, Mandell GL, Dolin R, Bennett JE, Blaser MJ, Mandell, et al. Principles and practice of infectious diseases. 8th ed: Elsevier/Saunders; 2015.
- [2] Bonell A, Lubell Y, Newton PN, Crump JA, Paris DH. Estimating the burden of scrub typhus: a systematic review. *PLoS Negl Trop Dis*. 2017;11(9):e0005838.
- [3] Ministry of Public Health. Department of Disease Control. Bureau of General Communicable Diseases. Scrub typhus disease, guidelines for prevention and control. Vol.1. The War Veterans Organization of Thailand Under Royal Patronage His Majesty the King Publisher. 2008.
- [4] Peter JV, Sudarsan TI, Prakash JAJ, Varghese GM. Severe scrub typhus infection: clinical features, diagnostic challenges and management. *World Journal of Critical Care Medicine*. 2015; 4(3): 244.
- [5] Taylor A, Paris D, Newton P. A systematic review of mortality from untreated scrub typhus (*Orientia tsutsugamushi*). *PLoS Neglected Tropical Diseases*. 2015;9:e0003971.
- [6] George T, Rajan SJ, Peter JV, Hansdak SG, Prakash JAJ, Iyyadurai R, et al. Risk factors for acquiring scrub typhus among the adults. *Journal of Global Infectious Diseases*. 2018;10(3):147-51.
- [7] Prakash JAJ. Scrub typhus: risks, diagnostic issues, and management challenges. *Research and Reports in Tropical Medicine*. 2017;8:73-83.
- [8] Rose W, Kang G, Verghese VP, Candassamy S, Samuel P, Prakash JJA, et al. Risk factors for acquisition of scrub typhus in children admitted to a tertiary centre and its surrounding districts in South India: a case control study. *BMC Infectious Diseases*. 2019;19(1):665.
- [9] Tran HTD, Hattendorf J, Do HM, Hoang TT, Hoang HTH, Lam HN, et al. Ecological and behavioural risk factors of scrub typhus in central Vietnam: a case-control study. *Infectious Diseases of Poverty*. 2021;10(1):110.
- [10] Wangrangsimakul T, Elliott I, Nedsuwan S, Kumlert R, Hinjoy S, Chaisiri K, et al. The estimated burden of scrub typhus in Thailand from national surveillance data (2003-2018). *PLoS Neglected Tropical Diseases*. 2020;14(4):e0008233.
- [11] Xu G, Walker DH, Jupiter D, Melby PC, Arcari CM. A review of the global epidemiology of scrub typhus. *PLoS Neglected Tropical Diseases*. 2017;11(11):e0006062.
- [12] Ministry of Public Health. Summary of surveillance report for the Year 2022; 2022. Available from: http://doe.moph.go.th/surdata/506wk/y65/d44_5265.pdf. [Accessed 2023, December 25]
- [13] Ministry of Public Health. Summary of surveillance report for the Year 2023.; 2023. Available from: http://doe.moph.go.th/surdata/506wk/y66/d44_5366.pdf. [Accessed 2024, January 29]
- [14] Ministry of Public Health. Summary of Surveillance Report for the Year 2019.; 2019. Available from: <https://apps.doe.moph.go.th/boeeng/annual.php>. [Accessed 2023, December 15]
- [15] Wangrangsimakul T, Greer RC, Chanta C, Nedsuwan S, Blacksell SD, Day NPJ, et al. Clinical characteristics and outcome of children hospitalized with scrub typhus in an area of endemicity. *Journal of the Pediatric Infectious Diseases Society*. 2020;9(2):202-9.
- [16] Mae Fah Luang hospital. Information on patients admitted to Mae Fah Luang Hospital with scrub typhus. 2018.
- [17] Ministry of Social Development and Human Security. Community directory in the highland covers an area of 20 provinces in Thailand for the Year. 2016.
- [18] Apidechkul T, Wongnuch P, Sittisarn S, Ruanjai T. Health situation of Akha hill tribe in Chiang Rai Province, Thailand. *Journal of Public Health and Development*. 2016;14(1):77-97.
