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Control of Scabies in a Boarding School Using 5% Permethrin Applied on Lesion Only

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Abstract Scabies is one of the most neglected tropical skin diseases in Indonesia. It is usually found in overcrowded communities with poor hygiene. The gold standard for scabies treatment is the whole-body topical application of 5% permethrin cream. However, the treatment causes inconvenience and stickiness for a prolonged period. The modification of topical treatment by applying only to the lesion yielded results similar with whole-body topical application. We consider using this mode of treatment to control the disease in a boarding school. The study was conducted from June to August 2019. All students were examined by dermatologists, and individuals who were diagnosed with scabies were treated using 5% permethrin for 12 h before wash-off (week 0) applied on the lesion only and reapplied a week after. The evaluation was conducted on weeks 4 and 8 by observing scabies lesions. Local health cadres were also trained, and environmental interventions were also performed. A total of 75 participants were analyzed. Most lesions were found on predilection sites such as finger web spaces of the left (57.3%) and right (58.7%) hands, gluteal region (60%), and penis (40%). The cure rate (CR) was 83%–100% of the lesions in week 4, which increased to 95%–100% in week 8. The CR on week 8 compared with baseline was 94.7% ($p < 0.001$). A total of 23 cadres were trained, and from post-test, 84% of the cadres showed good knowledge of scabies management. This novel application of 5% permethrin cream on the lesion only is an effective alternative to the conventional whole-body topical application.

Keywords: management of scabies; permethrin 5%; whole body; lesion only; scabies.

1. Introduction

Scabies is a neglected tropical skin disease caused by the parasite *Sarcoptes scabiei*. Scabies is mainly prevalent in developing countries, with its most important risk factors being household overcrowding (Chosidow, 2006) along with socioeconomic status, malnutrition, and poor hygiene standards (Dogra & Kumbar, 2003). A survey by the International Foundation of Dermatology on main skin diseases in the community of several countries

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worldwide, which included Indonesia and other developing countries, stated that scabies was a common, emerging skin problem. The worldwide prevalence of scabies was up to 300 million, making it a significant health problem in developing countries (Chosidow, 2006). A Global Burden of Disease study in 2015 revealed that of the 195 countries analyzed, Indonesia had the highest scabies infection (Karimkhani et al., 2017). The highest rates of infection are present in children, specifically from preschool to adolescence (Hay et al., 2012).

Household overcrowding is common in developing countries, as the socioeconomic factor limits families or institutions to small living spaces. In Indonesia, household overcrowding can be seen in Islamic boarding schools, most known as *pesantren*. As one of the largest Muslim countries worldwide, *pesantren* is a common sight in Indonesia. These schools are mostly limited in facilities including living quarters. Children and teenagers are usually living in a cramped space with close and direct contact with each other. That and the limited knowledge of proper hygiene standards result in the development of various skin diseases including scabies. Multiple studies have reported high prevalence of scabies in *pesantren* in Indonesia ranging from 51.6% (Ratnasari & Sungkar, 2014) to 68% (Sahala et al., 2016). Other places that show high rates of scabies infection include orphanages (87%) (Pruksachatkunakorn et al., 2003) and welfare homes (46%) (Zayyid et al., 2010).

The highest burden of scabies is recorded in tropical countries associated with drought, limited clean water facilities, and poverty. In 2017, this disease is considered a neglected tropical disease by the World Health Organization (Chandler & Fuller, 2019). Scabies had a significant effect on the quality of life, with a burden on disability-adjusted life year ranked at 101, above atrial fibrillation. The effect of scabies on the skin is associated with 1.5 million years lived with disability, comparable with diseases on other systems such as the kidneys and the heart (Karimkhani et al., 2017).

The female scabies mites lay 40–50 eggs during their life at approximately 4–6 per day and burrow into the upper layer of the skin (stratum corneum). The clinical manifestations of scabies include severe itching and skin rash caused by sensitization to mite proteins or feces. The itchiness worsens at night (nocturnal pruritus) and by a damp environment (sweating). Other manifestations may be present upon secondary infection or by scratching including pustules, excoriations, pain, and fever (Chandler & Fuller, 2019). Constant scratching will induce skin damage and facilitates secondary bacterial infection with group A *Streptococcus* or with *Staphylococcus aureus*, commonly presented as impetigo. In the Solomon Islands, scabies was associated with active impetigo infection with 41.1% of active impetigo cases

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also having scabies (Mason et al., 2016; Osti et al., 2019). Overall, scabies causes sleep deprivation and loss of focus, resulting in lower quality of life and academic abilities. Over 15.5% of boarding school students with scabies experienced a decline in grades and failure to pass examinations and even graduate (Muzakir, 2008). Thus, scabies presents a significant effect on one's quality of life and increases the risk of complications such as infection.

