The Effectiveness of 5% Tea Tree Oil cream, 10% Tea Tree Oil cream, and 5% Permethrin Cream for Scabies Treatment in Pediatric Patients

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ABSTRACT

Background: Scabies, an infectious disease caused by *Sarcoptes scabiei* mites, is still one of the most common skin diseases found in developing countries, including Indonesia. The 5% permethrin cream for scabies treatment has been investigated as having 2–3 time to cure scabies. Tea Tree Oil (TTO) is one of the agents that has been proven to have acaricidal potential as an anti-inflammatory, antibacterial, and antipruritic agent. It has minimal side effects in topical use. **Purpose:** To evaluate the effectiveness of 5% TTO cream and 10% TTO cream in scabies treatment of pediatric patients. **Methods:** This was an experimental, analytical study with controlled clinical trial methods, and a double-blind, parallel design comparing 5% TTO cream (treatment 1), 10% TTO cream (treatment 2), with 5% permethrin cream (control) to children with scabies. **Result:** The 5% TTO cream gave a cure rate of 61.5% and was significantly different from the 5% permethrin cream groups with a p-value = 0.044 in the first week of the study. The 5% permethrin cream gave a cure rate of 15.4%, and the cure rate of 10% TTO cream was 53.8% in the first week of the study. **Conclusion:** There was a significant difference between the 5% TTO cream and 5% permethrin cream in the first week of the study. The highest and fastest cure rates were found in the 5% TTO cream treatment group.

Keywords: scabies, tea tree oil, permethrin, children.

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INTRODUCTION

Scabies, an infectious disease caused by *Sarcoptes scabiei* mite, is still one of the most common skin diseases found in developing countries, including Indonesia. Every year, there are approximately 300 million cases of scabies in worldwide.[1] Symptoms of this disease are severe itching, especially at night with clinical manifestations of papules and pustules accompanied by tunnel-shaped lesions where *S. scabiei* is lodged in the epidermis. Scabies also causes complications such as rheumatic fever, nephritis, and sepsis, which are caused by secondary infection by *Group A Streptococcus sp*. or *Staphylococcus aureus*.[2] Scabies is generally occurred in low economic areas, areas with limited resource, and areas where people have to live in close proximity such as prisons, nursing homes, and dormitories. In addition, low socio-economic conditions, lack of hygiene, crowded neighborhoods, lack of nutrition, and sexual behavior are risk factors for the spread of scabies.[3]

Although scabies is a highly prevalent disease and potentially cause life-threatening complications, there has been not enough attention that is still considered a neglected disease. Treatment for scabies has now been investigated to have alarming local and systemic side effects, and its safety has not yet known in elderly patients, patients with impaired liver function, in patients younger than five years old, and in pregnant women. Several studies conducted in Australia found that the survival time of *S. scabiei* after exposure to acaricide drugs has increased to 2 to 3 times compared to 10 years ago.[1]

The diagnosis of scabies is made through clinical manifestations and microscopic examination. Identifying lesions can be difficult because it often becomes unclear due to eczema or impetigo. A presumptive diagnosis can be made based on a history

of typical pruritus, pruritus that gets worse at night, distribution of the lesion, and a history of contact with other scabies patients. Definitive diagnosis is through microscopic findings of scabies mites, eggs, pieces of eggshell, or fecal matter (scybala) taken from a skin scraping from papules or under the nails. On dermoscopy, *S. scabiei* looks like a dark triangular shape resembling the letter "V". In the absence of mites found or negative dermoscopic examination, the diagnosis is based on clinical findings and epidemiology.[4,5]

Tea Tree Oil (TTO) is a derivate of essential oil attained from the distillation of leaves and terminal branches of the *Melaleuca alternifolia* plant. TTO is a colorless or pale yellowish liquid, clear, and has a scent of terpenes, conifer, and minty, camphoraceous. TTO is an agent that has been proven in vivo and in vitro to have an acaricidal potential. TTO has three main components, namely terpinene-4-ol, γ-terpinene, and α-terpinene, which has anti-inflammatory, antibacterial, and antipruritic properties, with very minimal side effects in topical use. Topical TTO preparations will have several advantages as scabies therapy, which are more economical, easy to use, and can be implemented in various communities as a traditional medicine.[1]

