Comparison of videomicroscope and dermoscopy examination in detecting *Sarcoptes scabiei*

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Abstract. A non-invasive method of examination, dermoscopy (DS) can be used to detect *Sarcoptes scabiei*, but needs special training and expensive. Videomicroscope (VM) is able to visualize burrow, mites and eggs, so prompt treatment can be given. The aim of the study is to compare VM and DS, confirmed by skin scraping microscopic examination as standard diagnostic. The method was analytic observational study comparing VM and DS in 210 presumptive scabies patients in Palembang municipal orphanage. By consecutive sampling, 139 patients were included, 73 (52.5%) were men, 66 (47.5%) were women. Majority age were 11-20 years: 85 (61.2%) and 5-11 years: 44 (31.7%). The most common locations were interdigital manus/pedis 125 (89.9%), dorsum manus/pedis 106 (76.6%), wrist joint 102 (73.4%). VM’s sensitivity 92%, specificity 88%, accuracy 91%, positive predictive value (PPV) 96%, negative predictive value (NPV) 79%, area under curve (AUC) 90.3%. DS’ sensitivity 85%, specificity 71%, accuracy 81%, PPV 90%, NPV 60%, AUC 77.7%. There is a significant difference in specificity, accuracy and AUC, specificity of VM 88% and DS 71%, p = 0.0007 < 0.05, accuracy value of VM 91%, DS 81%, with p = 0.0257 < p = 0.05; AUC of VM examination 90.3%, DS 77.7%, p = 0.0069 < p = 0.05. There was a significant difference between VM and DS examination with Z=2.23 p = 0.0257 (Z>1.96). VM is better than DS, VM can be used as a diagnostic method especially at primary health service, a rapid mass screening and for evaluation of post-therapeutic follow up of scabies in epidemic area.

1. Introduction

Scabies is a very contagious parasitic infestation disease in human skin caused by *Sarcoptes scabiei var hominis*. Tropical developing countries such as Indonesia, especially in densely populated areas with low socioeconomic conditions often suffer from scabies outbreaks. It is necessary to establish a diagnosis as early as possible to manage outbreaks, to prevent morbidity that significantly constitute to the economic burden [1,2]. According to the clinical practice guidelines of Indonesian Society of Dermatology and Venereology or ISDV and to the other countries guideline such as England and France, standard diagnostic tool for scabies is microscopic examination with skin scrapings (SS) sampling, to identify *S. scabiei* mite [3]. The limitation of this technique is that it needs to be done repeatedly, causes discomfort especially in children and sensitive patients, risk of infection, bleeding, relatively time consuming, requires a special room, and well-experienced examiner [4,5].

A non-invasive method, dermoscopy (DS) is used in the detection of pigmented lesions, is proven to be able to detect *S. scabiei* mite, but DS is quite expensive and requires special training and experience, so it is not suitable for primary health care epidemic areas affected by outbreaks [6,7].
Currently, there is videomicroscope (VM) a non-invasive method that do not require special training, affordable, simple, faster and more accurate in detecting \textit{S Scabiei}. Videomicroscope is a digital microscope connected to a computer with magnification up to 1000x [8,9]. Clinical study by Larurubba (2015) compared VM with videodermoscopy (VD) in detecting 15 of 20 presumptive scabies patients that are confirmed by skin scraping microscopic examination, with the findings of \textit{S scabiei} mites in 15 patients in less than 10 minute [7,8].

The objective of this study is to compare VM and DS examination in detecting \textit{S scabiei}, with confirmation of SS microscopic examination as a gold standard. Benefit of this study is VM can be used as a diagnostic tool in epidemic areas and infected with scabies outbreak, especially in developing countries.