Predilection sites of scabies are regions of skin folding, i.e., finger webs, interdigital spaces, wrists, armpit, penis, nipple, and mammary fold. In children and infants, it can also involve the head, feet, neck palms, and soles (Perez-Crespo et al., 2016). Patients who have a weakened immune system or neurological diseases such as neuropathy, old age, cognitive deficit, and psychiatric disorders, and disability to scratch the lesions easily progress to severe forms of scabies, called Norwegian scabies. It is an infestation characterized by thick crusts of skin that contain numerous mites and eggs. The treatment for crusted scabies is difficult and requires prolonged treatment with systemic scabicides (Ebrahim et al., 2016).

Scabies affects people of all races and social classes and can spread easily in crowded conditions where close body and skin contact is common. The risk factors for scabies are overcrowding, poor income, and poor level of education. Other risk factors include the type of employment, personal hygiene, and contact history with patients having scabies. In adults, scabies can be acquired through sexual intercourse or other close-distance contact (Karimkhani et al., 2017).

Scabies is highly infectious, difficult to eradicate, and mostly affects marginal age groups. Mites are highly mobile and can survive on inanimate objects (Sungkar et al., 2014) causing a high rate of reinfestation and quickly spread in a crowded space. Thus, scabies eradication requires large-scale, simultaneous treatment using pharmacological agents, personal hygiene, and environmental sanitation. Poor sanitation, i.e., inaccessibility and poor utilization of water, lack of personal and/or group hygiene such as sharing clothes or bed among group members, poor hand washing practices (Ejigu et al., 2019), or rarely washing and/or ironing of clothes (Sahala et al., 2016), increases the risk for reinfestation. Scabies also requires health education to enhance primary prevention (Wijayanti & Ainiyah, 2019).

Closed institutions such as schools, prisons, and refugee camps are vulnerable to outbreaks. In an event of an outbreak, a team should be formed, comprising all elements within the boarding school, including school leaders, religious pillars, administrators, cleaners, and health officers. The team should report and coordinate the management effort with local health authorities and the closest medical facilities. It is best to manage the outbreak within 24 h to allow containment and prevent mass spreading. Screening should be

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performed for all individuals within the boarding school. Individuals showing signs and symptoms of scabies should be kept away from the rest and are referred to a medical doctor for diagnosis and treatment. Once individuals affected are treated with scabicides, mass environment cleaning and distribution of scabies prophylaxis to those who were in contact with those deemed affected are required (Abdel et al., 2016).

The agent of choice for scabies eradication is 5% permethrin cream, which is applied topically to the whole body, from the neck down to the toes, including areas of in-folding for 12 h. A single topical application should be effective for scabies; however, clinically, the full treatment regimen requires a minimum of two applications one week apart (Chandler & Fuller, 2019). While the drug of choice is considered safe, topical application combined with a prolonged duration of application causes discomfort and sensation of stickiness, even erythema, pruritus, and burning sensation (Thadanipon et al., 2019). Some patients experienced dermatitis (Bassi et al., 2011).

Whole-body topical application of permethrin requires large amounts of drugs. We estimate that one tube (30 g) is needed for topical whole-body topical application per treatment session. This cost is a burden to people of low socioeconomic status in developing countries, especially when mass treatment is required to prevent reinfestation.

A previous pilot study and quasi-experimental studies conducted by Sungkar et al. (2014) showed a similar cure rate (CR) of topical application of permethrin on the lesion site alone compared with the conventional whole-body topical application, making it a cheaper and more convenient method of application, with less discomfort and side effects for scabies eradication. Thus, this study aimed to eradicate scabies and assess the CR of topical lesion site-only application of 5% permethrin cream on boarding school students in Jakarta with the involvement of local health cadres (non-medical personnel) to ensure the proper use of permethrin cream and monitoring of side effects.

2. Methods

This community service-based study was performed from June 2019 to August 2019 at an Islamic boarding school in South Jakarta, Indonesia. The participants were all students residing in the boarding school, diagnosed with scabies, and willing to receive treatment and follow the study protocol. Participants who were hypersensitive to permethrin were excluded, and those who were absent on one or more study visits were considered dropouts. The study is generally divided into knowledge assessment and impartation, formation of cadres, scabies pharmacological treatment, periodic assessment, and environmental cleaning.

