

Original Article

## A qualitative study to explore farmworkers' knowledge, beliefs and preventive practices toward ticks and tick-borne diseases

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### Abstract

**Introduction:** Farmworkers are considered a high-risk group for tick-borne diseases (TBDs). This qualitative study aimed to gain an in-depth understanding of the farmworkers' experience, knowledge, health beliefs, information needs, and preventive practices of tick bites and TBDs. **Methodology:** A total of nine focus group discussions with 56 farmworkers across eight animal farms in Peninsular Malaysia were conducted between August and October 2013.

**Results:** Farmworkers explained their experience of tick bites, but no one reported TBDs. Many farmworkers indicated that they did not seek any medical treatment. There was a misconception that ticks are solely pathogenic to farm animals. Farmworkers perceived low severity and susceptibility of tick bites, and low self-efficacy of tick bite prevention, however, a group also perceived susceptibility to getting tick bites due to the characteristics of their job. Barriers for prevention were related to the perception and knowledge towards ticks. Farmworkers requested information about TBDs.

**Conclusions:** This study of farmworkers identified gaps in the knowledge of TBDs, barriers of the tick bite preventive measures and information needs. These findings suggest a need for education programs to improve the knowledge of ticks and TBDs, change health beliefs and address the barriers of tick bite preventive measures.

**Key words:** Tick bites; Tick-borne diseases; Farmworkers; Prevention; Malaysia; Qualitative research.

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### Introduction

Tick-borne pathogens circulate between reservoirs of wildlife animals and tick vectors, while humans are aberrant hosts [1]. Farmworkers are considered a high-risk group to tick-borne diseases (TBDs) due to their daily exposure from their working environment [2–4]. Studies of people who are occupationally exposed to tick bites in eastern Poland showed that serological reactions to spotted fever group rickettsioses, tick-borne encephalitis virus and *Bartonella henselae* were high [5–7]. Malaysia has a tropical climate and vast areas of the tropical rain forest. Environmental negligence such as deforestation occurred due to the industrialization of the country and subsequently, it led to the invasion of wild animals into human habitats and the presentation of zoonotic infections into domestic

animals and humans [8–10]. Currently, multiple tick-borne pathogens of human and veterinary significance have been documented in Malaysia. A serosurvey of indigenous community and farmworkers in Peninsular Malaysia showed that these groups had a higher likelihood of rickettsial infections as compared to blood donors from urban areas [11]. Recent studies showed the detection of IgG antibodies against *Ehrlichia chaffeensis* (29.9%), *R. felis* (16.1%), and both rickettsia species *R. felis* and *R. conorii* (5.7%), and tick-borne encephalitis virus (4.2%) among farmworkers of this study [11–13]. Furthermore, ticks collected from farm animals, domestic animals in the rural areas and wildlife animals confirmed the presence of *Rickettsia* spp, *Anaplasma* spp. and *Ehrlichia* spp. in Malaysia [11,12].

The changes in health beliefs have been considered an important method to decrease the burden of infectious diseases in humans [14,15]. The Health Belief Model (HBM) is a frequently used psychological model to explore a health behavior, and it assesses the perception of severity, susceptibility, benefits, barriers and self-efficacy [16]. Studies of endemic areas and among high-risk groups for Lyme disease (LD), a widespread TBD in northern hemisphere, which used HBM to investigate tick bite prevention behaviors, declared that farmworkers who perceived LD was a severe disease and concerned about being bitten by ticks were more likely to practice prevention against tick bites [17,18].

Tick bite preventive practices consist of environmental modification, chemical control measures and personal preventive measures [19]. Personal tick bite prevention practices include wearing protective clothing (hat and light-colored clothing, long-sleeved shirts and long pants tucked into socks or boots), using tick repellent, performing tick checks, changing clothes and bathing after spending time in tick habitat and removing attached ticks [20,21]. Other studies have illustrated gaps in the knowledge, health beliefs and preventive practices of ticks and TBDs [15,17,22]. This study aimed to gain an in-depth understanding of Malaysian farmworkers’ knowledge, health beliefs, information needs, and preventive practices of tick bites and TBDs.