2. Methods

This was an observational analytic study with diagnostic test design comparing VM and DS in 210 presumptive scabies patients by consecutive sampling, the following examination were done including history taking (chief complaint, additional complaints, history of present illness, past medical history); physical examination (general status, specific condition and primary lesions); and diagnostic procedures (SS microscopic, DS and VM examination). Patients were excluded if they received scabies treatment in the prior 4 weeks. The research was conducted on the residents of orphanage and street children institution of municipality of Palembang, 139 presumptive scabies patients who met the inclusion criteria were included. Patients or guardians who consented to follow this study had signed informed consent. In this study, dermoscopy (DS) examination was done using handheld microscope based on transillumination principle with optical magnification up to 10x. Second examination was using videomicroscope (VM), a digital microscope with magnification up to 1000x, which connected to the computer. This tool used LED light to transilluminate to the superficial dermis. Diagnosis of scabies was established by finding a "jetliner with trail" structure of brown triangular head and legs of \textit{S scabiei} mites, burrows, eggs and feces. Lastly, the diagnosis was confirmed by SS microscopic examination, by taking samples from the previous lesion confirmed with VM, using sharp blade, then the sample was attached to object glass that had been dripped in 10% KOH solution and examined with a light microscope using a 10x ocular lens and 10-40x objective lens. The result was positive if there were \textit{S scabiei} mites and eggs detected.

3. Results

In this study, the characteristic of patients according to age, sex, education, duration of disease, and location of lesions showed on table 1. Characteristics of patients with scabies are summarized in table 1 (n = 139). There were 73 male (52.5%) and 66 female (47.5%) subjects. The age ranged between 2 months to 36 years, consisted of 5 groups, the most common age was the adolescents (11-20 years) 85 subjects (61.2%), followed by children (5-11 years) 44 subjects (31.7%), < 5 years 5 subjects (3.6%), 21-30 years 3 subjects (2.1%) and 31-40 years 2 subjects (1.4%). There were 4 groups of educational level: no school/not yet attending school 17 subjects (12.2%), primary school 40 subjects (28.8%), junior high school 52 subjects (37.4%), senior high school 30 subjects (21.6%). Duration of lesion was < 1 month in 45 subjects (32.4%), 1-6 months in 84 subjects (60.4%) and > 6 months in 10 subjects (7.2%). The site of predilection was varied, 125 subjects (89.9%) in interdigital manus/pedis, 106 (76.3%) subjects in the dorsum manus/pedis, 102 subjects (73.4%) in wrist joint, 44 subjects (31.7%) in flexor of superior/inferior extremity, 44 subjects (31.7%) in inguinal/genitalia, 29 subjects (20.9%) in gluteus, 28 subjects (20.1%) in abdomen, 9 subjects (6.5%) in antebrahanii.

In VM examination, \textit{S scabiei} was detected in 101 subjects (72.7%), negative in 38 subjects (27.3%). In DS examination, \textit{S scabiei} was detected in 99 subjects (71.2%), negative in 40 subjects (28.8%). In SS microscopic examination, \textit{S scabiei} was detected in 105 subjects (75.5%), negative in 34 subjects (24.5%). The distribution frequency of \textit{S scabiei} are described in table 2.

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Table 1. Characteristics of the study subjects.

| Variable                  | Total (n) | Percentage (%) |
|---------------------------|-----------|----------------|
| 1. Gender                 |           |                |
| Male                      | 73        | 52.5           |
| Female                    | 66        | 47.5           |
| 2. Age                    |           |                |
| < 5 year                  | 5         | 3.6            |
| 5 – 11 years              | 44        | 31.7           |
| 11 – 20 years             | 85        | 61.2           |
| 21 – 30 years             | 3         | 2.1            |
| 31 – 40 years             | 2         | 1.4            |
| 3. Education              |           |                |
| None                      | 17        | 12.2           |
| Primary school            | 40        | 28.8           |
| Junior high school        | 52        | 37.4           |
| Senior high school        | 30        | 21.6           |
| 4. Duration               |           |                |
| Duration < 1 month        | 45        | 32.4           |
| Duration 1 – 6 months     | 84        | 60.4           |
| Duration > 6 months       | 10        | 7.2            |
| 5. Location of the lesion |           |                |
| Interdigital manus/pedis  | 125       | 89.9           |
| Dorsum manus/pedis        | 106       | 76.3           |
| Wrist joint               | 102       | 73.4           |
| Flexor of superior/inferior extremity | 44 | 31.7 | 44 | 31.7 |
| Inguinal/genitalia        | 29        | 20.9           |
| Gluteus                   | 28        | 20.1           |
| Abdomen                   | 9         | 6.5            |

Table 2. Distribution frequency of *S. scabiei* detected using VM, DS, SS.

| Frequency *S. scabiei* | VM | DS | SS |
|------------------------|----|----|----|
| n                      |    |    |    |
| Positive               | 101| 99 | 105|
| Negative               | 38 | 40 | 34 |

| Total                  | 139| 139| 139|
| Percentage (%)         | 100.0| 100.0| 100.0|