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2.1. Knowledge assessment and formation of cadres

First, we performed a school-wide assembly. Participants were given a pretest of structured questionnaires to collect basic information and knowledge about causes of scabies, clinical manifestation, treatments, mode of transmission, and prevention of scabies. Basic information includes sociodemographic variables such as age, duration of stay in *pesantren*, and history of drug used, if any. The questionnaire consisted of 25 questions in a multiple-choice format. The students must choose one correct answer among the options provided or opted for a "do not know" option when they did not possess the answer to the question. The questionnaires were prepared in Bahasa, using non-medical terminology (layman's terms) with *kudisan* as the widely used term for scabies. The questionnaire has been validated previously (Sahala et al, 2016).

Every correct answer was scored 1. A wrong answer or a "do not know" answer was scored 0. The level of knowledge was derived from the total score, corresponding to the number of correct answers. A student scoring 75%–100% was deemed as having good knowledge, 50%–<75% as having moderate knowledge, and <50% as having poor knowledge.

After the pretest, health education was then given to educate all students, teachers, and the owner of the boarding school about healthy lifestyles and scabies. Healthy lifestyles include how to perform the six steps of hand washing, how to shower with soap, how to cleanse personal belongings and maintain good hygiene, and how to perform room cleaning and discourage lending of personal effects. This health education session was delivered in layman's terms with adequate audiovisual support. After the health education, a post-test was then performed using the same questionnaire.

Student health supervisors (health cadres) were chosen based on several criteria. The candidates must possess adequate work ethics, good discipline, and good behavior as recommended by the teachers and head of the boarding school. The candidates were then chosen based on the scores achieved in the post-test. A total of 23 health cadres were chosen, and any discomforts or side effects were reported to the head of the boarding school, who will then report it to the researchers. Student groups were formed to create rosters for room hygiene maintenance and personal health under the supervision of health cadres.

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2.2. Scabies diagnosis and treatment

A school-wide examination was performed by dermatologists and residents of the Faculty of Medicine Universitas Indonesia. The diagnosis of scabies was based on the International Alliance for Control of Scabies/IACS (Engelman et al. 2018). In this study, we refer to the clinical and suspected scabies criteria of the IACS. Students diagnosed with scabies were gathered and treated once with topical lesion site-only application of permethrin 5% for 12 h before washing off (week 0). If the cream was erased or wiped off due to activities before the intended duration is over, the students must reapply and keep the cream until the end of the duration.

The second round of treatment was performed 1 week after the first visit (week 1). CR evaluation was performed at weeks 4 and 8 after the visit. At each visit, we evaluated the treatment response and examined whether an additional round of treatment was necessary. At week 4, those who were positive were given another round of treatment using lesion site-only application. The topical application of 5% permethrin cream must encompass the lesion and region or area close to the lesion, with approximately 2–3 mm drug coverage beyond the edge of the lesion. At week 8, whole-body topical application was employed to those who are still deemed positive. The evaluation of scabies and treatment response was based on the clinical judgment of dermatologists.

Participants who were diagnosed with other skin diseases were treated based on the disease entity, i.e., bacterial skin infections were treated with antibiotics and atopic dermatitis with corticosteroids. The types of skin lesions, lesion sites, and drugs taken were noted upon evaluation and were recorded for data analysis.

2.3. Environment cleaning

To eradicate scabies, inanimate objects and personal items were cleaned and placed under the sun, including bedding, clothing, and towels. Living quarters and sleeping chambers were cleaned. Routine cleaning was performed under the supervision of health cadres.

2.4. Data processing and statistical analyses

Results of the pre- and post-test on knowledge were recorded. Lesion sites were mapped and recorded with respect to the total number of participants. Lesion improvement was analyzed using the McNemar test. The CR was measured using the following formula (on weeks 4 and 8):

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$$\text{Lesion cure rate on week 4} = \frac{\text{number of lesions on week 4}}{\text{number of lesions on week 0}} \times 100\%$$

$$\text{Lesion cure rate on week 8} = \frac{\text{number of lesions on week 8}}{\text{number of lesions on week 0}} \times 100\%$$

$$\text{Subject cure rate on week 4} = \frac{\text{participants negative for scabies on week 4}}{\text{participants positive for scabies on week 0}} \times 100\%$$

$$\text{Subject cure rate on week 8} = \frac{\text{participants negative for scabies on week 8}}{\text{participants positive for scabies on week 0}} \times 100\%$$

3. Results and discussion

3.1. Scabies and its management

A total of 132 students were examined, with 95 students (72%) positive for scabies. However, 20 participants were absent in the subsequent weeks and thus were dropped out from the analysis, and a total of 75 students were included in the analysis. Most of the participants were from the group aged 15–19 years (57.3%) and have stayed for more than 3 months (85.3%). In these 75 participants, some had tried to seek help from medical professionals (38.7%), and the rest tried to treat it themselves. Only 10 (13.3%) participants were prescribed 5% permethrin cream, whereas the rest were treated using agents (Table 1).