**Methodology**

The selection process and characteristics of the farms for investigation of TBDs have been previously described [22]. Briefly, farmworkers from eight government animal farms under the care of the Department of Veterinary Services (DVS), Ministry of

Agriculture and Agro-based Industry, who were Malaysians and over 18 years old with at least six months of service on the farm were recruited through purposive sampling. Qualitative focus group discussions (FGD)s were conducted with animal farmworkers from August to October 2013.

Farmworkers who were Malaysians over 18 years old with at least six months of service on the farm were recruited through purposive sampling. Each FGD consisted of 5 to 8 people, and at least one FGD in each farm was conducted. Farmworkers were either fieldworkers (who have direct contact with animals) or administrative workers (who have little or no contact, including secretaries, drivers, and accountants).

*Data collection*

The socio-demographic questionnaire covered age, gender, marital status, ethnicity, education, average monthly household income, years of service, and job categories. A guide with open-ended questions was used during the FGDs (Table 1). Interviews intended to focus on farmworkers’ understanding of experience, knowledge, health beliefs and preventive practices regarding tick bites and TBDs. The guide was pilot-tested with the first FGD and data was included because there were no considerable changes. The interviews were performed in a private room on each farm. Each FGD session lasted approximately one hour and was audio-taped and transcribed verbatim. All discussions were conducted in one language, Bahasa Malaysia (BM), the national language of Malaysia, as all farmworkers were able to understand this language. A moderator with the assistance of a note-taker, who was fluent in both English and BM conducted the interviews. The moderator was trained to have minimum verbal guidance and instigate only at a proper

**Table 1.** The FGD guide.

Questions	Probing
What do you know about ticks?	General knowledge, signs and symptoms, prevention and treatment
What is your experience of the encountering with ticks and tick-related diseases?	Experiences of signs and symptoms, places and activities that enhanced your exposure, severity of the experience
Have you ever sought for any treatment due to a tick bite and/or a tick-related infection?	Preferences of treatment? Why?
What is your chance of being bitten by a tick?	If low or high chance, why? Please explain the reasons
How severe health problem do you believe tick bite can cause?	Low/high, why? Please explain the reasons
How do you prevent tick bites? What prevention measures do you apply to reduce tick exposure while working in the field?	Most and least performed prevention measure, why?
What are the problems or barriers you face to perform preventive practices?	
What information would you like to know about ticks and tick-related infections? How would you like this information to be delivered to you?	
Is there anything you would like to add, say or ask?	

time. The researcher (MGK) attended and supervised all interviews. Notes backed up audiotapes to obtain more details and non-verbal responses to elucidate critical points of the interview. Before each FGD, farmworkers were informed about the objective of the study through an information sheet, and they signed a consent form. Farmworkers used pseudonyms and confidentiality of the provided information was guaranteed. Farmworkers were assured that they could leave the interview at any time and participation was voluntary. As farmworkers were government employees, they only received a small token of appreciation consisting of a multifunctional folding knife for his / her time and contribution.

*Data analysis*

The data collection and analysis were simultaneous and iterative. Each FGD was analyzed independently, and the comparison with previous FGDs helped to shape the process of study. Discussions continued until data saturation was achieved. All transcribed interviews were translated into English. Coding was performed by the QRS NVivo software for qualitative analysis. Analyzing data and identifying key themes were conducted by a directed content analysis method. Researchers read the transcripts and highlighted all texts representing the research questions. All highlighted texts were then categorized by the predefined codes corresponding to the constructs of HBM and the researchers’ previous findings [22]. Subsequently, open coding was used to identify themes which were developed under the concept, and then more specific axial codes were generated from the open codes. Farmworkers’ original words as quotes were continuously used to illustrate the data. The accuracy of the data was assured by using audio-tape and notes. A single moderator performed all FGDs, in the same manner, using a focus group guide for consistency during data collection. One person conducted data coding and repeated the coding in two different periods to assess intra-rater reliability (IRR), which demonstrates the consistency of the coding. IRR was calculated as the number of agreements divided by the total number of agreements and disagreements, and it was in the 90<sup>th</sup> percentile range.