In VM examination (n = 101), there were 96% (97/101) true positive, 4% (4/101) false positive. There were 96% (97/105) subjects in SS microscopic examination (n = 105) who were confirmed positive; 21.1% (8/38) were false positive, which are greater than VM examination’s false positive. The statistical test showed that there is a correlation between VM with SS microscopic examination with p value = 0.000 (p < α 0.05). True positive in DS examination were 89.9% (89/99), false positive in 10.1% (10/99); in SS microscopic examination, 89.9% (89/105) was true positive; 40% (16/40) false positive which are greater than false positive in DS. The statistical test showed that there is relationship between DS with SS microscopic examination, p value = 0.000 (p < α 0.05). The 2x2 table results of VM and DS with SS is presented in table 3.
Table 3. 2x2 table of VM and DS with SS microscopic examination.

|          | VM Microscopic | Total n (%) | DS Microscopic | Total n (%) |
|----------|----------------|-------------|----------------|-------------|
| Positive | n (%)          | n (%)       | n (%)          | n (%)       |
| Positive | 97 (96%)       | 4 (4%)       | 101 (100%)     | 89 (89.9%)  |
| Negative | 8 (21.1%)      | 30 (78.9%)   | 38 (100%)      | 16 (40%)    |
| Total    | 105 (75.5%)    | 34 (24.5%)   | 139 (100%)     | 105 (75.5%) |

From the Kappa test between two VM examiners, that was processed with SPSS software version 18.0 (Medcalc Software, Belgium), obtained kappa value 0.86. The result indicates that the degree of agreement among researcher and observer was very good (0.81-1.00). The kappa value of examiners is shown on table 4.

Table 4. Kappa value between VM researcher and observer.

| VM          | Total (n) | p value | Kappa Value |
|-------------|-----------|---------|-------------|
| VM 1 (Researcher) | 139     | 0.000   | 0.864       |
| VM 2 (Observer)     | 139     |         |             |

Table 5 presents the comparison of diagnostic values of VM and DS with SS microscopic examination as a gold standard. For VM, obtained 92% sensitivity (Sn), 88% specificity (Sp), 91% accuracy, 96% positive predictive value (PPV), 79% negative predictive value (NPV) and 90.3% area under curve (AUC). For DS, the results are 85% Sn, 71% Sp, 90% PPV, 60% NPV, 81% accuracy and 77.7% AUC. There was no significant difference in sensitivity between VM (92%) and DS (85%) with p 0.1007 > 0.05. There was a significant difference in specificity, accuracy and AUC value, specificity of VM 88% and DS examination 71%, with p 0.0007 < p 0.05; accuracy value of VM (91%), DS (81%), with p 0.0257 < p 0.05; the AUC value between VM (90.3%), DS (77.7%) with p 0.0069 p<0.05. In this table also seen Z test value of 2.23 with p 0.0257, this analysis showed there was a significant difference between the VM and DS (Z > 1.96). Statistical analysis showed no significant difference between VM and DS examination with Z test value of 2.23 (p 0.0257). This result shows that VM is better than DS examination (Z test score 2.23) The diagnostic value results were shown in table 5.

4. Discussions
Scabies is a parasitic infestation disease of the skin caused by S scabiei, highly contagious, transmitted either through direct or indirect contact, affecting all sex, ethnic and socioeconomic strata. The most common education level of the study subjects were Junior High School (37.4%) and Primary school (28.8%) (table 1). In Indonesia especially in Palembang, Yahya's (2016) study of elementary school children in slum areas with low socioeconomic proven scabies has a correlation with streptococcus and staphylococcus infections that increased the morbidity [10]. There is a need for scabies diagnostic tool that is easy to use, rapid, accurate, without needing special room, with affordable examination fee and can be done by all health workers.
According to ISDV clinical practice guidelines and to the guidelines from other western countries (France, UK), skin scraping (SS) microscopic examination, still a standard method for detection of *S. scabiei* [3,6,11]. This examination method is very specific, but has disadvantages of causing pain with risk for bleeding and bacterial infections, it also can not be done for mass examination in epidemic areas infected with outbreaks. Besides, the sensitivity varies depending on the technique and location of skin scraping sampling [5,12]. In this study, *S. scabiei* detected with VM, DS and SS microscopic examination obtained in 101 subjects (72.1%), 99 subjects (71.2%) and 105 subjects (75.1%), respectively. From the statistical analysis, these three diagnostic supporting tools are equally good in detecting *S. scabiei* mites and eggs (p 0.0000) (table 2). According to Golant, these three methods of examination can be used as diagnostic supporting tools, but SS microscopic examination needs skill and experience, mite retrieval can only be taken on a typical skin lesion, on a burrow/canaliculi or papule at the end of the burrow, and it need to be done in a special room. DS examination needs to be done by trained people, it needs skill and experience in finding "trail & jail", and the price is quite expensive [13].