Table 1. Characteristics of the participants

Characteristics of the participants	n (%)
Age group	
10–15	6 (8)
15–19	43 (57.3)
>19	26 (34.7)
Duration of stay	
<3 months	11 (14.7)
>3 months	64 (85.3)
Seek for help	
Alternative medicine (Chinese herb, scabies cream)	14 (18.7)

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Characteristics of the participants	n (%)
Went to a doctor	29 (38.7)
None	32 (42.7)
History of drug use	
Alternative medicine (Chinese herb, scabies cream)	3 (4)
Permethrin 5%	10 (13.3)
Antibiotics	3 (4)
Antifungal	1 (1.3)
Salep 88 (sulfur ointment)	1 (1.3)
Antimicrobial	1 (1.3)
Forgot	22 (29.3)

Scabies is a major problem in developing countries. Overcrowding, low socioeconomic status, and poor hygiene worsen the spread of scabies. The signs and symptoms of scabies are mainly caused by hypersensitivity to the eggs and mites. Scabies causes itching and is often intensified by dampness and nighttime because the mites are more active at night. The cardinal sign of scabies is nocturnal pruritus; other signs including papules, excoriations, and hyperpigmentation might be present because of scratching. Secondary infection is often present, causing fever, pain, and pus production (Chandler & Fuller, 2019).

Scabies leads to a decrease in the quality of life and rest, leading to a decline in academic capabilities and studying effectiveness. Patients with scabies may suffer from many health problems that result in embarrassment, depression, anxiety, depression, and anger, leading to social isolation, absenteeism, or impaired school performance in school-age children (Muzakir, 2008). Upon secondary infection, participants often experience fever, pain, and swelling, which may lead to more serious conditions such as septicemia. In a recent meta-analysis of 52 studies searching for anti-scabies agent, permethrin was found to be the first-line treatment for scabies (Thadanipon et al., 2019). While the drug of choice for scabies is clear, complete eradication of scabies remains difficult. Scabies elimination should be conducted on a mass, simultaneous scale using the agent of choice, i.e., 5% permethrin cream (Sharma & Singal, 2011).

Permethrin has an excellent safety profile, with few severe side effects. It has an excellent CR with whole-body topical application lasting for 10–12 h. Repeated applications may be

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done as necessary. However, the use of permethrin for scabies eradication through whole-body topical application for prolonged treatment duration leads to discomfort and stickiness and thus may lead to a certain degree of unwillingness and hence reducing compliance (Sharma & Singal, 2011). The topical application of massive amounts of cream also adds economic burden, as those of low socioeconomic status are most prone to scabies. Whole-body topical application may increase the risk for systemic absorption of the drug and local side effects such as dermatitis (Bassi et al., 2011).

Failed scabies treatment might be due to improper application of permethrin, reinfection, or resistance. The reinfestation rate is high in scabies following eradication, and one of the reasons is the incomplete eradication of mites in the surrounding environment (De Sainte Marie B et al., 2016; Sunderkötter et al., 2019). Mites can survive on inanimate objects and burrow within the skin (Sungkar, 2016); thus, direct contact with infected individuals or sharing personal belongings is an important transmission method to break to prevent reinfestation. Personal hygiene, increasing awareness, and proper cleaning protocol are vital for successful eradication and prevention of reinfestation.

Scabies is often under- or even misdiagnosed. Patients often do not directly seek professional help and use alternative medicines such as Chinese herb cream or over-the-counter cream, which worsens the clinical manifestations. Similarly, our participants had previously tried self-medication, whereas others tried a more traditional approach. This result is similar to those of the study conducted by Kouotou et al. (2015) in Cameroon, reporting the delayed diagnosis is a big problem for scabies.

The eradication of scabies in boarding schools, orphanages, *pesantren,* and other crowded closed living spaces cannot be realized individually, but a mass, simultaneous, and complete eradication effort must be performed. All patients with scabies must be treated, and their immediate environment must undergo massive cleansing to ensure that none of the parasites are left in the inanimate objects, rooms, or other shared co-living spaces.

