

Efficacy and safety of 1% and 5% permethrin lotion as treatment for pediculosis capitis in children: A double blind randomized controlled study

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Abstract

Background Pediculosis capitis (PC) is a community disease caused by *Pediculus humanus capitis*, which commonly affects children aged 3–11 years. One percent permethrin is the drug of choice for treating PC, but resistance has been reported in many countries, thus 5% permethrin has been recommended as substitute with satisfactory results in such cases. This study aims to compare effectivity and safety of 1% permethrin lotion (PL1) and 5% permethrin lotion (PL5) as treatment for PC.

Methods A double-blind randomized controlled trial was performed in a female boarding school in Indonesia. The treatment was applied twice with a seven-day interval and response to treatment was evaluated on days 7 and 14. Pediculosis capitis was considered cured when no live louse was detected upon evaluation.

Results A total of 47 subjects aged 11-15 years completed the study. On days 7 and 14, 15 (62.5%) and 23 (95.8%) subjects were cured in PL1 group, respectively; while 15 (65.2%) and 22 (95.7%) subjects were cured in PL5 group, respectively ($p = 1.000$). Ten minutes after application on day 0, 3 and 2 subjects who received PL1 and PL5 respectively reported burning sensation ($p=0.527$). Also, 1 and 2 subjects reported erythema respectively ($p=0.467$).

Conclusion In this study, we found that PL1 applied twice with 1-week interval is as effective as PL5 for the treatment of PC in children. Both PL1 and PL5 are safe for the side effects were mild and not different significantly.

Key words

Pediculosis capitis; 1% and 5% permethrin; Efficacy; Safety.

Introduction

Pediculosis capitis (PC) is a worldwide health problem that is more common in developing

countries. It is predicted to affect 6 to 12 million Americans each year.¹ Published data regarding PC in Indonesia is limited. Prevalence of PC was reported at 64.6% in Malang, East Java, while another study reported 100% in East Jakarta.^{2,3} Prevalence in Asia is said to be $15.1\% \pm 12.8\%$.⁴ Risk factors leading to PC include poor hygiene and direct head-to-head contact with infected person in schools, day care centers, camps, or boarding schools.⁵ Generally, infestation occurs in childhood, with the peak incidence occurring

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in children aged 3 to 11 years and is more prevalent in girls.¹ Although the disease is not life threatening, its manifestations have been proven to have caused social pressure, parental worry, shame, and decreased school attendance in children. If not treated properly, PC can lead to secondary infection and anemia from chronic infestations.^{6,7}

Pediculosis capitis can be treated using topical and/ or systemic pediculicides, which aims to eliminate lice and nits.¹ Considerations for selecting the ideal therapy for PC include safety, chemical contents, affordability, accessibility, and ease of use. In 2010, the American Academy of Pediatrics recommended the use of 1% permethrin lotion (PL1) as the treatment of choice for PC, which is also the first line medication in Indonesia.^{5,8,9} Permethrin is a synthetic pyrethroid that shares similarity with naturally occurring pyrethrin.¹ According to the Centers for Disease Control and Prevention (CDC) in 2016, PL1 has been approved by the United States (US) Food and Drug Administration (FDA) as the treatment for PC in adults and children 2 months of age and older.¹

Recently, there have been reports of PL1 resistance in several countries.^{10,11} Yoon *et al.*,¹² identified 2 mutations (T929I and L932F), while Lee *et al.*,¹³ found 3 mutations (M815I, T917I, and L920F) in lice that were suspected to have developed resistance to PL1. A possible explanation towards resistance may be due to the overuse of topical insecticides.¹¹

In cases with PL1 resistance, it is recommended to use 5% permethrin lotion (PL5) despite that fact that *in vitro* studies have reported that lice with resistance to PL1 still do not respond well to permethrin of higher concentration.^{10,14} Novianto, *et al.*,¹⁵ assessed the treatment of PC using PL5 and reported that the cure rate was as high as 73.9% and 97.1% on day 7 and 14,

respectively.

