IJTID. Volume 13 No 1 January-April 2025 e-ISSN: 2356-0991; p-ISSN:2085-1103
Sinta 2 (Decree No: 105/E/KPT/2022) Available online at https://e-journal.unair.ac.id/IJTID

Original Article

IJTID
(INDONESIAN JOURNAL OF TROPICAL AND INFECTIOUS DISEASE)
Scientific Journal of Tropical and Infectious Disease

Association between Hair Hygiene and *Pediculus capitis* Infestation among Elementary School Students in Sukorambi District, Jember Regency

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OPEN ACCESS

ARTICLE INFO

Received: October 7, 2024
Accepted: April 21, 2025
Published: April 30, 2025
Available online: April 30, 2025

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Keywords:
P. h. capitis
Hair hygiene
Students
Lice infestation
Elementary school

Abstract

Pediculus humanus capitis (*P.h. capitis*) is an ectoparasite which inhabits hair and scalp of human, causing a neglected disease called *Pediculus humanus capitis* infestation or *pediculosis capitis*. This disease, easily transmitted between people directly or indirect, often affects girls around 3–12 years old in tropical countries with high humidity. This can be avoided with applying personal hygiene focused on hair area (hair hygiene). Hair hygiene in this study was divided into several parameters, such as frequency of hair washing, shampoo usage, hair drying, towel sharing habit, comb and hair accessories sharing habit, head cover sharing habit, and close contact with an infested person. The aim of this study is not only to know the prevalence of *P. h. capitis* infestation, but also to determine the correlation between hair hygiene and *P. h. capitis* infestation among elementary school students in Sukorambi District, Jember Regency. This study was held around January to February 2024 using cross-sectional approach with total 83 respondents. Respondents were given several questions about parameters of hair hygiene and their hair was examined using lice comb to find *P. h. capitis*. Prevalence of *Pediculosis capitis* infestation among elementary school students in Sukorambi District reached 71.1%. Statistical analysis showed that towel sharing habit and comb and other hair accessories sharing habit had a significant relationship with *P. h. capitis* infestation (p-value <0.05). Multivariate analysis using logistic regression showed that comb and other hair accessories sharing habit were the most significant hair hygiene parameters.

Cite this as: Ali, A. M., Nurdian, Y., Rumastika, N. S. (2025). Association between Hair Hygiene and *Pediculus capitis* Infestation among Elementary School Students in Sukorambi District, Jember Regency. *Indonesian Journal of Tropical and Infectious Disease*, 13(1) : 1–9. https://doi.org/10.20473/ijtid.v13i1.60916

INTRODUCTION

Pediculus humanus capitis infestation or often known as *pediculosis capitis* is a neglected disease despite there being many cases globally.[12] It can affect every person but girls around 3-12 years old living in tropical country with high humidity are most likely affected more than boys, because they tend to get close to each other.[5,8] *P.h. capitis* is an obligate ectoparasite that inhabits scalp and hair, and sucks human blood to survive.[6,10] Its life cycle starts from eggs (nits), nymph, and then into fully developed adult lice that can get transmitted to people.[15]

P.h. capitis sucks human blood from people's head every three to six hours. It will trigger productivity of Ig-E. Histamin is released which will make human feels itchy[1] and develop anemia symptoms among people who are chronically infected. Other symptoms are feeling uncomfortable, losing concentration, and disturbed while studying and sleeping. Some people may develop secondary bacterial infection.[3,15,24]

About 6-12 million cases happen every year with prevalence rate reaching 50% in the US, United Kingdom, and France.[15] Some children got *P.h.capitis* infestation more than two times in Estonia[14]. Tropical Southeast Asia countries such as Malaysia, Philippines, and Thailand reached more than 60% in prevalence rate.[13,19,28] There were studies conducted in some cities in Indonesia about the prevalence of pediculosis capitis, which found most of them reached 50%.[16,20,27]

P.h. capitis infestation can be treated with topical drug with pediculicide effect, such as permethrin, topical ivermectin, and pyrethrin. There is also non-medical treatment such as removal of the lice, which is safer than medical treatment. Maintaining personal hygiene that focuses on hair and scalp area can be a way to prevent *P.h. capitis* infestation[15]. Hair hygiene is a way to keep hair cleanliness and health in order to prevent *P.h. capitis* infestation; it entails hair washing behavior, post hair washing, and avoid sharing hair accessories with others so it can prevent *P.h. capitis* infestation.[20,22]

There are not enough data and research studies about the prevalence rate of *P.h. capitis* infestation in Indonesia. Correlation between hair hygiene and *P. h. capitis* infestation has never been studied, especially in Sukorambi District, Jember Regency. Sukorambi District is one of the districts located in Jember Regency that has the largest population of children under 14 years old based on data by Badan Pusat Statistik (BPS) Jember. This research aimed to know the prevalence of *P. h. capitis* infestation and to find the correlation between hair hygiene and *P.h. capitis* infection among elementary school students.