Patients with scabies who are receiving treatment with topical ointment must follow a healthy lifestyle and practice good hygiene. Shower and baths at least twice daily using adequate soap, with or without antiseptic content, are recommended. Daily washing with soap helps in reducing mites and eggs present on the skin surface. Soap without antiseptic content can facilitate mechanical removal of pathogens present on the skin but is unable to kill the pathogen. Antiseptic soaps usually contain triclosan with concentration between 0.1 and 0.45% mass/volume. This agent is effective against bacteria and fungi but is ineffective against viruses. Soap with a high concentration of triclosan can reduce the number of bacteria

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when compared with normal soap. Another active substance exhibiting similar antiseptic properties is triclocarban, which is commonly used in solid bar soap.

Healthcare facilities usually use antiseptic or antimicrobial hand wash containing high concentrations of triclosan or chlorhexidine. These products are effective against bacteria, fungi, and viruses. These antiseptic agents commonly possess residual effects on the skin that may last for quite some time even after rinsing. Antiseptic soaps are expected to reduce secondary infection in scabies lesion. However, drug interaction between permethrin and antiseptic soap may reduce effective skin penetration of permethrin.

Treatment response is highly dependent on several factors, including but not limited to accuracy and timing of diagnosis, adequate dosing, proper selection of pharmacological intervention, especially topical agents, and treatment duration. Most cases of treatment failure are caused by improper drug usage. Thus, patients should be well-informed and briefed thoroughly on the application method and use of a pharmacological agent.

Furthermore, the patients must be informed of the possibility of hypersensitivity and side effects before therapy. The patients must also be educated that itching does not equate to treatment failure. Itching may be a delayed hypersensitivity reaction of the mite, or its excrements left within the skin, despite being dead following successful eradication using pharmacological agents. This possibility must be communicated well to avoid misinterpretation of unsuccessful therapy and excessive use of the topical agent. For adults, 30 g of 5% permethrin cream is adequate for a single session of treatment through whole-body topical application. Symptomatic treatment using antihistamine and anti-inflammatory agents may be indicated in certain patients with moderate-to-severe symptoms. However, persistent pruritus may be indicative of treatment failure, especially in patients with immunocompromised status or recipients of immunosuppressants.

3.2. Lesion sites and treatment response

In this study, we treated students with topical lesion site-only application with 5% permethrin for 12 h before washing off (week 0), followed by subsequent topical lesion site-only application at week 1. Those who were positive at week 4 received another round of lesion site-only application. At week 8, those who were deemed positive received whole-body topical application of 5% permethrin. Lesions were recorded and analyzed, as shown in Table 2. The most common predilection sites are finger web spaces of the left (57.3%) and right (58.7%) hands, gluteus (60%), and penis (40%).

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Table 2. Proportion of scabies lesions on weeks 0, 4, and 8 based on the lesion location (n = 75)

Scabies Lesion	Week 0 n (%)	Week 4 n (%)	p-value	Week 8 n (%)	p-value
Finger web (left)	**43 (57.3)**	7 (9.3)	<0.001	2 (2.2)	<0.001
Finger web (right)	**44 (58.7)**	7 (9.3)	<0.001	2 (2.2)	<0.001
Wrist (left)	25 (33.3)	2 (2.7)	<0.001	0	<0.001
Wrist (right)	24 (32)	1 (1.3)	<0.001	0	<0.001
Elbow (left)	16 (21.3)	1 (1.3)	<0.001	0	<0.001
Elbow (right)	15 (20)	1 (1.3)	<0.001	0	<0.001
Axilla (left)	13 (17.3)	2 (2.7)	<0.001	0	<0.001
Axilla (right)	15 (20)	2 (2.7)	<0.001	0	<0.001
Umbilicus	20 (26.7)	0 (0)	-	0	-
Gluteus	**45 (60)**	4 (5.3)	<0.001	1(1.1)	<0.001
Areola (left)	6 (8)	0 (0)	-	0	-
Areola (right)	5 (6.7)	0 (0)	-	0	-
Testis	29 (38.7)	2 (2.7)	<0.001	0	<0.001
Penis	**30 (40)**	5 (6.7)	<0.001	0	<0.001
Subjects Positive	**75 (100)**	**16 (21.3)**	**<0.001**	**4 (5.3)**	**<0.001**

Upon topical application in the lesion site alone, compared with baseline, the lesion CR of 83%–100% was observed on week 4 ($p < 0.001$). On week 8, the lesion CR significantly increased to 95%–100% (Table 3), whereas the subjective CR increased from 78.8% to 94.7%. Those who remain positive on week 8 received a whole-body topical application of 5% permethrin cream. After the study, all participants were completely cured of scabies.