The Medical Ethics Committee, University Malaya Medical Centre, Kuala Lumpur, Malaysia (MEC Ref. No. 968.31) approved this study.

**Results**

*Participants*

A total of 56 farmworkers from eight farms participated in Nine FGDs. One FGD was conducted on each farm, which resulted in eight FGDs. An extra FGD administered on the first farm during a logistic visit of that farm. The socio-demographic characteristics of the farmworkers are shown in Table 2. The mean age of the farmworkers was 39.73 years (SD ± 10.35, range 23-58). The majority were male (83.9%), married (87.5%) and Malay (94.6%). Most of the farmworkers (75.0%) had at least a high school education. About half of the farmworkers (41.1%) had 5 to 10 years of service on the farm, and they had an average monthly household income less than RM2000 (44.6%). A large proportion of the farmworkers were field workers (89.3%).

*Themes identification*

Seven major themes were elicited from the interviews. The identified themes areas were: experience and knowledge of ticks, perceived severity of tick bites, perceived susceptibility of tick bites,

**Table 2.** Characteristics of the farmworkers (N = 56).

Socio-demographic variables	n (%)
<b>Age group (years old)</b>	
18-35	25 (44.6)
36-50	20 (35.7)
> 50	11 (19.6)
<b>Gender</b>	
Male	47 (83.9)
Female	9 (16.1)
<b>Marital Status</b>	
Single	7 (12.5)
Married	49 (87.5)
<b>Ethnicity</b>	
Malay	53 (94.6)
Indian	3 (5.4)
<b>Highest educational level</b>	
Primary school	5 (8.9)
High school	42 (75.0)
Technical diploma	8 (14.3)
Tertiary	1 (1.8)
<b>Years of service on the farm</b>	
< 5years	17 (30.4)
5-15	23 (41.1)
> 15	16 (28.6)
<b>Average monthly household income (MYR)*</b>	
< 2000	25 (44.6)
2001-3000	19 (33.9)
> 3000	12 (21.4)
<b>Job categories</b>	
Administrative workers	6 (10.7)
Field workers	50 (89.3)

\* 1 US Dollar = 4.0 Malaysian Ringgit (MYR).

perceived self-efficacy of prevention, preventive practices, and information needs (Table 3).

*Experience of ticks*

Although some farmworkers mentioned the experience of tick bites, none of them indicated deteriorated health conditions due to tick bites, but mild pains. The majority of farmworkers who were fieldworkers stated that they experienced tick bites when they were working on the farm. A farmworker cited his experience as follows:

*“So far, the worst I have experienced from a tick bite were redness, itchiness, and pain at the biting site, that’s all. There are no obvious serious symptoms.”* Male, 30 years, fieldworker.

Regarding treatment-seeking behavior, many farmworkers indicated that they did not seek any medical treatment; they mentioned that they got rid of ticks and used natural home remedies, traditional or over the counter medicine. Tobacco juice, lime juice, coconut oil and sea cucumber oil were mentioned as home remedies and traditional medicine. The farmworkers mentioned that if they had difficulty removing the tick, they would visit a doctor. Farmworkers quotes are as following:

*“I got a tick bite at my waist, and I didn’t put any medicine on the biting site, just took Panadol.”* Male, 34 years, fieldworker.

*“Once I had a tick bite ... then, I removed the tick’s teeth by using a clipper and put Minyak Gamat (a traditional oil which is composed of sea cucumber,*

*coconut oil, and herbs). After three days, my fever was recovered.”* Male, 26 years, fieldworker.

*Knowledge of ticks*

Many farmworkers were aware of ticks and their habitats. Farmworkers were knowledgeable that ticks suck blood and transmit diseases during a blood meal, while they had poor knowledge of TBDs. It was a common thought across all FGDs and in different farms that ticks are solely pathogenic to farm animals. A large group had heard of TBDs for domestic animals, but they had no idea about diseases transmitted by ticks in humans. Another misconception was the tick exposure methods, which some of the farmworkers mentioned water and soil as the most common ways of exposure.