TTO has a promising acaricidal effect against scabies mites in vitro. It has been used successfully as a topical adjuvant treatment in the treatment of crusted scabies, including cases that do not respond to standard therapy. The combined effects of acaricidal, antibacterial, antipruritic, anti-inflammatory, and wound healing effects on TTO can potentially reduce scabies infection due to bacterial complications.[1,6] TTO has been used as a remedy for several diseases such as acne, eczema, skin infections such as herpes simplex and warts, wounds, burns, insect bites, dandruff, and nail mycosis.[6] TTO as essential oil is also used as therapy for dermatosis, respiratory infection, oral and vaginal, and antiseptic and disinfectant.[6]

Terpinen-4-ol, at 0.125% concentration, can inhibit the production of several inflammatory mediators, such as tumor necrosis factor α, interleukin-1β, and prostaglandin E2, equivalent to the production of superoxide, thereby reducing the inflammatory response. TTO has been shown to reduce the inflammatory response to the skin, including responses to insect bites, bee stings, hives/itches, and metal-induced hypersensitivity. This is due to the ability of TTO to modulate vasodilation and plasma extravasation related to inflammation caused by histamine.[1,8]

Various compounds in TTO have different use profiles. For example, terpinen-4-ol, a major component of TTO, exhibits strong anti-inflammatory, antimicrobial and anti-tumor properties[9], while 1.8-cineole is an unwanted allergen in TTO products. The anti-inflammatory activity of TTO is mediated by the reduction of TNF α, IL-1, IL-8, prostaglandin E, and superoxide monocytes. Topical TTO can regulate wheal and flare by reducing histamine-induced edema. TTO is an excellent alternative antioxidant. Its antioxidant activity reflects the properties of α-terpinene, α-terpinolene, and γ-terpinene.[8]

There are no studies that examine the effectiveness of acaricide drugs. Permethrin 5% works by blocking sodium channels in parasitic organs that can cause paralysis and arthropod death. The mechanism of the 5% TTO as an acaricide drug is thought to be the same as that of other acaricide drugs, blocking the sodium channel causing paralysis of the arthropods.[10] TTO is believed to block the parasitic motility which causes elimination of the parasite from the host. One example of an anti-parasitic drug, Levamisole, works as an agonist on the nicotinic acetylcholine receptor in the parasitic neuromuscular junction, causing neuromuscular depolarization and spastic paralysis of the parasite.[8]

The topical application of TTO has a low incidence of side effects. The most frequent side effects are irritant and allergic reactions to the oil. Irritant reactions can be significantly avoided through a lower concentration. Although the threshold limits for irritant reactions have not been described, TTO with concentrations below 25% is said to rarely cause side effects.[11,12]

METHODS

This study was an experimental, analytical study using controlled clinical trial methods, random pair selection, and a double-blind, parallel design comparing 5% TTO cream (treatment 1), 10% TTO cream (treatment 2) with 5% permethrin cream (control) on child scabies.

The inclusion criterion was scabies patients aged 5 to 16 years old who were willing to participate in the study by signing informed consent. The diagnostic criteria for scabies are the presence of a burrow in the form of linear or winding and/or a typical scabies lesion, i.e., the discovery of papules or pustules in the area of scabies predilection, a complaint of itching, especially at night, and similar complaints in the family or close people were present, and/or the presence of triangular structure in the form of the letter 'V' in a dermoscopic examination, and/or one of the following is obtained from light microscopy: eggs, larvae, lice, or fleas. The exclusion criteria were patients with a secondary infection, patients with severe systemic

abnormalities, patients with immunosuppression, and Norwegian/crusted scabies.

The sampling technique was consecutive, selecting participants who pass the inclusion and exclusion criteria at the Nurul Cholil Islamic Boarding School in Bangkalan. A total of 39 samples were then divided into three groups, and each group consisted of 13 people. The allocation of samples to the treatment and control group was done randomly.

The procedure and objective of the study were conveyed to the eligible samples and their guardians, and if they are willing to participate in the research, informed consent will be signed by the representative of the Nurul Cholil boarding school, Bangkalan. Subjects were interviewed, then underwent physical examinations to measure weight and height, inspect and palpate the location of the complaint, conduct a dermoscopy examination, and dermal lesion scrapings. The subjects were then prescribed with cream for night use after they shower. The subjects applied the cream all over their bodies, including the crease areas and areas without complaints, as instructed. The cream was left for 8 hours and rinsed in the following day. The cream can be reapplied once a week if there is positive sign of scabies, established by a doctor's physical examination.