Table 5. Diagnostic values of VM and DS.

| Diagnostic Values | VM   | DS   | *p* value | Z test | Significance |
|-------------------|------|------|-----------|--------|--------------|
| Sensitivity       | 92%  | 85%  | 0.1007    | 1.64   | Not significant |
| Specificity       | 88%  | 71%  | 0.0007    | 3.36   | Significant   |
| Accuracy          | 91%  | 81%  | 0.0257    | 2.23   | Significant   |
| PPV               | 96%  | 90%  | 0.0844    | 1.73   | Not significant |
| NPV               | 79%  | 60%  | 0.0009    | 3.31   | Significant   |
| Likelihood Ratio +| 7.85 | 2.88 | -         | -      | -            |
| Likelihood Ratio -| 0.086| 0.22 | -         | -      | -            |
| Likelihood Ratio test | 91.27 | 13.09 | -         | -      | -            |
| AUC               | 90.3%| 77.7%| 0.0069    | 2.70   | Significant   |

Videomicroscope (VM) is a non-medical digital microscope, commonly used in entomology, botanical and microelectronics, whose magnification can be adjusted on the handpiece. The size of VM handpiece is small, 14.2 cm in length, 3.8 cm in diameter and 90 g weight. The inspection field can be adjusted according to magnification, for example 30x magnification will obtain a field of view of 13.6 mm and 200x magnification will obtain a 2 mm view field [14]. Videomicroscope examination was done by connecting it to the computer using USB cable data, to display image and store the data, at a very affordable price of $30 (Rp 1 million). VM is a non-invasive method, well-tolerated, especially child or patients who are very sensitive, and time-efficient for it only takes less than 10 minutes in detecting *S. scabiei* mites, eggs, and specific, the patient can directly see the movement and image of *S. scabiei* mite, so false positive can be ignored. Examination with VM makes patients are more compliant to treatment [9].

In Ferdinand’s study in Palembang, Indonesia, the sensitivity and specificity of SS microscopic examination are 43.2% and 75%, respectively [15]. It may cause scabies diagnosis is made only by clinical symptoms. As it is difficult to find *S. scabiei* mites, inaccurate diagnosis may be made, causing an improper or delayed treatment, which may result in outbreak and potential endemic. In contrast, this study shows 92% Sn and 88% Sp of VM (table 5). In Western countries, in nursing homes or, schools, prisons and in developing countries, primarily tropical and sub-tropical climates with densely populated areas such as orphanages, low incomes, increasing outbreaks of scabies, the use of VM at an affordable price has significant impact in the treatment of this scabies [7]. This study
proves that VM examination can be done in the densely populated residential community such as orphanage, boarding school, so it can be used for mass diagnostic tool and as post-treatment evaluation, from this research can be concluded the use of VM is absolutely necessary especially in epidemic areas, densely populated, infected with epidemics of scabies. The value 92% Sn of VM (table 5) indicated the ability of VM to detect S scabiei mite by 92% and there was still no chance of finding S scabiei mite at 8%. VM's specificity value indicated that VM could identify non-scabies patients by 88%, so the probability of non-scabies patients diagnosed with scabies is only 12%. Juhendy (2017) found in 139 presumptive scabies patients of VM compared with SS microscopic examination had 89.9% Sn, 82.9 Sp, 83.8% PPV, 89.2% NPV, 5.25% positive likelihood ratio (PLR), 0.12% negative likelihood ratio (NLR), 86.3% accuracy and 0.864 AUC [16]. The results of this study are better and more reliable compared to Juhendy's research.