*“Tick is an infective insect to cattle, as far as I know; ticks don’t bring any diseases to individuals, because they don’t spread diseases to humans”* Male, 45 years, fieldworker.

The farmworkers’ awareness of signs and symptoms of tick bites was restricted to itchiness and redness at the biting site, a few also mentioned fever. There was a misconception that the fever after a tick bite is related to a weak immune system in some age groups.

*“Never heard of symptoms of diseases carried by ticks. The only sign of the tick bite which I know is a rash at biting site like being bitten by a mosquito.”* Male, 26 years, fieldworker.

*“For older people, the immune system is stronger, so they don’t get a fever, it’s just itchiness, but for small*

**Table 3.** Summary of themes and sub-themes of FGDs.

Theme area	Themes and their sub-themes
Experience of tick bites and TBDs	Experience of tick bites and TBDs Treatment-seeking behavior
Knowledge	Knowledge about ticks and TBDs (general knowledge and misconception of ticks and TBDs, knowledge and misconception of sign and symptoms, knowledge of preventive practices, and knowledge and misconception of treatment)
Health beliefs	Not severe or low severity of tick bites
Perceived severity	
Perceived susceptibility	Perceived low susceptibility or not susceptible to tick bites Perceived susceptibility to tick bites
Perceived self-efficacy	Perceived low self-efficacy of tick bite preventive measures
Tick bite preventive practices	Prevention of ticks in the farm and personal tick bite preventive practices Barriers to prevention
Information needs	Information of TBDs (the severity of diseases, transmission methods and prevention measures) Delivery of information

*kids due to low immunity they will get sick.*" Female, 27 years, administrative worker.

The farmworkers were aware of protective clothing such as wearing long-sleeved shirts, long pants and tucking pants into socks, changing clothes after work and taking a shower. They also know that farms require acaricide programme to control the abundance of ticks in farms. However, a few fieldworkers were aware of the tick repellent.

*"We know to take care of our clothing; besides we wear different clothes during herding the animals."* Male, 32 years, fieldworker.

*"We control the tick on the farm animals. If there are ticks, usually we need to have proper maintenance. After that, if our livestock has anything, it will call for a tick's shower, which is spray."* Male, 49 years, fieldworker.

Farmworkers across all FGDs from different farms mentioned their tendency to seek treatment from traditional healers. They also cited home remedies and over the counter medicine to treat the itchiness. Across the FGDs, farmworkers knew to visit a hospital to disinfect the biting site; however, they were not aware of medical treatment for TBDs.

*"I heard about the lemon juice and kerosene (coal oil). First, we bathe thoroughly then apply the cream on the bitten area. Within two days the marks would be fine."* Female, 26 years, administrative worker.

#### *Perceived severity of tick bites*

Farmworkers believed that since they have worked on a farm for many years and never encountered a TBD; therefore, it is not a severe health problem to be noticed or prevented. They believed that mosquitoes are more dangerous compared to ticks. Across all discussions, farmworkers viewed tick bites as regular occurrences because they are rural dwellers and their workplace is a farm. Farmworkers considered the consequence of a tick bite in humans as simple itchiness and redness in the biting site, while it can cause lethal diseases in animals.

#### *Perceived susceptibility of tick bites*

A group of farmworkers mentioned that they are not susceptible or low susceptible to tick bites because the exposure to ticks was infrequent and the chances of encountering TBDs were even less. Moreover, they added that ticks are on the animal body and rarely a person can get tick bites. They also stated that ticks prefer to bite animals rather than humans.

*"Exposure to ticks is rare. I have been working for over 20 years in the farm and experienced a tick bite, only once."* Male, 49 years, fieldworker.

*"Ticks prefer biting animals rather than humans. The possibility of ticks spread from livestock to humans is infrequent."* Female, 27 years, administrative worker.

