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Characterization of Dermatophyte Fungi Causing Tinea pedis in Fishermen of Karang Serang Village, Tangerang Regency

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Abstract

Fishermen are individuals whose primary occupation is catching fish at sea and are at a high risk of experiencing various health disorders. One such risk is infections caused by dermatophytic fungi. A common example of this infection is tinea pedis, which typically appears between the toes or on the soles of the feet. Fishing is considered a high-risk occupation for developing dermatophytosis. One preventive measure against tinea pedis is maintaining good personal hygiene. This study aimed to determine the presence of dermatophytic fungi on the feet of fishermen in Karang Serang Village, Tangerang Regency, and to identify the specific fungal species involved. This study employed a cross-sectional descriptive design, conducted at the Parasitology Laboratory of Poltekkes Banten. A total of 46 foot swab samples were collected from fishermen using purposive sampling, with inclusion criteria including fishermen exhibiting skin disorders, practicing personal hygiene, and voluntarily participating. Samples were inoculated onto Potato Dextrose Agar (PDA) supplemented with chloramphenicol to inhibit bacterial growth. Fungal isolates were identified through macroscopic colony morphology and microscopic examination using Lactophenol Cotton Blue (LPCB) staining. The dermatophytic fungi identified included Trichophyton rubrum (68%), Trichophyton mentagrophytes (23%), and Epidermophyton floccosum (9%). Out of 46 samples, 22 (47.8%) tested positive for dermatophytes, while the remainder showed non-dermatophytic fungi (e.g., Aspergillus, Penicillium). Chi-square analysis revealed a significant association (p=0.014) between poor personal hygiene and dermatophyte infection, underscoring the need for health interventions in this high-risk group.

Keywords: Fishermen, Dermatophytosis, *Tinea pedis*, Personal hygiene

Introduction

Indonesia is a tropical country characterized by high temperatures and humidity, providing a favorable environment for fungal growth. Consequently, fungi can be found in almost all places.[1] Dermatophytosis is a disease affecting keratinized tissues, such as the stratum corneum of the epidermis, hair, and nails, caused by dermatophytic fungi. There are three genera responsible for dermatophytosis: *Microsporum*, *Trichophyton*, and *Epidermophyton*.[2] The prevalence of dermatophytosis in Asia has been reported to be 35.6%.[3]

Tinea pedis is commonly observed in individuals who frequently wear closed shoes, have poor nail care, or work in environments where their feet are persistently or frequently wet. The condition can persist for years. One of its clinical aspects is maceration, which manifests as whitish, fragile skin. When the dead skin is removed, newly exposed skin, which is often already affected by fungi, becomes visible.[2]

Data from Indonesia's 2010 Health Profile indicate that skin and subcutaneous tissue diseases ranked third among the ten most common outpatient conditions in hospitals nationwide, with 371,673 visits and a total of 247,256 reported cases. This suggests that skin diseases remain highly prevalent in Indonesia.[4]

Fishermen are highly vulnerable to occupational diseases, primarily due to their limited knowledge of occupational health and safety. Insufficient awareness of hygiene and sanitation during fishing activities contributes to the high incidence of work-related diseases among fishermen.[5]

Personal hygiene refers to practices that maintain an individual's cleanliness and health, promoting both physical and psychological well-being.[6] Proper personal hygiene is essential, as it minimizes microbial entry points and helps prevent disease.[7]

Muhtadin and Latifah (2018)[8] examined the incidence of *Tinea pedis* in relation to the duration of employment among fishermen on Panggang Island, Seribu Islands, and North Jakarta. Among 60 samples, 13.33% (8 individuals) tested positive based on the presence of fungal elements in skin scrapings between their toes, whereas 86.66% (52 individuals) tested negative. More recently, a study by Zara and Yasir (2019) investigated dermatophytosis in the fishing community of Tanah Pasir District, North Aceh Regency, Indonesia, and found that 56% of the fishermen were affected.[9]

However, most previous studies on Tinea pedis among Indonesian fishermen have focused on

epidemiological prevalence without comprehensive identification of specific dermatophyte species involved. There is also a lack of microscopic and cultural characterization of fungi isolated from fishermen's feet, especially in West Java regions such as Tangerang. Moreover, the correlation between personal hygiene behavior and confirmed dermatophyte infection using laboratory-based methods is underexplored[10–12]

This study offers novelty by not only determining the prevalence of Tinea pedis among fishermen in Karang Serang Village, but also by identifying specific dermatophytic species using both macroscopic and microscopic criteria. Furthermore, the study evaluates the association between personal hygiene practices and infection rates, providing evidence-based insights for public health intervention at the coastal community level.