The kappa test of VM examination in this study was 0.86 (table 4), shows that the degree of agreement between researcher and examiner is very good. The result is supported by Micali's study, VM can be used as a reliable diagnostic support similar to videodermoscopy (VD) examination. In the previous study comparing VD and VM examination and confirmed by SS microscopic examination in 20 presumptive scabies patients, the canaliculi, mites, eggs can be seen in 15 patients with both VD and VM by three dermatologist who did the examination with identical result in less than 10 minutes. Five presumptive scabies patients who was negative finding in S scabiei and eggs using VD and VM, further confirmed by SS microscopic examination [8]. However, VD shows a clearer picture of canaliculi, mites and eggs, because the VD is specially designed, priced over $25,000 (Rp 350 millions), which is much more expensive than VM [7].

The statistical test results show that there is a correlation between DS with SS microscopic examination, p value = 0.000 (p < a 0.05). Many study before obtained by examining the DS image of the mite appear as a small dark brown triangular structure such as the "jetliner & trail" image located at the end of the canaliculi as an unstructured twisty white line, whereas with SS microscopic examination mite appears as a dark brown triangle corresponding to the anterior portion pigmented from mites (ie, the mouth and two pairs of anterior legs), while the posterior part including the abdomen and hind legs are transparent, which is not visible by DS examination, whereas the canal could not be seen by SS microscopic examination, so SS microscopic examination often not found S scabiei [17,18]. Table 5 also shown the 85% Sn, 71% Sp, accuracy 81% and 77% AUC of DS. Zalaudek study comparing DS with SS microscopic examination showed DS had higher sensitivity which is 91% compared to 90% SS microscopic examination, according to this study DS examination improves diagnostic ability of inexperienced practitioners [19].

This study proves that there is no significant difference of sensitivity between VM and DS examination p = 0.1007. In accordance with previous research, the comparison of VM and VD examinations can be well tolerated, and both devices are equally good and optimal in viewing specific features of the canaliculi, S scabiei mites, eggs and the time required to perform the examination less than 10 minutes, but VD is slightly better in viewing these specific images (canaliculi, S scabiei mite, egg [8]. Previously prospective, non-randomized, double blind study comparing DS with SS microscopic examination in 238 presumptive scabies patient DS 91% Sn, SS 90% Sn, and DS 86% Sp compared to SS microscopic 100% Sp. But there is a significant difference between trained and untrained examiners. Unskilled and inexperienced examiners are difficult to distinguish between "jetliner with trail" with artifacts of blood clot due to scratching of patients, resulting in bleeding, crusting, excoriations and signs for post-inflammatory [9]. Arnyi’s study indicated that non-contact DS can be used as screening examination method, but DS need special training and experience in detecting S scabiei mites [20]. Walter’s study and according to some DS experts with low magnification is hard to assess the presence of S scabiei mites, eggs or feces as diagnostic guidance, especially in colored or dark-skinned and hairy patients, "jetliner with trail" signs are almost invisible, patients were often embarrassed when the examination is done in the area around the genital and buttocks due to close contact between the examiner and the area of the lesion examined. Some expert advised DS to be only used where VD facilities are not available or for screening in suspected cases of scabies prior to SS microscopic examination. Further research needed to compare between VM and VD examination as diagnostic tool of scabies [1,9,21].
In this study can be concluded VM examination as diagnostic tool to detect mites better than DS especially examination in area infected by outbreak of scabies like orphanage, nursing homes, dormitories, and endemic areas, it also can be used for post-therapeutic follow up because observations can be repeated and direct viewing by the patient through the computer, make the patient more compliant for treatment. VM is a non-invasive, rapid, more practical, diagnostic tool of scabies with high specificity and accuracy, so it can be used as a rapid diagnostic tool for rapid screening of the epidemic with an outbreak of scabies also can be used as a tool for evaluation in post-therapeutic follow up.

This study had some limitations, it did not classify clinical manifestations of disease based on the degree of severity, the sample size was not large enough and heterogeneous, and was conducted in the summer period where the scabies was not in an outbreak condition so that positive results were found in the mite of this study was low.

5. Conclusions
In conclusion, videomicroscope (VM) and DS have diagnostic values with high accuracy and excellent interoperability between examiners, but VM better than DS examination in area infected by outbreak of scabies like orphanage, nursing homes, dormitories, and endemic areas, it also can be used for post-therapeutic follow up.