- [19] Napat Prachasuchart. Accessibility system of health services and mechanisms of health service rights for the stateless persons (in Thai). *Connexion: Journal of Humanities and Social Sciences*. 2016;5(2):178-94.
- [20] In J. Introduction of a pilot study. *Korean Journal of Anesthesiol*. 2017;70(6):601-5.
- [21] Sirisuwan P. Effects of health promotion programs for prevention new case of diabetes mellitus in a diabetes risk group in Singkok Sub-District, Kasetwisai District, RoiEt Province. *Journal of Boromarajonani College of Nursing, Surin*. 2018;8(1):45-58. (In Thai)
- [22] Chaktrimongkhon U. Scoring rubric. *Journal of Educational Measurement*. 2014;31(89):17-26. (In Thai)
- [23] Lyu Y, Tian L, Zhang L, Dou X, Wang X, Li W, et al. A case-control study of risk factors associated with scrub typhus infection in Beijing, China. *PLoS One*. 2013;8(5):e63668.
- [24] Apidechkuk T, Laingoen O, Suwannaporn S. Inequity In Accessing Health Care Service in Thailand In 2015: A case study of the hill tribe people in Mae Fah Luang District, Chiang Rai, Thailand. *Journal of Health Research [Internet]*. 2017;30(1):67-71.

- [25] Greer RC, Kanthawang N, Roest J, Wangrangsimaikul T, Parker M, Kelley M, et al. Vulnerability and agency in research participants' daily lives and the research encounter: a qualitative case study of participants taking part in scrub typhus research in northern Thailand. *PLoS One*. 2023;18(1):e0280056.
- [26] Ma J, Zhang N, Xiao J-Y, Wang J-X, Li X-W, Wang J, et al. Public awareness of acute myocardial infarction symptoms and emergency response in community residents. *European Heart Journal*. 2021;42(Supplement_1).
- [27] Thompson A, Hunt C, Issakidis C. Why wait? Reasons for delay and prompts to seek help for mental health problems in an Australian clinical sample. *Social Psychiatry and Psychiatric Epidemiology*. 2004;39(10):810-7.
- [28] Kittijaruwattana J, Lee SH, Chotikhun A. Evaluation of the knowledge and attitude of using personal protective equipment among rubber farmers in Southern Thailand. *Bulletin of the Transilvania University of Brasov Series II: Forestry Wood Industry Agricultural Food Engineering*. 2022:119-30.
- [29] Charoenphorn P. Knowledge, behavior, and cholinesterase level among pesticide sprayers in farmers, Mae Sai district, Chiang Rai Province. *Journal of MCU Nakhondhat*. 2020;7(3):64-78.
- [30] Kweon S-S, Choi J-S, Lim H-S, Kim J-R, Kim K-Y, Ryu S-Y, et al. A community-based case-control study of behavioral factors associated with scrub typhus during the autumn epidemic season in South Korea. *The American Journal of Tropical Medicine and Hygiene*. 2009;80(3):442-6.
- [31]. Sharma K, Neupane M, Poudyal S, Subba H. Prevalence and knowledge of scrub typhus in patients with acute febrile illness in teaching hospital, Chitwan, Nepal. *International Journal of Medical Science and Public Health*. 2019;8(11):897-901.
- [32] Kim D-S, Acharya D, Lee K, Yoo S-J, Park J-H, Lim H-S. Awareness and work-related factors associated with scrub typhus: a case-control study from South Korea. *International Journal of Environmental Research and Public Health*. 2018;15(6):1143.
- [33] Hughson J-a, Woodward-Kron R, Parker A, Hajek J, Bresin A, Knoch U, et al. A review of approaches to improve participation of culturally and linguistically diverse populations in clinical trials. *Trials*. 2016;17(1):263.
- [34] Lee SK, Sulaiman-Hill CR, Thompson SC. Overcoming language barriers in community-based research with refugee and migrant populations: options for using bilingual workers. *BMC International Health and Human Rights*. 2014;14(1):11.
- [35] Palazzani L, Macioce F, Daverio M, Ferro V, Persampieri L. New strategies for increasing participation of patients from diverse cultural and religious backgrounds in clinical trials. *BioLaw Journal-Rivista Di BioDiritto*. 2019(1S):101-22.