Based on previous studies and existing data, the researcher is interested in conducting a study entitled: "Identification of Dermatophytic Fungi Causing Tinea pedis Among Fishermen in Karang Serang Village, Tangerang Regency."

Materials and methods

Research Design

This study will employ a cross-sectional research design, analyzing the dynamic relationship between risk factors and health disorders or diseases.

Research Location

This study will involve sample collection from fishermen's interdigital and plantar areas in Karang Serang Village, Tangerang Regency. Sample identification will be conducted at the Mycology Laboratory, Department of Medical Laboratory Technology, Poltekkes Kemenkes Banten.

Research Time

The study will be conducted from February to March 2020.

Population

The research population consists of 137 fishermen residing in RW 006, Karang Serang Village, Tangerang Regency.

Sample

A purposive sampling method will be applied, selecting 46 fishermen from Karang Serang Village. Sample collection will involve swabbing interdigital and plantar regions suspected to be contaminated with dermatophytic fungi, which are the causative agents of *Tinea pedis*.

The inclusion criteria were fishermen residing in Karang Serang Village, Tangerang Regency, who exhibited skin disorders, practiced personal hygiene, and were willing to participate in the study.

Sample Size Formula (N Known):

$$n = \frac{N.Z^2.P(1-P)}{d^2.(N-1) + Z^2.P(1-P)}$$

Where:

- P = Estimated prevalence (0.5)
- d = Precision level (0.1)
- Z = Confidence level (90%) = 1.64
- n = Required sample size
- N = Population size = 137 fishermen

$$n = \frac{137.1.64^2.0.5(1-0.5)}{0.1^2.(137-1) + 164^2.0.5(1-0.5)}$$

The required sample size is approximately 46 fishermen.

Research Instruments

The equipment used in the study included an autoclave, Petri dishes, test tubes, dropper and Pasteur pipettes, microscope slides, watch glasses, stirring rods, Erlenmeyer flasks, graduated cylinders, microscope, sterile swabs, spatula, labels, loop needles, Bunsen burner, matches, wrapping paper, cotton, oven, hotplate, and incubator, while the materials used consisted of distilled water, 70% ethanol, Potato Dextrose Agar (PDA), Lacto Phenol Cotton Blue (LPCB), chloramphenicol, and sodium chloride (NaCl).E. Data Collection Methods

Data Collection

Primary and secondary data collection was conducted on January 30, 2020, in Karang Serang Village, Tangerang Regency, with primary data obtained through interviews and questionnaires completed by fishermen, and secondary data sourced from official village records, including fishermen population statistics from the Village Head Office; sample collection took place on February 7, 2020, during which fishermen signed an attendance sheet, completed questionnaires, had their feet cleaned with 70% ethanol, and provided samples using sterile swabs placed in NaCl-containing containers, which were then stored in cool boxes with ice gel to maintain sterility before laboratory transport.

Specimen Observation and Examination

Specimen observation and examination were conducted at the Parasitology Laboratory of Poltekkes Banten from February 7 to 15, 2020, involving sample inoculation on Potato Dextrose Agar (PDA) prepared by weighing PDA reagents with an analytical balance, heating with a hotplate and magnetic stirrer, and sterilizing with an autoclave, followed by the addition of chloramphenicol to prevent bacterial contamination, pouring the medium into Petri dishes to solidify, streaking swabbed samples using an inoculating loop, incubating them at room temperature, and observing them daily for 9 days to record macroscopic and microscopic fungal colony characteristics, with Lacto Phenol Cotton Blue (LPCB) staining used for fungal identification, positive results indicated by dermatophytic fungal growth on PDA, and findings from 46 samples verified by Dr. Hamtini, M.Si, a Mycology Lecturer at Poltekkes Banten.

Data Analysis

Research results will be presented in tables, figures, and analyzed using tabulation and the Chi-square test.