In this study, we compared the use of PL1 and PL5 for treatment of PC in female students of a boarding school.

Methods

The study was conducted in a boarding school in October 2018. A total of 100 female students were screened for PC by dermatologists. The diagnosis of PC was established by finding live head lice. Lice were considered to be living if they were gray in color or found moving on hair shaft, towels, combs, and/or scalp.

Those diagnosed with PC were consecutively selected based on the inclusion and exclusion criteria. The inclusion criteria were female with medium length hair and willingness to participate. Medium hair length was described as hair length extending beyond the ear margins and above the shoulders. The exclusion criteria included those who had treatment of PC within 10 days prior to the trial, history of hypersensitivity to permethrin, had secondary infection, and/or female with long or short hair.

This study was done per protocol and subjects were randomized to receive either PL1 or PL5. Since PL5 was not available in Indonesia, it was manufactured by request to an Indonesian pharmaceutical company along with the PL1 used in this study. Both were lotion-based product with propylene glycol as solvent, and contained paraffin liquid, glycerin, octyldodecanol, PEG-30 dipolyhydroxystearate, octyldodecyl xyloside, nipagin, nipasol, and menthol. The lotions were similarly packaged and applied by trained technicians under the investigators' supervision. Both investigators and the participants were blinded. After 10 minutes, the participants' hairs were washed by the technicians and were examined by the

investigators. Permethrin lotion administration was repeated on day 7.

Efficacies of each treatment were evaluated on days 7 and 14, while adverse effects were assessed on days 0, 7 and 14. If no live head lice were detected upon evaluation, participants would be considered as cured. They were considered to be dropped out of the study if they failed to complete treatment.

Consents from parents and participants were obtained. The study has received ethical approval from the Health Research Ethics Committee, Faculty of Medicine Universitas Indonesia, dr. Cipto Mangunkusumo National Central General Hospital (No: 1099/UN2.F1/ETIK/2018).

Statistical analysis was performed using IBM SPSS Statistics, Version 22.0 (IBM Corp.) software and open Epi. Chi-square and Fisher tests were used to compare the efficacy of treatment between groups.

Results

The study flowchart is shown in **Figure 1**. Subjects were female students aged 11–15 years (mean 13.3 ± 1.167) living in a boarding school. At baseline, no significant difference in clinical characteristics was seen (**Table 1**). Overall, 47 subjects completed the study. 1 subject from PL5 group dropped out due to absence.

On day 7, 15 of 24 subjects (62.5%) in PL1 and 15 of 23 subjects (65.2%) in PL5 were cured. On day 14, 23 of 24 subjects (95.8%) in PL1 and 22 of 23 subjects (95.7%) in PL5 were cured. There was no significant difference found in terms of cure rate between the two groups on either day 7 or 14 (**Table 2**).

Evaluation of adverse effect on day 0 showed that 3 subjects in PL1 group and 2 subjects in PL5 group reported burning sensation, along with 1 subject experienced itching and 1 subject had dizziness/nausea in PL5 group ($p=0.527$). Erythema was observed in 1 subject in PL1 group and 2 subjects in PL5 group ($p=0.467$).

On days 7 and 14, no complain was reported in both groups.