Table 3. Cure rate based on the location of the scabies lesion (n = 75)

Scabies lesion	Cure rate	
	Week 4 n (%)	Week 8 n (%)
Finger web (left)	36 (83.7)	41 (95.3)
Finger web (right)	37 (84.1)	42 (95.5)
Wrist (left)	23 (92)	25 (100)

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Scabies lesion	Cure rate	
	Week 4 n (%)	Week 8 n (%)
Wrist (right)	23 (95.8)	24 (100)
Elbow (left)	15 (93.8)	16 (100)
Elbow (right)	14 (93.3)	15 (100)
Axilla (left)	11 (84.6)	13 (100)
Axilla (right)	13 (86.7)	15 (100)
Umbilicus	20 (100)	20 (100)
Gluteus	41 (91.1)	44 (97.8)
Areola (left)	6 (100)	6 (100)
Areola (right)	5 (100)	5 (100)
Testis	27 (93.1)	29 (100)
Penis	25 (83.3)	30 (100)
Participants	**59 (78.7)**	**71 (94.7)**

Sungkar et al. (2014) conducted a preliminary study that showed that novel topical lesion site-only application of 5% permethrin cream is an effective alternative to conventional usage of whole-body topical application of permethrin. The method was supplemented with health education, raising awareness of scabies, encouraging healthy lifestyle, and proper cleaning protocol of the person and belongings including their immediate and shared environment.

The study showed an excellent CR with less discomfort and less drug usage. This reduces the economic cost burden and risk of side effects of permethrin. On a massive scale, this method would allow public health policies to be implemented at a cheaper cost while providing similar benefits of scabies eradication. This is important as permethrin is one of the more expensive pharmacologic agents, despite having an excellent CR (Roos et al., 2001).

We showed that topical lesion site-only application provides an excellent CR of 94.7% at week 8 compared with the conventional whole-body topical application of permethrin. Our result also showed certain regions that show better treatment response, such as the umbilicus and areola, achieving a 100% CR at week 4. Other sites such as the wrists, elbow, gluteus, and testis achieved a CR >90% at week 4. The limbs and areas prone to sweat, such as the axilla, achieve a much lower CR <90% at week 4. The frequent use of limbs for ablution leads to the removal of permethrin, thus affecting the CR of the drug. Nevertheless, these

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regions showed a considerable lesion CR following two topical applications of permethrin at the lesion site alone.

Scabies treatment is evaluated at week 4, 4 weeks following treatment. Screening was also performed on those around them. New lesions or clinical manifestations should be treated as signs and symptoms should be managed accordingly. Treatment failure should be considered if the signs and symptoms, especially itching, do not improve by 14 days. The main reasons for treatment failure include improper instruction and method of the usage of the scabicide cream, usage of topical steroids during treatment duration, and/or mite resistance to the drug. Lowered immune response may cause decreased inflammatory response and treatment failure (Abdel et al., 2016).

3.3. Health education on scabies for health cadres

The study also gave a short interactive health awareness education campaign, outlining the general knowledge of healthy lifestyle, on how to maintain personal hygiene. An ideal knowledge package would contain the disease entity, signs and symptoms, management, and prevention. Before and after the education session, a test was given and recorded. The top 23 students were appointed as scabies health cadres based on their post-test grades and their performance at the *pesantren*.

The results of their pre- and post-test were analyzed. Of 23 health cadres assessed on the pretest, 13 achieved good, 9 achieved mediocre, and only 1 had low grades (Table 4). On the post-test, the number of health cadres who achieved good results increased to 20, whereas the rest (3) achieved moderate results. The enrolment of health cadres is expected to help in the maintenance of hygiene, detection of scabies signs and symptoms, ensuring proper use of the permethrin cream, monitoring of side effects, and prevention of recurrence.

Table 4. Results of the health education on scabies for health cadres

Test	Level of knowledge		
	Low	Moderate	Good
Pretest	1 (4%)	9 (39%)	13 (57%)
Post-test	0 (0%)	3 (13%)	20 (87%)

The successful control of scabies in the boarding school was not solely attributed to pharmacologic intervention but to the changes in the knowledge and awareness of scabies,

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proper personal hygiene, cleaning methods, and implementation of healthy lifestyles. We showed that topical lesion site-only application of permethrin provides an excellent CR when supplemented with these changes in behavior. These ensure better supervision and awareness for the participants, as they understood how to maintain hygiene and proper cleaning and why they are important in scabies eradication. Empowering the participants will allow them to become better at identifying suspicion of scabies. The supervisors will also ensure proper cleaning of environmental factors, including living spaces and communal areas. These will help in reducing the reinfestation rate.