Another group of farmworkers believed that they are susceptible to get tick bites due to the characteristics of their job and their workplace (farm). Farmworkers also believed that they ate at risk of getting tick bites due to delaying or long intervals between applying tick control measures on farms, tick-infested wild animals and imported farm animals.

*"The probability of tick bite is high, as we are working every day with the livestock. In this farm, animals are not allowed to graze freely, and we carry the grass, collect it in the stall and arrange it for the animals to eat. Maybe sometimes the tick is at the grass and once we carry it sticks onto us."* Male, 47 years, fieldworker.

*"If we go to the farms which have imported cows, the possibilities of getting tick bites may be high, because the cows are not tick-resistant, in our farm, the possibilities are low in KK-cows (Kedah-Kelantan cattle, a local breed) because the cows are resistant. If we are running late in eradicating ticks on those cows, the possibilities are high."* Male, 49 years, fieldworker.

#### *Perceived self-efficacy of prevention*

Farmworkers across all discussions perceived low self-efficacy of tick bite prevention. They believed that personal preventive measures are not practical and useful, and they experienced a tick bite despite performing personal tick bite prevention.

*"I'm not sure to be able to find ticks after checking"* Male, 32 years, fieldworker.

Moreover, there was more concern on the efficacy of tick bite prevention measures in farm 3 and 5, where the acaricide usage on farm animals was irregular and dependent on the abundance of ticks in the farm.

*"In this farm after the upsurge of ticks, only then farm authorities would use acaricide to control ticks. So, I can't think that my prevention is effective."* Male, 31 years, fieldworker.

#### *Tick bites preventive practices*

Regarding prevention of ticks in the farm, farmworkers mentioned that they checked farm animals to find ticks, and in the case of tick abundance they would inform farm authorities for further action. Farmworkers stated that there are tick control programmes in each farm, and some alternative tick

control measures such as burning pasture also were indicated. Following statements are farmworkers quotes regarding prevention measures in the farm:

*"We have many treatment programmes. We put the livestock in the barn for three days, and then treatment through ticks' disinfectant programme. If we do the routine checking of livestock, we won't have a spraying programme. We just put 'pour on cream' on the back of cattle, but we can't do for all livestock here, just a few and we have to choose."* Male, 33 years old, fieldworker, Farm 2.

*"If we find that there are ticks in the paddock, we will burn it. That is one way to eradicate the tick."* Male, 42 years, fieldworker, Farm 4.

Personal tick bite preventive practices stated by the farmworkers include wearing protective clothes, changing and washing clothes, showering after work, and checking clothes and body for ticks. The majority expressed that they changed clothes and took a shower after dealing with farm animals. Farmworkers stated that they wear a uniform or other clothes for work on the farm, and then they changed clothes after work. Some farmworkers also mentioned that they checked their body for ticks after daily work and tried to remove attached ticks as soon as possible. Various methods were cited to removing ticks from the body, such as using oil, bare hand, tissue and tweezers.

*"We take care of our clothing, whereby during herding the animals we wear different clothes. We have to check our body for a tick, then take a bath and change our clothes."* Female, 24 years, fieldworker.

*"I don't wear the same clothes for work and at home; however, there is no specific dress code to wear on the farm. We wear like normal, but we control the animals' hygiene."* Male, 31 years, fieldworker.

*"We wear gloves and boots when herding animals. Every time I go to the woods, I will spray my boots with pesticide repellent. Usually, the spray is for the leech, but sometimes it can be used for ticks. The ticks will fall when it attaches to the boots. I always spray at my shirt, even on my skin too. However, I don't use the spray at this farm, just when I go to the woods."* Male, 33 years, fieldworker.

*"We usually use kerosene or wind oil to remove the tick from the skin, when kerosene is used the tick will die, but if you pluck it from the body, the tick's teeth might get stuck on our skin. So, if we apply kerosene, it will run itself."* Male, 34 years, fieldworker.

#### *Barriers to tick bite prevention*

Various reasons as barriers to tick bite prevention practices were stated. The grounds behind some of

these barriers were farmworkers' perception, including low perceived severity and susceptibility of tick bites and low perceived self-efficacy of tick bite preventive practices which discouraged farmworkers from applying prevention.