MATERIALS AND METHODS

This is a cross-sectional study with purposive sampling technique. The research was held January-February 2024 in five elementary schools in Sukorambi District, Jember Regency. The respondents are elementary school girls who never been diagnosed with scalp diseases nor having treatment of *P.h. capitis* infestation. They had to be in fourth/fifth/sixth grade and their hair length must be under their shoulder when this research was conducted.

All respondents were given seven questions about their hair hygiene such as frequency of hair washing, shampoo usage, hair drying, towel sharing habit, comb and other hair accessories sharing habit, head cover sharing habit, also close contact with any infested person recently.

P.h. capitis infestation was examined using dry combing method throughout their hair; it was counted as a positive infestation if any lice or nits were found. Results from the questions and physical examination were analyzed using chi-square or Fisher's exact to determine the correlation between hair hygiene and *P.h. capitis* infestation. The most dominant hair hygiene parameter is determined using a logistic regression multivariate test.

RESULTS AND DISCUSSION

There are 83 respondents from five elementary schools. There are 59 (71.1%) respondents who tested positive in *P.h. capitis* infestation and 24 negative as the result of hair examination. The result counted as positive if there were found any egg lice (nits), nymph, or lice within hair and scalp area. Nits and lice found were identified using microscope to make sure it was *P.h. capitis*. Figure 1 shows an example of lice and nits that were found during this research using microscope with 40x magnification.

P.h. capitis were measured for their size, their length and width were about 2-2.5 mm and 0.5-1 mm. Lice eggs that found were 0.75-1 mm in length and 0.25-0.5 mm in width.

The questions that were given to the respondents are described in Table 1 below. Most respondents wash their hair at least three times per week, using shampoo, drying their hair, not sharing their towel and head cover, sharing their hair accessories, and also had close contact with an infested person.

Table 1. Distribution of hair hygiene parameters

Variable	Category	Total (n=83)	%
Frequency of hair washing	≥3x/week	62	74.7
	<3x/week	21	25.3
Shampoo usage	Yes	80	96.4
	No	3	3.6
Hair drying	Yes	53	63.9
	No	30	36.1
Towel sharing habit	Yes	37	44.6
	No	46	55.4
Comb and other accessories sharing habit	Yes	52	62.7
	No	31	37.3
Hair and head cover sharing habit	Yes	24	28.9
	No	59	71.1
Close contact with infested person	Yes	68	81.9
	No	15	18.1

There were seven parameters analyzed using SPSS to determine the correlation between the parameters and *P.h. capitis* infestation.

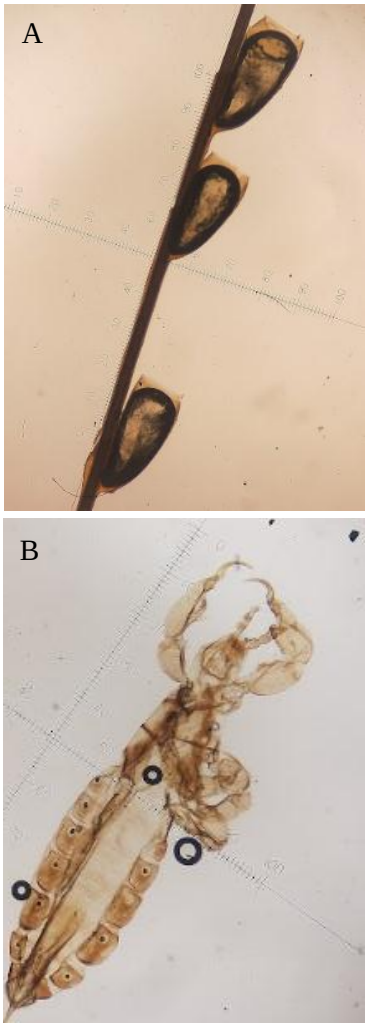

Figure 1. *P. h. capitis* with 40x magnification A) Lice eggs (nits) B) Mature head lice

Table 1. Hair washing frequency

Hair washing	Infestation (+)	Infestation (-)	p-value	OR
≥3x/week	41	21	0.087	0.325
<3x/week	18	3		

Table 2 shows there are 41 respondents washing their hair more than three times a week and 18 respondents washing their hair less than three times a week who got *P.h. capitis* infestation, meanwhile 21 respondents who wash their hair more than three times a week and three respondents washing their hair less than three times a week did not get *P.h. capitis* infestation. After being analyzed using chi-square test, it resulted in p-value 0.086 and OR 0.325. It means there is no significant relationship between hair washing frequency and *P.h. capitis* infestation (p-value >0.05); hair washing more than three times a week has risk of having *P.h. capitis* infestation 0.3 times more than washing hair less than three times a week.