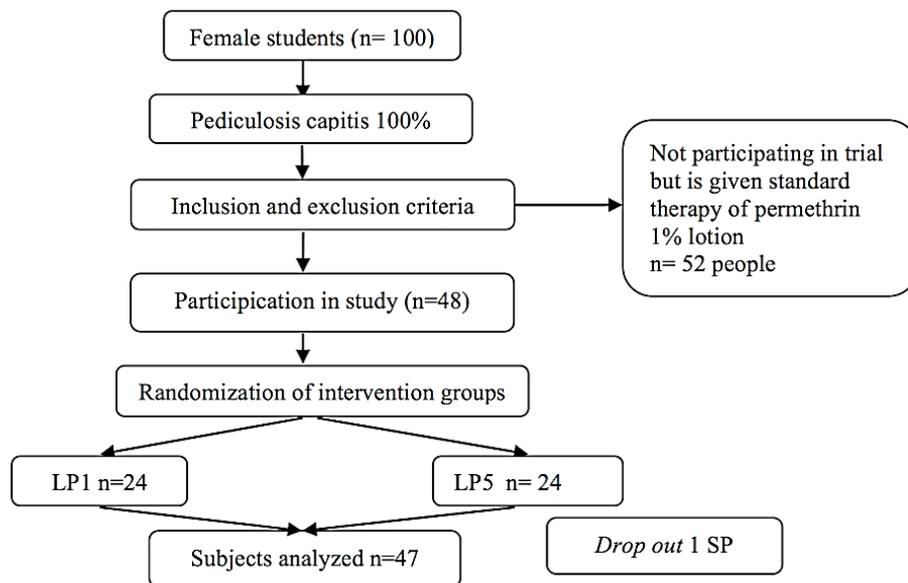


Figure 1 Study flow chart, treatment allocation and study subject analysis.

Table 1 Clinical characteristics of study subjects.

Primary data		Total		Group				P value
		(N = 48)		LP1 (n = 24)		LP5 (n = 24)		
		N	%	n	%	n	%	
Hair type	Straight	30	62.5	17	70.8	13	54.2	0.104
	Curly	4	8.3	0	0.0	4	16.7	
	Wavy	14	29.2	7	29.2	7	29.2	
Itching	Yes	47	97.9	24	100	23	95.8	N/A
	No	1	2.1	0	0.0	1	4.2	
Crawling sensation	Yes	48	100	24	100	24	100	N/A
	No	0	0.0	0	0.0	0	0.0	
History of medications	None	32	66.7	14	58.3	18	75	0.367
	1% Permethrin	8	16.7	4	16.7	4	16.7	
	Gamexan	6	12.5	5	20.8	1	4.2	
	Others	2	4.1	1	4.2	1	4.2	

Note: n = number of subjects; p value < 0.05 was considered significant; N/A = Not available

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Table 2 Treatment efficacy.

Therapy	Day 7				p	Day 14				p
	Cured	%	Not cured	%		Cured	%	Not cured	%	
LP1 (n = 24)	15	62.5	9	37.5	1.000*	23	95.8	1	4.2	1.000*
LP5 (n = 23)	15	65.2	8	34.8		22	95.7	1	4.3	

*Chi square

Discussion

One percent permethrin is the drug of choice for PC treatment. However, as more studies reporting PC resistance towards 1% permethrin, two applications of 1% permethrin is now recommended to increase cure rate.¹⁶ In this study, no significant difference was found in terms of cure rate between those given two applications of PL1 or PL5 for 14 days. Cure rates are 65.2% on day 7 and 95.7% on day 14, which is similar to those reported by Novianto *et al.*¹⁵ (73.9% cure rate on day 7 and 97.1% on day 14) in participants with PC whom received two applications of 5% permethrin lotion. Previously, Subahar *et al.*¹⁷ reported an in vitro study that showed PC resistance to permethrin 1%. This different result might be due to

different study conditions that affect the amount and application method of permethrin to the mites. Also, these studies were done in different location which might lead to different lice population and different kdr trait mutation.¹⁷⁻¹⁹

The subjective complaints reported in this study is less than reported by Novianto *et al.*,¹⁵ where evaluation in the first 10 minutes after the initial treatment of PL5 on day 0 included itching in 9 subjects (13%) and burning sensation in 22 subjects (31.9%). Other subjective symptoms reported by 1 subject in this study, dizziness/nausea, was considered not related to treatment as improvement was observed after having a meal.

This study is a randomized double blind controlled trial using lotions in two concentrations made by the same pharmaceutical company to reduce bias. Moreover, each female student diagnosed with PC was also provided with the same type of shampoo, towel and comb and were educated not to share them. To prevent reinfection, all students with PC who were not included in this study were also treated with PL1. This study was conducted for 2 weeks, longer period of follow up maybe needed. The research demonstrated that PL1 is as effective as PL5 and safe for PC in children in this study.

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