In the following week, the first week, the first evaluation included physical examination, dermoscopy examination, and scrapping examination. If all examinations showed negative results, the subject would be declared cured. If one of the examinations showed a positive result, the subject would be prescribed with the cream for the second time (the first repetition). The second evaluation was carried out in the following week, the second week, using the same method and criteria. Should the tests showed at least one positive result, the subject would receive the treatment for the third time (the second repetition) and re-evaluate the following week, which was the last evaluation. If one of the test results showed positive, then the research subject would be declared not cured.

RESULTS

This research is a clinical trial conducted in August to October 2019 aimed to compare the 5% TTO cream and 10% TTO cream to 5% permethrin cream, which has been used as standard therapy in treating scabies in this research. Subjects who participated in this study were patients who had positive results on physical examination and positive results on either scrapping or dermoscopic examinations for scabies infection. Two positive results from the three examinations aim to increase the diagnostic value of scabies in this study. Thirty-nine subjects participated in this study, and they were divided into 3 treatment groups, consisting of 13 participants each group. Each group received 5% permethrin cream, 5% TTO cream, 10% TTO cream, respectively. This was a double-blind study in which the creams had identical packaging and numbered accordingly. Therefore, only the researcher knew which cream was which.

Table 1 shows that most research subjects were males, amounting to 82.1%. The Pearson Chi-Square test shows a value of $p = 0.498$, which means that the data distribution of sex in the three study groups was not different. The high prevalence of scabies in male children was possible because of the sex ratio. There were 2,000 males and 1,200 females in Nurul Cholil Islamic boarding school. Also, males' poorer self-hygiene and care may contribute to the disease. Females tend to be more attentive to complaints and are responsive to seek treatment compared to males. Poor self-hygiene behaviors include sharing towels, sharing bed which facilitates skin-to-skin contact with scabies sufferers, and not immediately wash clothes after use.[13]

The age range of the subjects was 10–16 years old. A retrospective study conducted by Paramita in 2015 on scabies in the Dermatology and Venerology Outpatient Clinic of Dr. Soetomo General Academic Hospital, Surabaya states that the highest prevalence (63.8% of 282 patients) of scabies was observed in 4–14 years age group.[14] Kruskal Wallis p score was 0.257, which means that no difference in terms of age range between the study groups. This was because the majority of research subjects were in the same age group (early teens), where someone has begun to understand pay attention to their health. Early adolescence is a turning point age where someone interacts more with other people. Scabies that infects skin between fingers and toes and are visible. This can cause embarrassment and inferiority. As many as 80% of scabies patients claim that this disease affects their quality of life, including sleep disorders, community stigma, and causes shame.[15,16]

Table 2 shows the comparison of cure rates between 5% permethrin cream and 5% TTO cream. The cure rate of 5% permethrin cream was 15.4%, and the cure rate of 5% TTO cream was 61.5%. The statistical analysis using the Pearson Chi-square test showed a p-value of 0.044. It means that there were significant differences between the two groups.

The statistical analysis of the 5% Permethrin cream and 10% TTO cream resulted in a p-value of 0.097. It means that there was no significant difference between the two groups. The 5% permethrin cream had a cure rate of 15.4%, and the 10% TTO cream had a 53.8% cure rate. A similar result was obtained from a comparison between 5% TTO cream and 10% TTO

cream, as shown in Table 4, with a p-value of 1.000. It means no significant difference between the two groups.

Table 1. Characteristics of the research subjects

Variable	Permethrin 5%, n=13	TTO 5%, n=13	TTO 10%, n=13	p-Value
Sex				p=0.498 (Chi Square)
Male	12 (92.3%)	10 (76.9%)	10(76.9%)	
Female	1 (7.7%)	3 (23.1%)	3 (23.1%)	
Age (years)				p=0.257 (Kruskal Wallis)
10	0 (0%)	0 (0%)	1 (7.7%)	
11	0 (0%)	0 (0%)	1 (7.7%)	
12	1 (7.7%)	0 (0%)	3 (23.1%)	
13	6 (46.15%)	2 (15.35%)	1 (7.7%)	
14	1 (7.7%)	5 (38.5%)	2 (15.35%)	
15	3 (23.1%)	2 (15.35%)	2 (15.35%)	
16	2 (15.35%)	4 (30.8%)	3 (23.1%)	
Nutritional status (BMI, kg/m^2)				
Underweight (BMI <18.5)	5 (38.5%)	8 (61.5%)	7 (53.85%)	p=0.740 (Oneway ANOVA)
Normal (BMI 18.5–22.9)	8 (61.5%)	5 (38.5%)	4 (30.8%)	
Overweight (BMI 23–29.9)	0 (0%)	0 (0%)	2 (15.35%)	
Obese (BMI >30)	0 (0%)	0 (0%)	0 (0%)	

