



Prevalence and Alternative Treatment of Head-Lice Infestation in Rural Thailand: A Community-Based Study

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Abstract: Head-lice infestation, pediculosis capitis, remains a public-health burden in many countries. The widely used first-line pediculicides and alternative treatments are often too costly for use in poor socio-economic settings. Ivermectin has been considered an alternate treatment for field practice. This study was composed of 2 parts, a cross-sectional survey and an intervention study. The main objectives were to determine the prevalence and potential factors associated with head-lice infestation, and to evaluate the effectiveness and safety of oral ivermectin administration. A community-based cross-sectional survey was conducted among 890 villagers in rural areas along Thai-Myanmar border. Females with infestations were eligible for the intervention study, and 181 participated in the intervention study. A post-treatment survey was conducted to assess acceptance of ivermectin as a treatment choice. Data analysis used descriptive statistics and a generalized-estimation-equation model adjusted for cluster effect. The study revealed the prevalence of head-lice infestation was 50% among females and only 3% among males. Age stratification showed a high prevalence among females aged <20 years, and among 50% of female school-children. The prevalence was persistent among those with a history of infestation. The major risk factors were residing in a setting with other infected cases, and sharing a hair comb. The study also confirmed that ivermectin was safe and effective for field-based practice. It was considered a preferable treatment option. In conclusion, behavior-change communication should be implemented to reduce the observed high prevalence of head-lice infestation. Ivermectin may be an alternative choice for head-lice treatment, especially in remote areas.

Key words: Head louse, ivermectin, rural health, community-based study

INTRODUCTION

Infestation with *Pediculus humanus capitis*, commonly named head lice, has been a persistent problem worldwide. Each year, hundreds of millions of people suffer from head-lice infestation [1,2]. Although infestation does not cause a severe health problem, it is a personal and public health burden physically, psychologically, and socially. Infestation has been reported mainly among school children, people with poor hygiene habits, and people residing in resource-poor communities [3-8]. Reported prevalence varied, even among studies performed in the same country, due to several factors, including sample size and study sites with different sociocultural and socioeco-

nomics status [9]. In Thailand, several studies in different areas during 1981-2017 reported prevalence rates ranging from 15.1% to 86.1% [10-16].

Various treatments are available for head-lice infestation. In Thailand, the gold standard treatment for head lice is topical 25% benzyl benzoate lotion, which requires at least 2 applications. Typically, the infested person will apply approximately 30 ml of topical 25% benzyl benzoate lotion thoroughly onto a dry scalp until wet and leave the lotion on the affected area for 12 to 24 hr before rinsing off with shampoo and water; application is usually repeated on Day 7. This treatment has been reported to cause irritation and burning sensations, especially in the scratched or infected scalp [17,18]. Several oral-ivermectin treatments have been studied, particularly in hard-to-treat head-lice infestations [17-23]. This treatment has not yet been tested in Thailand.

This study comprised 2 parts. The objectives of the first part were to determine the prevalence of head lice and to identify potential factors associated with head-lice infestation in rural Thai-

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land. The second part of the study aimed to evaluate the effectiveness of oral ivermectin administration among infested persons.

MATERIALS AND METHODS

Study sites and study participants

The study sites were 3 rural village communities along the Thai-Myanmar border (i.e., Tanaosri Subdistrict, Suan Phung District, Ratchaburi Province), with a total of about 3,000 permanent residents. Eligible study participants were those who resided permanently in the selected villages, age ≥ 5 years, willing to provide their background information and test for head-lice infestation. For Part I, a community-based survey was conducted using a systematic sampling technique to select households, then requesting willingness of household members to participate in the study. Study participants positive for head-lice infestation were eligible for Part II of the study. The eligibility criteria for Part II also included age ≥ 5 years, body weight ≥ 15 kg, not being pregnant or lactating, not being treated with pediculicidal agents within the previous 14 days, not having uncontrolled systemic underlying disease, and having no history of allergy to the study drug.

Determination of head-lice infestation

The diagnosis of head-lice infestation in this study used the method of a previous study, where active infestation was defined as the presence of living head lice, determined with a fine-toothed de-lousing comb to detect living head lice under natural sunlight [22]. The detection of viable nits (louse eggs) was also considered positive [24]. In the present study, the detection of a living head louse was considered an active infestation by using a fine-toothed de-lousing comb under natural sunlight, after combing the hair 20 times and visual observation above the ears and along the nape of the neck. Identification was reported as number of nymph, adult head lice, and nits. Each participant used their own comb, which was provided by the investigators to prevent head-to-head contamination. A positive case was defined as the detection of at least 1 living head louse.