Mass curative effort should be made together with mass cleaning of the environment, including sleeping quarters, bedding, and other furniture. These inanimate objects are best to be placed under the sun, with sufficient ventilation, to promote environmental hygiene. Essentially, failure to treat furniture and mattresses confers a higher risk of treatment failure (Aussy et al., 2019). Scabies eradication should be coordinated with the local health authorities, including primary health centers and local health offices (Sungkar, 2016).

Routine, standardized screening for scabies should be emphasized in crowded living spaces. For boarding schools that allow an extended duration of going back home, screening for scabies and other infectious disease is necessary upon coming back before entering the premises to minimize the risk of recurrence and spread. This screening should allow clinicians to inspect underneath clothing. To increase adherence and compliance, authoritative figures and religious leaders in boarding schools should be involved, as their support is the key to the elimination of scabies.

3.4. Local culture and their effect on the study

As our study is based on an Islamic male-only boarding school, we rely heavily on the school's administrative and religious leaders to improve cooperation among the students. This ensures smooth arrangement of curative efforts, environment cleaning, and educational activities.

3.4.1. Establishment and local culture

Pesantren is a boarding school with an educational focus on religious studies. Students of *pesantren* are called *santri*. Indonesia has one of the largest Islamic populations in the world with over 16,000 *pesantren* all over the country. Most of these *pesantren* are placed in rural areas. The teaching activities were mostly performed in the local mosque, imperial halls, or houses of religious leaders. The *santri* are usually divided to groups of approximately 50

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students, taught by a religious leader (*kyai*). In the beginning, *santri* were expected to stay around close to the *kyai* in a small cottage, containing 2–3 persons each to maximize religious teaching activities and allow students to observe and mimic the daily behaviors of the *kyai*. Following the increase in interest of the locals, religious leaders then developed a larger school; thus, more *santri* were enrolled. The largest *pesantren* is *pesantren Lirboyo* in Kediri, East Java, with over 10,000 *santri* (Syauqi, 2014).

3.4.2. Local customs, habits, and beliefs

In the daily living of the *santri* within the *pesantren*, they frequently sleep together in a room, and they share their belongings with their friends including clothing and towels. This sharing attitude also denotes their character, personality, solidarity, and tolerance. However, these acts facilitate the spread and transmission of scabies. Some common misconception then arises from these *santri* that having scabies is equivalent to receiving recognition that the *santri* is qualified to take on higher classes within the holistic education in the *pesantren*. In fact, the misconception was then further amplified when a few of the religious leaders stated that itching in the *pesantren* means the *santri* has fully integrated the way of living in the *pesantren* and that he/she will experience improvement in receiving the teaching in the *pesantren.* Some even consider having scabies, or more commonly called as *kudis*, a blessing.

Socially and psychologically, when a *santri* has experienced or is infected with scabies, the *santri* exhibited a certain level of social connection and closeness to other *santri.* Interpersonal relation and/or intergroup relationship and closeness signify a certain level of comfort in socializing, which is beneficial to the learning process. Psychologically, a new *santri* that suffer from scabies will be trained to be patient in dealing with his/her disease and shows a certain level of maturity and independence in solving his/her problem and exhibits self-assessment/awareness of personal hygiene. In the book of Tasawuf, blessing is defined as an increase in the goodness of all things. Prophet Muhammad SAW preached "*Yang disebut kaya bukanlah kaya harta, kekayaan sebenarnya adalah kekayaan hati."* This motto is very much emphasized in *pesantren*; thus, the *santri* believed that blessing is of utmost importance. Blessing can be conceptualized as the numerous benefits that keep increasing every day together with a feeling of gratefulness for one's situation. The simple daily living experienced by the *santri* enhanced the perception that everything gained in the *pesantren* is a blessing, a good thing, or a good learning process, including scabies. This contradicts the notion that a disease should not be taken as a blessing. The question then arises: is it true that a *santri* must experience scabies? Is scabies a good learning process that led to the gift of

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knowledge? With the improvement of science and technology, maintenance of good and hygienic *pesantren* should be very feasible compared with the past; thus, the old notions of scabies as a form of recognition should be abolished. *Pesantren* as a school and a community should be free from scabies. Personal and environmental hygiene should be kept and maintained.