BMI= Body Mass Index; TTO= Tea Tree Oil

Table 2. Treatment outcomes of 5% permethrin cream and 5% Tea Tree Oil cream

	Week 1	Week 2	Week 3
Permethrin 5%	(n=13)	(n=11)	(n=8)
Cured	2 (15.4%)	3 (27.3%)	3 (37.5%)
Not Cured	11 (84.6%)	8 (72.7%)	5 (62.5%)
TTO 5%	(n=13)	(n=5)	(n=2)
Cured	8 (61.5%)	3 (60%)	0 (0%)
Not cured	5 (38.5%)	2 (40%)	2 (100%)
p value (Chi Square)	0.044		

TTO = Tea Tree Oil

Table 3. Treatment outcomes of 5% permethrin cream and 10% Tea Tree Oil cream

	Week 1	Week 2	Week 3
Permethrin 5%	(n=13)	(n=11)	(n=8)
Cured	2 (15.4%)	3 (27.3%)	3 (37.5%)
Not cured	11 (84.6%)	8 (72.7%)	5 (62.5%)
TTO 10%	(n=13)	(n=6)	(n=5)
Cured	7 (53.8%)	1 (16.7%)	0 (0%)
Not cured	6 (46.2%)	5 (83.3%)	5 (100%)
p value (Chi Square)	0.097		

TTO= Tea Tree Oil

Table 4. Treatment outcomes of 5% Tea Tree Oil cream and 10% Tea Tree Oil cream

	Week 1	Week 2	Week 3
TTO 5% cream	(n=13)	(n=5)	(n=2)
Cured	8 (61.5%)	3 (60%)	0 (0%)
Not cured	5 (38.5%)	2 (40%)	2(100%)
TTO 10%	(n=13)	(n=6)	(n=5)
Cured	7 (53.8%)	1 (16.7%)	0 (0%)
Not cured	6 (46.2%)	5 (83.3%)	5(100%)
p value (Chi Square)	1.000		

TTO= Tea Tree Oil

Tabel 5. Treatment outcomes of each group in each week of evaluation

Treatment	Week 1 (n=39)	Week 2 (n=22)	Week 3 (n=15)
Permethrin 5%	2 (5.1%)	3 (13.6%)	3 (20%)
TTO 5%	8 (20.5%)	3 (13.6%)	0 (0%)
TTO 10%	7 (17.9%)	1 (4.5%)	0 (0%)
Total	17(43.5%)	7 (31.8%)	3 (20%)

TTO = Tea Tree Oil

Table 5 shows that the highest and fastest cure rates were found in the 5% TTO cream, a treatment group. In the first week of treatment, the 5% TTO group had the highest cure rate compared to the other two groups, which was 20.5% with a p-value of 0.044, indicating no significant difference between the 5% TTO cream group and the 5% permethrin cream. This was possibly because of Terpinen-4-ol found in TTO, which works by inhibiting the production of inflammatory mediators and paralyzing arthropods by blocking the sodium channel and the nicotinic acetylcholine receptor agonist in the neuromuscular junction of *S. scabiei*. Permethrin 5% only paralyzes *S. scabiei*; therefore, it makes sense that TTO can cure scabies more quickly. The use of 5% permethrin cream in treating scabies also gives excellent and satisfying results. The 5% permethrin cream is the most widely used first-line topical drug for scabies treatment, and some countries use it as the gold standard of therapy. Research conducted by Goldust found that treatment using 5% permethrin achieved a cure rate of 92.5% in the second week of treatment.[10]

This study concluded that there were significant differences between 5% TTO cream and 5% permethrin cream in scabies treatment in the first week. Environment is one of the factors that could not be controlled in this study. Dense populations and close interactions can cause reinfection and hinder the healing process. Environmental control, such as personal hygiene and comprehensive management, can increase the successful rate of therapy.

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