Intervention and outcome measures

For Part II, a trained research team study administered oral ivermectin at a dosage of 200 $\mu\text{g}/\text{kg}$ Day 0, repeated on Day 7, 1 hr before a meal. Cure was defined as the absence of living head lice post-treatment, on Days 7, 14, and 28. Safety was measured by participants' self-reporting of any adverse reactions during or

after treatment. Beside self-reported adverse reactions, physical examinations were performed on Days 0, 7, 14, and 28. Five milliliters of whole blood were obtained from each participant on Days 0 and 14 by well-trained certified nurses for laboratory testing of complete blood count (CBC), blood chemistry profiles (liver and kidney function), and electrolytes.

Data collection

For part I, the questionnaire was developed to collect potential risk factors of head-lice infestation, and comprised 2 main sections, personal characteristics, and hygiene behaviors. The research team interviewed the study participants, or the guardians of the children who were willing to participate in the study. The interview was conducted before measuring the hair length and determining infestation. At the end of Part II, a post-treatment survey was conducted to collect participants' perceptions of treatment. The post-treatment questionnaire assessed the satisfaction and acceptability of the users.

Data analysis

Descriptive statistics were used to determine the prevalence of infestation among different sub-groups of the study participants. A generalized estimation equation model of binary outcome among individuals clustered in the same residence (household) was used to estimate prevalence ratios among the study participants with potential risk factors. Cure rates were described at Days 7, 14, and 28. Complaints and side effects were presented descriptively. Due to non-responses and incomplete data, all analyses were performed based on complete information for each variable.

Ethical considerations

This study was approved by the Ethics Committee of the Faculty of Tropical Medicine. All participants were informed about the project objectives and the research procedures, and they were advised they could refuse to join or withdraw from the study at any time without negative consequences. Informed consent or assent were obtained from all participants, depending on age.

RESULTS

Prevalence and risk factors for head-lice infestation

In the community survey, 890 participants from 9 hamlets in 3 villages joined the study. All were willing to be tested for

Table 1. Prevalence of head lice in rural community

Characteristics	n/N	Prevalence (%)
Gender (n=890)		
Male	7/231	3.0
Female	330/659	50.1
Age (yr) (n=884)		
< 10	117/326	54.3
11-20	119/244	48.8
21-30	13/84	15.5
31-40	17/90	18.9
>40	9/140	6.4
Schoolchildren (n=890)		
Yes	286/529	54.1
No	51/361	14.1

head lice. As shown in Table 1, about half of the 659 women in the study area were infested with head lice, compared with only 3% of the 231 men. About half of the infested cases were aged 5-20 years; a decreasing trend was observed, with 15-20% among those aged 21-40 years, and 6% among those aged >40 years. About half of the infested cases were schoolchildren.

To avoid possible bias due to the small number of male cases, only the female study participants were included in the analysis of risk factors associated with head-lice infestation. As shown in Table 2, age was a significant risk factor associated with head-lice infestation, and prevalence decreased with ad-

Table 2. Potential risk factors of head-lice infestation among female participants