No significance was found between hair washing frequency and *P.h. capitis* infestation in line with some previous studies.[18,21,27] This is because hair washing alone could not kill the lice. Hair washing is focused on cleaning up the hair scalp area and reducing hair moisture. The lice still can survive with a healthy environment. After hair washing, people should do manual hair examination to make sure there are no lice left. It will be more effective than just doing hair washing.[4,16,17]

Table 2. Shampoo usage

Shampoo usage	Infestation (+)	Infestation (-)	p-value	OR
Yes	57	23	1.000	-
No	2	1		

Table 3 shows 57 respondents washing their hair using shampoo and two respondents not using shampoo got *P.h. capitis* infestation, meanwhile 23 respondents who use shampoo and one respondent who did not use shampoo did not get *P. h. capitis* infestation. After being analyzed using Fisher's exact test, it resulted 1.000 in p-value. It means there was no significant relationship between shampoo usage and *P. h. capitis* infestation (p-value >0.05). No significance was found between shampoo usage and *P. h. capitis* infestation in line with previous studies.[16,18,20] Almost all shampoo products that are sold publicly do not contain pediculicide or substances that will kill *P. h. capitis*, it is only to clean, give moisture, and balance pH around the hair area.[15,22]

Table 3. Hair drying

Hair drying	Infestation (+)	Infestation (-)	p-value	OR
Yes	38	15	0.870	1.086
No	21	9		

Table 4 shows there were 38 respondents who dry their hair and 21 respondents who never dry their hair who got *P. h. capitis* infestation, meanwhile 15 respondents who dry their hair and nine respondents who never dry their hair did not get *P. h. capitis* infestation. After being analyzed using chi-square test, it resulted in p-value 0.870 and OR 1.086. It means there was no significant relationship between hair drying and *P. h. capitis* infestation (p-value >0.05); drying hair has risk of having *P. h. capitis* infestation one time more than not drying hair.

No significance between hair washing frequency and *P. h. capitis* infestation was the same result as a previous study.[11] This is because drying hair will not kill the lice.

Drying hair is a hair hygiene process that reduces hair moisture and humidity, it should be done with giving pediculicide to kill the lice. The lice still can survive with that environment if pediculicides are not used or being picked manually.[11,15]

Table 1. Towel sharing habit

Towel sharing habit	Infestation		p-value	OR
	(+)	(-)		
Yes	31	6	0.022	3.321
No	28	18		

Table 5 shows there were 31 respondents who share their towel and 28 respondents who never share their towel who got *P. h. capitis* infestation, meanwhile six respondents who share their towel and 18 respondents who never share their towel did not get *P. h. capitis* infestation. After being analyzed using chi-square test, it resulted in p-value 0.022 and OR 3.321. It means there was significant relationship between towel sharing habit and *P. h. capitis* infestation (p-value <0.05); towel sharing has three times greater risk of having *P. h. capitis* infestation than not sharing towel.

Significance between hair washing frequency and *P. h. capitis* infestation had the same result with some previous studies .[9,23,26] This is because towel sharing can trigger indirect *P. h. capitis* transmission between people. Lice could crawl within the towel and will stay there for hours until days and when someone uses the towel to rub their hair and scalp, they will get a new host to live on.[2,15]

Table 2. Comb and other hair accessories sharing habit

Comb and other hair accessories sharing habit	Infestation		p-value	OR
	(+)	(-)		
Yes	45	7	0.000	7.806
No	14	17		

Table 6 shows there were 45 respondents who share their comb also other hair accessories and 14 respondents who never share their comb and also other hair accessories who got *P. h. capitis* infestation, meanwhile seven respondents who share their comb also other hair accessories and 17 respondents who never share their comb or other hair accessories did not get *P. h. capitis* infestation. After being analyzed using chi-square test, it resulted in p-value 0.000 and OR 7.806. It means there was significant relationship between towel sharing habit and *P. h. capitis* infestation (p-value <0.05); comb and other hair accessories sharing has risk of having *P. h. capitis* infestation three times bigger than not sharing.