*"The risk of tick bites is not high, so we don't take it seriously to apply preventive measures. The prevention of tick bites isn't as important as dengue, not even reaching that level."* Male, 26 years, fieldworker.

*"Even wearing long-sleeved shirts do not show any difference, we still get the bite... it cannot be avoided."* Male, 31 years, fieldworker.

Farmworkers also considered some personal tick bite preventive measures as impractical despite being aware of those measures; for instance, staying away from bushes or high grass areas were impossible due to the nature of jobs in dealing with farm animals.

*"Taking part in tick bite prevention means we cannot do our tasks at all, we can't stay away from bushes... it's not practical. Our workplace is surrounded by bushes."* Male, 26 years old, fieldworker, Farm 4.

Farmworkers also stated some reasons as barriers to wearing protective clothing. Lack of uniform was mentioned in a few FGDs, while others stated inappropriate uniforms such as short-sleeved shirts and dark color uniforms. The tropical climate of the study setting also was another barrier to wear protective clothing.

*"Nowadays we don't have a complete uniform; it is just a t-shirt and pants."* Male, 33 years old, fieldworker, 6 years of service, Farm 2.

*"Our uniforms are in the dark blue, and we prefer dark-colored clothing as it does not look dirty."* Male, 26 years old, fieldworker, 4 years of service, Farm 4.

*"We change our clothes after work, but we only have two uniforms which we change and wash once in every two days. I know wearing long-sleeved shirts, but we usually don't wear long-sleeved because it is hot."* Male, 45 years old, fieldworker, 4 years of service, Farm 6.

Regarding checking body or clothes for ticks, farmworkers' lack of knowledge and low perceived self-efficacy of prevention were the sources of barriers for tick checking measure. Farmworkers cited that they would check their body for ticks in the case they felt something on their body. Farmworkers were not aware of tick checking as precaution behavior, and a few of them were uncertain about their ability to check their body or clothes successfully.

*"If I feel something is crawling, then I check my body. I don't see a need to check myself for ticks every*

day.” Male, 26 years old, fieldworker, 4 years of service, Farm 6.

Application of repellent was unpopular for various reasons such as unavailability, forgetfulness, unreliability and overdoing. Farmworkers had concerns about the safety of using repellent on their body. They also were concerned with the longevity of effectiveness of the repellent.

*“I don't have enough time to spray. I know that it's our own initiative and in the thick woods, there are a lot of ticks, but I am forgetful and lazy to apply.”* Male, 33 years old, fieldworker, 4 years of service, Farm 1.

*“Our farm doesn't provide repellent for us, and it is not easy and affordable for us to provide repellent.”* Male, 26 years old, fieldworker, 6 years of service, Farm 6.

*“Our colleague sprays repellent on his clothes and boots when he goes to woods, but I think it's overdoing, and anyway he might get a tick bite.”* Male, 31 years old, fieldworker, 7 years of service, Farm 2.

*“For spraying insect repellent on my body or clothes, the effect is not too long, and I should reapply it during the day, which I afraid of its safety for my health.”* Male, 39 years old, fieldworker, 4 years of service, Farm 1.

#### *Information needs*

In all FGDs farmworkers were curious to get information about TBDs, including signs and symptoms, methods of transmission and treatment of TBDs in humans. Farmworkers expressed their interest to receive information regarding the importance and severity of TBDs through farm authorities.

*“I need to receive information about ticks and prevention. I hope that farm authorities provide some education here on the farm and give us some knowledge about tick-related diseases.”* Male, 26 years old, fieldworker, 4 years of service, Farm 4.

*“I don't know tick-related diseases in humans; all I know is that ticks cause diseases in animals. I want to know about diseases in humans, whether these diseases are important for people's lives or not.”* Male, 51 years old, fieldworker, 30 years of service, Farm 7.