3.4.3. Tapping into beliefs to induce habitual changes

Scabies affects the patient's quality of life (Menaldi et al., 2021). Thus, as previously stated, we tried to incorporate a multi-pronged approach to tackling scabies. We believe that the ultimate goals of scabies eradication should lie in the changes in habits and lifestyle, health awareness, environmental cleaning, and cooperative effort rather than a simple pharmacological intervention. Since the study was conducted in an Islamic boarding school, we utilized local customs, including religious texts, related to hygiene and health. Essentially, the Prophet Muhammad SAW in the Islamic religion established multiple statements regarding hygiene. He encouraged good personal hygiene and the environment. His statements were:

1. Verily Allah is Pure and loves purity, Clean and loves cleanliness, Noble and loves nobility, Generous and loves generosity. So, keep your courtyards [of your homes] clean, and do not resemble the Jews (Sunan Tirmidhi).
2. Whoever wears clothes, should be clean. (Ath-Thahawi).
3. O Abu Huraira, cut (shorten) yout nails (Ahmad).

The local saying is that hygiene is a part of faith, which means that one's belief or faith will not be complete without the ability to maintain hygiene. Thus, one's inability to maintain hygiene is a defect or a flaw of his/her faith. Maintaining hygiene is the practice of ablution, and this was stated in the Al-Qur'an Surah Al-Ma'idah verse 6 (5:6 Quran):

> "… Believers! When you stand up for Prayer wash your faces and your hands up to the elbows, and wipe your heads, and wash your feet up to the ankles …"

Ablution is the act of cleaning up oneself and an act of purification before participating in religious activities. The act of absolution involved the washing of both palms with water while scrubbing the interdigital spaces, followed by gurgling, and washing of the face, both hands and arms up to the elbow, head, and finally the legs. This act is performed before religious activities, including *sholah*, or daily prayer. A Muslim is tasked with performing

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five daily prayers; since ablution is required before each session, he/she has to perform absolution five times daily. Scabies mite lives in the stratum corneum but can emerge from it and move on the skin surface. If one performs five absolutions daily and shower/baths twice daily, performed correctly, the probability of the mite getting washed away is enormous. One of the typical cardinal symptoms of scabies is nocturnal pruritus. This elicits a scratching response, especially when the patients are asleep. The act of scratching transfers the mites from one place to another. Thus, hand washing is required in the morning upon waking up. Similarly, absolutions before morning prayers might confer similar protection to hand washing after waking up. If *santri* performed their hygienic practice, it would reduce their chance of getting scabies. We reminded and encouraged hygiene practices as stated by the local religion. According to the Al-Qur'an and *hadits*, Islam as a religion that teaches hygiene, and if the students follow the teachings, the risk of getting diseases is reduced. Thus, the *santri* and management staff of the *pesantren* must be reminded of the importance of maintaining hygiene according to their Islamic practice.

The article shows that proper cleaning of the environment and personal belongings, discouraging sharing of personal belongings, and maintaining personal hygiene combined with proper monitoring, could prevent reinfestation in overcrowded areas following mass, simultaneous pharmacologic intervention. The approaches to encourage changes in daily habits should be reinforced with consideration of local customs and beliefs.

4. Conclusion

This novel application of 5% permethrin cream on the lesion site alone is an effective alternative to the conventional whole-body topical application. The CR ranges from 83% to 100% on week 4 and from 95% to 100% of lesions on week 8. The CR on week 8 was 94.7% compared with baseline ($p < 0.001$). A multi-pronged approach to scabies eradication lies in promoting health awareness, hygiene practices, and mass simultaneous eradication. The involvement of health cadres (non-medical personnel) contributes to the significant result.

Despite the great success in the elimination of scabies in boarding schools, we believe that one of the major limitations of this study is the inability to enforce attendance on study visits, thus leading to dropouts. Furthermore, we could not trace scabies to the families of the said students, as they are allowed to go home to their families on certain days. We could not be sure that their family members are not infested with scabies and thus may lead to reinfestation. As mites are mobile, a single source of transmission may lead to reinfestation of the whole boarding school. Finally, while we proved that lesion site-only application of

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permethrin cream is effective, a larger non-inferiority trial is required to achieve statistical power to warrant changes in the current literature.

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Declaration of Conflicting Interest

There is no conflict of interest in this manuscript. The study proposal has been assessed, reviewed, and has received ethical clearance from the ethics committee in the Faculty of Medicine Universitas Indonesia with clearance number: 0855/UN2.F1/ETIK/2018.

Author Contribution

Saleha Sungkar: conceptualization, methodology, funding, and data curation; Aria Kekalih: methodology, software; Sri Wahdini, Risa Rilanda, Hansen Angkasa: validation, software, writing and original draft preparation, and formal analysis; Sandra Widaty: writing and review & editing.

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