Risk factors	n/N	Prevalence (%)	PR (95% CI)*
Age (yr) (n=655)			
< 10	173/236	73.3	8.4 (4.2-16.8)
11-20	117/185	63.2	7.4 (3.6-14.8)
21-30	13/67	19.4	2.4 (1.0-5.6)
31-40	17/70	24.3	2.9 (1.3-6.7)
>40	8/97	8.3	1
Being schoolchildren (n=659)			
No	50/267	18.7	1
Yes	280/392	71.4	3.7 (2.7-5.0)
Hair length (n=654)			
Very short (<5 cm)	3/12	25.0	1
Short (5-20 cm)	175/256	68.4	2.4 (0.8-7.2)
Medium (21-30 cm)	90/144	62.5	2.3 (0.8-6.8)
Long (>30 cm)	57/242	23.5	0.9 (0.3-2.6)
History of infestation (n=656)			
No	10/113	8.9	1
Yes	319/543	58.8	6.7 (3.6-12.6)
Recognition of infestation at current episode (n=658)			
No	24/313	7.7	1
Yes	290/309	93.9	12.1 (8.9-18.5)
Not sure	15/36	41.7	5.4 (2.8-10.4)
Share comb			
No	71/198	35.9	1
Yes	255/457	55.8	1.6 (1.2-2.0)
Frequency of shampooing per week (n=658)			
1 time	110/206	53.4	0.9 (0.7-1.3)
2 times	84/137	61.3	1.4 (1.0-1.9)
3 times	89/210	42.4	0.9 (0.7-1.2)
>3 times	46/105	43.8	1
Frequency of house cleaning (n=653)			
Daily	157/333	47.2	1
Weekly	109/230	47.4	1.1 (0.8-1.4)
Monthly	58/90	64.4	1.3 (0.9-1.8)
Frequency of mattress cleaning (n=656)			
Daily	15/29	51.7	1
Weekly	133/289	46.0	0.9 (0.6-1.7)
Monthly	179/338	53.0	1.1 (0.6-1.9)
Number of infested persons in the same household (n=659)			
None	0/213	0.0	1
1 person	108/171	63.2	1
2 persons	91/118	77.1	1.2 (0.9-1.6)
>2 persons	131/157	83.4	1.3 (1.1-1.5)

*Adjusted for cluster effect (residence).

Table 3. Effectiveness and complaints/side effects of IVM administration (n= 181)

	n	Prevalence (%)
Effectiveness		
Day 7	169	93.4
Day 14	172	95.0
Day 28	180	99.4
Complaints/Side effects		
Headache	14	7.7
Dizziness	5	2.8
Itch	4	2.2
Burning sensation	0	0.0
Vomiting	1	0.6
Stomach-ache	1	0.6
Nausea	1	0.6

vancing age. Prevalence among schoolchildren was 3.7-times (95% CI: 2.7-5.0) higher than among those not of school age. Hair length appeared not to be associated with infestation. Those with a history of head-lice infestation had a 6.7-times (95% CI: 3.6-12.6) higher prevalence of current infestation. Interestingly, about 7.7% of infested participants did not realize they were infested.

Regarding personal hygiene and risk behaviors, those who shared a comb in the family had a higher prevalence of infestation, at about 1.6 (95% CI: 1.2-2.0), than those who did not. Frequency of shampooing, house cleaning, and mattress cleaning were shown not statistically significantly associated with infestation. A higher number of infested individuals in the same household appeared to be an increasing risk factor for infestation.

Effectiveness of oral ivermectin (IVM)

To evaluate the effectiveness of administering oral IVM to infested persons, 181 female cases agreed to participate. Cure rates were calculated at days 7, 14, and 28 (final follow-up). As shown in Table 3, cure rates increased from 93% at Day 7 to 99% at Day 28. Among 7.7% of the study participants, headache was the main complaint after IVM application.

In the post-treatment survey, 128 study participants provided their opinions regarding the use of IVM as a treatment choice. As shown in Table 4, almost all participants indicated that IVM was easy to use and did not involve a long treatment time. Most participants also accepted that the treatment was safe. Interestingly, while about 87% preferred oral treatment compared with 13% preferring topical treatment, almost all would choose this medication as their treatment choice and use it to treat head-lice re-infestations in future.

Table 4. Satisfaction with and acceptance of IVM administration (n= 128)

Opinion	Yes	No
	n (%)	
Easy to use	127 (99.2)	1 (0.8)
Acceptable time consumed in administration	126 (98.4)	2 (1.6)
Safety	125 (97.7)	3 (2.3)
Preference of oral treatment	111 (86.7)	17 (13.3)
Preference as treatment choice	127 (99.2)	1 (0.8)
Will use IVM in case of re-infestation	125 (97.7)	3 (2.3)

DISCUSSION

This community-based study was conducted to assess the head-lice infestation prevalence and risk factors among villagers in a rural area of Thailand. Unlike previous studies on head-lice infestation, this study employed cluster data analysis taking into consideration that infected and non-infested cases were clustered in similar residential areas or environments. This study also evaluated the effectiveness and acceptance of using a novel intervention, oral ivermectin, instead of the typical standard treatment for infested persons. If the new treatment were to be proved effective, it could be another choice for mass treatment administration in problematic areas.