#### **Discussion**

Farmworkers mentioned the experience of tick bites, but they did not explain any diseases related to tick bites. They explained their experience as rashes, pain, itchiness, and in some cases fatigue and fever. Previous studies of these farms illustrated the potential exposure of farmworkers to ticks and TBDs [11-13,22].

Regarding treatment behavior, the majority believed that they did not need medical treatment for tick bites. Instead, removing ticks and applying natural home remedies, traditional or over the counter medicine were considered enough. Accordingly, a previous survey of these farms found that treatment preferences of farmworkers with an experience of tick bite were home remedies (54.1%), traditional medicine (49.5%), over-the-counter medications (45.1%) such as pain killers and fever reducers, and visiting clinic and hospital (39.6%), respectively [22]. The results suggest raising farmworkers' awareness of the risk of tick bites and timely and appropriate treatment of the signs and symptoms.

The farmworkers' knowledge of ticks and TBDs was twisted with some misconceptions. The majority had some knowledge of ticks, while their knowledge of TBDs in humans was poor. Farmworkers had wrong notions that ticks are solely pathogenic to animal farms; they do not transmit important diseases to humans, as well as having the wrong knowledge of methods of exposure to ticks. These findings were shared among all FGDs in all the farms, and this shows the lack of information regarding ticks and TBDs for the farmworkers. Other than itchiness, redness, and pain at the biting site, farmworkers were not aware of other signs and symptoms of TBDs. Likewise, a survey of farmworkers of these farms demonstrated that the majority were aware that sign of tick bite is rash (82.8%), swelling (85.4%), and itchiness (95.4%) at the biting site. On the other hand, less than half of the farmworkers were aware that flu-like symptoms (42.4%), muscle and joint pains (30.5%), and persistent weakness and tiredness (27.8%) were some of the symptoms suggestive of TBDs [22]. Farmworkers were knowledgeable about protective clothing, and they were aware of the necessity of having an acaricide programme to control the abundance of ticks in the farm animals. Only some farmworkers were aware of applying tick repellent as a personal tick bite prevention, while others did not know about it. Farmworkers were aware of treatments such as home remedies, traditional and over the counter medicine to relieve the itchiness and pain at the biting site. They had no idea of the availability of treatment for TBDs. This study suggests a thorough education programme to address all gaps concerning the knowledge of tick bites and TBDs.

Farmworkers did not perceive that tick bites are severe because they never encountered a TBD. Farmworkers mentioned that they believe mosquitoes are more severe than ticks, which might be a result of

campaigns and awareness programs regarding dengue and dengue hemorrhagic fever in the community, while such programs on ticks and TBDs were not available. Farmworkers mentioned that tick bites are frequent occurrences in their daily life due to the nature of their life and work. Farmworkers did not consider tick bites significant since they were not aware of TBDs in humans. Farmworkers' lack of knowledge of tick bites and TBDs have an impact on the perceived severity of tick bites, and it warrants the necessity of increasing the awareness of farmworkers on the risk of tick bites.

A group of farmworkers believed that they had no or low susceptibility to getting a tick bite, because they incorrectly believed that they had no previous experience of tick bite or TBDs, and ticks can only cause diseases in animals. Another group of farmworkers expressed that they were susceptible to tick bites due to the nature of their daily job, delay in the application of tick control measures on farms, contact with wild animals infested by ticks in their working areas, and contact with imported farm animals which are more vulnerable to tick infestation. The vector surveillance of these farms demonstrated the presence of various spotted fever group rickettsiae and *R. felis* in cattle ticks. Farmworkers of these farms also had detectable IgG antibodies to *E. chaffeensis*, rickettsial species *R. conori* and *R. felis*, and tick-borne encephalitis virus [11-13]. Hence, farmworkers as a high-risk group for the tick bite and TBDs should be informed of their susceptibility to tick bites.

Regarding perceived self-efficacy of tick bite preventive measures, most farmworkers perceived to have low self-efficacy and they believed that personal tick bites preventive practices were impractical and ineffective since they experienced a tick bite regardless of prevention measures. Moreover, many farmworkers in farms with irregular acaricide application had a low self-efficacy of prevention. Farmworkers believed that factors beyond their control would waste the personal tick bite preventive measures. The control of tick infestation in the farm and knowledge of effective prevention measures may improve uptake of tick bite preventive measures.