6. References
[1] Walton S F and Currie B J 2007 Problems in diagnosing scabies, a global disease in human and animal populations Clin. Microbiol. Rev. 20 268–79
[2] Monsel G, Delaunay P and Chosidow O 2016 Rook’s textbook of Dermatology ed G Monsel, P Delaunay and O Chosidow (West Sussex: Wiley Blackwell)
[3] Perhimpunan Dokter Spesialis Kulit dan Kelamin Indonesia I 2017 Panduan Praktik Klinis Perdosisi (Jakarta)
[4] Buckhart, Buckhart and Morell 2012 Dermatology ed J L Bologna, J V Schaffer and L Cerroni (Edinburgh: Mosby)
[5] Hengge U R, Currie B J, Jäger G, Lupi O and Schwartz R A 2006 Scabies: a ubiquitous neglected skin disease Lancet Infect. Dis. 6 769–79
[6] Leung V and Miller M 2011 Detection of scabies: A systematic review of diagnostic methods. Can. J. Infect. Dis. Med. Microbiol. 22 143–6
[7] Micali G, Lacarrubba F, Verzi A and Nasca M 2015 Low-cost equipment for diagnosis and management of endemic scabies outbreaks in underserved populations Clin Infect Dis 60 327–9
[8] Micali G, Lacarrubba F and Verzi A 2015 A controlled, dermatologist independently assessed, noninferiority clinical trial of high resolution medically marketed videodermatoscopy versus low cost nonmedical videomicroscopy for the diagnosis of scabies J. Am. Acad. Dermatol. 72 AB123
[9] Micali G, Lacarrubba F, Verzi A E, Chosidow O and Schwartz R A 2016 Scabies: Advances in Noninvasive Diagnosis PLoS Negl. Trop. Dis. 10 1–10
[10] Romani L, Steer A C, Whitfeld M J and Kaldor J M 2015 Prevalence of scabies and impetigo worldwide: A systematic review Lancet Infect. Dis. 15 960–7
[11] Dupuy A, Dehen L, Bourrat E, Lacroix C, Benderdouche M, Dubertret L, Morel P, Feuilhade de Chauvin M and Petit A 2007 Accuracy of standard dermoscopy for diagnosing scabies J. Am. Acad. Dermatol. 56 53–62
[12] Chosidow O and Ph D 2006 Scabies N Engl J Med 354 1719
[13] Golant A K and Levitt J O 2012 Scabies: A Review of Diagnosis and Management Based on Mite Biology Pediatr. Rev. 33 e1–12
[14] Micali G, Lacarrubba F, Verzi A E and Nasca M R 2015 Low-cost equipment for diagnosis and management of endemic scabies outbreaks in underserved populations Clin. Infect. Dis. 60 327–9
[15] Ferdinan, Thaha M, Rusmawardhiana R and Tjekyan R 2012 Nilai diagnostik skin surface...
biopsy pada skabies di RSUP Dr. Muhammad Hoesin Palembang (Universitas Sriwijaya Palembang)
[16] Juhendy M, Yahya Y and Aryani I 2018 _diagnostik skin surface biopsy pada skabies di RSUP Dr. Muhammad Hoesin Palembang_ (Surabaya)
[17] Argenziano G and Fabbrocini G 2015 _No Title_ 2–4
[18] Park J H, Kim C W and Kim S S 2012 _The diagnostic accuracy of dermoscopy for scabies_ _Ann. Dermatol._ **24** 194–9
[19] Zalaudek I, Giacomel J, Cabo H, Di Stefani A, Ferrara G, Hofmann-Wellenhof R, Malvehy J, Puig S, Stolz W and Argenziano G 2007 Entodermoscopy: A new tool for diagnosing skin infections and infestations _Dermatology_ **216** 14–23
[20] Aryani I, Yahya Y, Zulkarnain M and Ramdja M 2011 _Keandalan pemeriksaan dermaskopik non kontak dibanding pemeriksaan mikroskopik dengan oriented scraping untuk mendeteksi Sarcoptes scabiei_ (Universitas Sriwijaya, Palembang)
[21] Walter B, Heukelbach J, Fengler G, Worth C, Hengge U and Feldmeier H 2011 _Comparison of dermoscopy, skin scraping, and the adhesive tape test for the diagnosis of scabies in a resource-poor setting_ _Arch. Dermatol._ **147** 468–73

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