Significance between comb and other hair accessories sharing habit and *P. h. capitis* infestation had the same result with some previous studies.[9,16,23,26] Comb and other hair accessories sharing can trigger indirect *P. h. capitis* transmission between people. Lice could stay there for hours until days and when someone uses the comb or other hair accessories, they will get a new host to live on.[2,15]

Table 3. Head and hair cover sharing habit

Head and hair cover sharing habit	Infestation		p-value	OR
	(+)	(-)		
Yes	19	5	0.300	1.805
No	40	19		

Table 7 shows there were 19 respondents who share their head cover and 40 respondents who never share their head cover who got *P. h. capitis* infestation, meanwhile five respondents who share their head cover and 19 respondents who never share their head cover did not get *P. h. capitis* infestation. After being analyzed using chi-square test , it resulted in p-value

0.300 and OR 1.805 . It means there was no significant relationship between head or hair sharing habit and *P. h. capitis* infestation (p-value >0.05); head and hair cover sharing has a one time greater risk of having *P. h. capitis* infestation than not sharing.

No significance between hair or head cover sharing habit and *P. h. capitis* infestation was the same result with some previous studies.[21,27,29] Head cover such as veil, scarf, and mukena (prayer veil) mostly has soft and smooth surface so it will be difficult for lice to crawl there. Also, many people always use a kind of personal fabric to cover their hair before using veil or helmet. If their veil or helmet is borrowed, it will not cause any indirect transmission.[25]

Table 1. Close contact with infested person

Close contact with infested person	Infestation		p-value	OR
	(+)	(-)		
Yes	51	17	0.119	-
No	8	7		

Table 8 shows there were 51 respondents who had close contact with an infested person and eight respondents who did not have close contact with an infested person who got *P. h. capitis* infestation, meanwhile 17 respondents who had close contact with an infested person and seven respondent who did not have close contact with an infested person did not get *P. h. capitis* infestation. After being analyzed using Fisher's exact test, it resulted in p-value 0.119. It means there was no significant relationship between close contact with an infested person and *P. h. capitis* infestation (p-value >0.05). It was caused by there being no head to head interaction between two people that are close to each other, so the lice would not get transmitted because lice only can crawl, not fly or jump toward other people's hair.[7,20] Beside that, we did not know nor ask about preventive care that individuals already did to prevent head lice transmission.

Among seven parameters about hair hygiene, parameters that have p-value <0 are comb and other hair accessories sharing habit, and close contact with an infested person.

Table 2. Multivariate analysis

Variable	p-value	OR	CI 95%
Frequency of hair washing	0.176	0.351	0.077-1.601
Towel sharing habit	0.175	2,431	0.674-8.774
Comb and other hair accessories sharing habit	0.004	5,581	1,720-18,106
Close contact with infested person	0.558	1,552	0.357-6,753

Table 9 shows the result of multivariate analysis. Comb and other hair accessories sharing habit is the most dominant hair hygiene parameter that can cause *P. h. capitis* infestation with p-value 0.004, OR 5.581, and CI 95% in range 1,720-18,106. That habit can trigger indirect transmission of *P. h. capitis* to other individuals.

Hair hygiene is one of preventive care to prevent ourselves from getting *P. h. capitis* infestation. However, there are other ways to prevent the infestation. Also, curative care is needed because it can kill the lice more effective. Prevalence rate is still high among elementary school students, so health promotion needs to be done by the government.

STRENGTH AND LIMITATION

Few studies having discussed about this topic is the limitation of this study thus more research is needed. Also, the answers from respondents are mostly subjective, the authors did not ask to crosscheck respondents' answers. However, we believe this study will help other people to research more about this topic.

CONCLUSIONS

Prevalence rate of *P.h. capitis* infestation among elementary school students in Sukorambi District, Jember Regency was counted 71. There were two parameters which have a significant relationship with *P.h. capitis* infestation. The most dominant hair hygiene parameter toward *P.h. capitis* infestation is hair accessories sharing habit because this habit may trigger indirect transmission between people.

ACKNOWLEDGMENT

We would like to thank all respondents, including their family and teachers for their cooperation during this research.

ETHICAL CLEARANCE

The research protocol was approved by The Ethics Committee of the Faculty of Medicine, Jember University (0152/UN25.1. 10.2/KE/2024).

CONFLICT OF INTEREST

All authors declare that they have no conflict of interest during this research.

FUNDING

This research received no external funding. This research was self-funded by the authors.

AUTHOR CONTRIBUTION

First author designed, collected, and analyzed the data. Second and third author contributed to data interpretation and manuscript writing. All authors reviewed and approved the final manuscript.

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