Tick bite prevention was classified into two categories: tick control programmes in each farm and personal preventive practices. Farmworkers stated that each farm has a tick control programme, such as the application of acaricide and burning pasture as an alternative method. Besides, personal preventive practices mentioned by farmworkers include wearing protective clothing, changing and washing clothes, showering after work and checking clothes and body for

ticks. Farmworkers should be educated regarding other tick bite preventive measures, for instance, applying tick repellent. Farmworkers mentioned methods such as using oil, bare hand, tissue and tweezers to remove attached ticks. They should be encouraged to apply a proper and effective method to remove attached ticks such as tweezers to avoid contact with ticks.

Concerning barriers to personal tick bite preventive practices, farmworkers cited that the lack of uniform or inappropriate uniforms discouraged them from wearing protective clothing. This finding suggests that farm authorities can provide proper uniforms with long sleeves and light-colored shirts for farmworkers. The tropical climate of the study setting was an obstacle for the farmworkers to wear protective clothing. In accordance, some of the respondents of a survey of the tick bite preventive behaviors across recreational parks in the endemic region for some TBDs cited the high temperatures of summer months or special activities as barriers to wear protective clothing [23]. Education regarding the advantages of wearing protective clothing inspires farmworkers to uptake tick bite preventive measures and overcoming the barriers. Some farmworkers were not aware of regular tick checking as a preventive practice, and a group also did not perceive self-efficacy to check and remove attached ticks effectively. These suggest that lack of knowledge and low perceived self-efficacy of tick bite prevention impede tick checking measure. It is in accordance with a study by Herrington (2004) who reported that factors such as confidence in finding a tick after checking and perceived benefits of prevention outweigh its difficulties, and decreased the risk of LD. Hence to improve this prevention measure, farmworkers should be educated to check their body and clothes after work properly. Out of all personal tick bite preventive practices, the farmworkers declared that utilizing tick or insect repellent was not common due to reasons such as unavailability, forgetfulness, and unreliability and overdoing. They were also concerned about the safety of daily and frequent application of the repellent and the effectiveness. A randomized control trial of outdoor workers in North Carolina showed the effectiveness of long-lasting permethrin-impregnated clothing for tick bite prevention [24]. It is anticipated that by providing these uniforms, the incidence of tick bites and health problems in the farm may decrease subsequently.

The identified barriers, as well as, the lack of knowledge, lack of perceived severity and lack of perceived susceptibility of tick bites and TBDs, and lack of perceived self-efficacy of prevention should be addressed in the awareness/education program to



promote the uptake of tick bite prevention amongst farmworkers.

Almost all farmworkers requested information about TBDs in humans. They specifically asked for information regarding the signs and symptoms, the methods of transmission, prevention and available treatment for tick-related diseases in humans. Farmworkers requested that farm authorities provide and disseminate the requested information regarding TBDs in humans, also information about the significance and severity of TBDs.

Lastly, the findings in this study should be inferred with caution due to the qualitative nature of the study. The FGDs with farmworkers from government farms in peninsular Malaysia restrict generalization of findings to all farmworkers in Malaysia. Additionally, reporting bias towards socially desirable responses may raise due to self-reporting nature of the study. Using one coder also raise the bias. Regardless of these methodological limitations, the study provides an in-depth understanding of farmworkers' knowledge, experiences, health beliefs and prevention practices toward tick bites and TBDs.

## Conclusion

Although farmworkers in the FGDs in this study reported the experience of tick bites, there was no self-report of TBDs, probably due to the lack of clinical information on TBDs occurring in this country. This study identified gaps in the knowledge of TBDs, barriers of the tick bite preventive measures and information needs of our farmworkers. Our findings suggest a need for the implementation of awareness/education programmes to improve the knowledge of farmworkers regarding ticks and TBDs.

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