The results of the study confirmed that head lice remain a bothersome and persistent problem even though many effective treatments were already in place. This study was conducted among villagers aged 5 to 76 years; the infection rate among females was about 50%, and among males only 3%; the oldest positive participant was 75 years of age. Like other studies worldwide [3,9,12,13,15], age stratification showed a high prevalence among females aged <20 years, with about half among female schoolchildren.

This study revealed similar risk factors to other studies elsewhere [15,16]; many of the infested had a history of head-lice infestation. About 7.7% did not recognize that they had head lice, and about 41% of those who were unsure were actually infected. This suggests that infested persons might not give their personal hygiene a high priority and could tolerate head-lice infestation. Hair length was not statistically significantly associated with head-lice infestation. Personal hygiene, including frequency of shampooing per week, and a frequency of house and mattress cleaning, appeared not to be significant risk factors; these findings differed from a previous study [13]. Residing with other infected persons in the same setting was a

potential risk factor. In attempt to reduce the burden in the community, mass treatment (MDA) might be one solution for handling the head-lice problem in high prevalence areas, particularly in school settings where transmission could proliferate dramatically. Most importantly, sharing a comb was shown to be a significant risk behavior for head-lice infestation. Those who shared a comb in the family had a higher prevalence of infestation than those who did not; the prevalence of infestation among those who shared a comb was 55.8%, which was significantly higher than the prevalence of 35.9% among those who did not share a comb. The analysis was conducted using the generalized estimating equation (GEE) method to identify risk factors, with adjustment for study participants in the same cluster (household). Sharing a comb was one of the specific risks that could affect cure rate due to the infested person sharing household living conditions. The study results also indicated that higher numbers of infested individuals in the same household increased the risk of infestation. Behavioral-change communication was needed for the general public at the community level, not just in the school setting.

The first-line pediculicides in wide use were pyrethroids, 1% permethrin, 0.5% malathion, and 5% benzyl alcohol [26]. Alternative treatment choices included dimethicone-based formulations, 0.5% topical ivermectin and spinosad [4,25-27]. However, these treatments are too expensive for use in poor socio-economic settings. Ivermectin was considered an alternative treatment in this study. Its efficacy has been supported by many studies [7,17,18,22,28]. The present study revealed that the cure rates of oral IVM were 93.4%, 95.0%, and 99.4% on days 7, 14, and 28, respectively. The study result revealed quite a high cure rate at Day 28. This observation may be influenced by the study design, since we had performed a community-based survey before implementing our intervention, the administration of oral ivermectin, among those positive for head-lice infestation and willing to participate in the study. However, for those not willing to participate, we had recommended treatment with the gold standard treatment, topical 25% benzyl benzoate lotion. With this approach, a high cure rate appeared to have accumulated and been sustained, as new infestations and/or re-infestations of people in the community could have been reduced over the follow-up period.

Regarding safety concerns, mild side effects were reported by a few IVM users, including headache, dizziness, itch stomachache, nausea or vomiting. While almost all users preferred IVM as their treatment choice, about 13% indicated they still pre-

ferred a topical form due to difficulties swallowing a tablet. Safety concerns were minimal, since the laboratory profiles of all study participants were in the normal range and no adverse results were observed. This study had some limitations. Topical 25% benzyl benzoate lotion is known to be effective and has been used as the gold standard treatment in Thailand for quite a long time; the present study was solely designed to explore the effects of a potential alternative, oral ivermectin. Therefore, no comparative analysis with the ivermectin group was performed. Moreover, there was an alternative and convenient method to cure lice infestation, i.e., washing the hair every day for 7 days with warm water and soap. The effectiveness of this traditional method should also be investigated further and assessed.

In conclusion, head-lice infestation remains a problem in rural areas of Thailand. High prevalence was reported among younger females, especially schoolchildren. The prevalence was persistent among those with a history of infestation. Major risk factors were residing in a setting with other infected cases, and sharing a hair-comb. Behavior-change communication should be implemented by local health authorities to reduce community burden. The present study confirmed that 2 doses of oral ivermectin (200 µg/kg once per week over 2 weeks) was safe and effective for field-based practice and may be an alternative for head-lice treatment, especially in remote areas.

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CONFLICT OF INTEREST

The authors declare no conflict of interest related to this study.

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