Results

Table 1. Figure microscopic and Macroscopic fungi

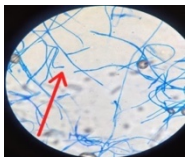
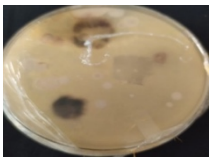
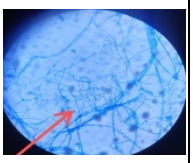
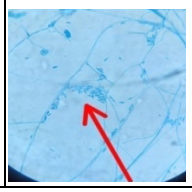
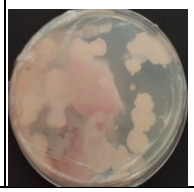
Fungi	Microscopic	Macroscopic
Epidermophyton floccosum		
Trichophyton mentagrophytes.		
Trichophyton rubrum.		

Table 2. Distribution of Dermatophytic Fungi Identified in Fishermen Respondents in Karang Serang Village, Tangerang Regency

Dermatophytic Fungi Species	Frequency	Percentage (%)
Trichophyton rubrum	15	68%
Epidermophyton floccosum	2	9%
Trichophyton mentagrophytes	5	23%
Total	**22**	**100%**

Table 2 shows the fungal colonies identified in the samples, which were observed daily for 8 days. Macroscopic characteristics such as colony shape and color, as well as microscopic features, were recorded. The dermatophytic fungi identified included *Trichophyton rubrum*, *Trichophyton mentagrophytes*, and *Epidermophyton floccosum*. A total of 21 samples were found to be positive for dermatophytic fungi.

In addition to the dermatophytes, other fungal species were also found in the 46 examined samples, including *Aspergillus flavus*, *Aspergillus fumigatus*, *Aspergillus niger*, *Penicillium*, and *Mucor*. The distribution was as follows: *Trichophyton rubrum* (15), *Trichophyton mentagrophytes* (5), *Epidermophyton floccosum* (2), *Aspergillus flavus* (4), *Aspergillus fumigatus* (15), *Aspergillus niger* (5), *Penicillium* (9), and *Mucor* (5). The most frequently isolated fungi were *Trichophyton rubrum* and *Aspergillus fumigatus*. *T. rubrum* was predominant due to its known association with *tinea pedis*, while *A. fumigatus* was likely due to environmental contamination, as it can survive in diverse habitats including air.

Table 3. Personal Hygiene Practices of Fishermen in Karang Serang Village

Personal Hygiene Category	Frequency	Percentage (%)
Poor	26	57%
Good	20	43%
Total	**46**	**100%**

Table 3 shows the personal hygiene habits of fishermen in Karang Serang Village. The most dominant figure is 57%, which means that the majority of fishermen have poor personal hygiene habits. This shows that most fishermen pay less attention to aspects of their personal hygiene, which has the potential to increase the risk of skin infections, including fungal infections, such as tinea pedis. Poor personal hygiene is an important factor that needs to be considered because it can directly affect skin health.

Table 4. Presence of Dermatophytic Fungi in Fishermen's Foot Swab Samples

Dermatophyte Result	Frequency	Percentage (%)
Positive (+)	21	46%
Negative (−)	25	54%
Total	**46**	**100%**

Table 4 shows the results of examining swab samples from fishermen's feet to detect dermatophytic fungi. The numbers detected showed that 54% of the samples were negative for dermatophyte fungi, while the other 46% were positive for the presence of these fungi. Thus, almost half of the samples collected showed the presence of dermatophyte fungi on fishermen's feet, indicating that the prevalence of this fungal infection was high in the fishing community in the village. This indicates that fungal infections, especially dermatophytes, are common and should be a public health concern in this region.

Table 5. Chi-Square Test

Chi-Square Tests

	Value	Df	Asymptotic Significance (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	6.083[a]	1	0.014		
Continuity Correction[b]	4.699	1	0.030		
Likelihood Ratio	6.281	1	0.012		
Fisher's Exact Test				.019	.014
Linear-by-Linear Association	5.951	1	0.015		
N of Valid Cases	46				

a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 9.13.
b. Computed only for a 2x2 table

Table 5 shows the results of the chi-square statistical test to determine the relationship between personal hygiene and the presence of dermatophyte fungi. A Chi-Square value of 6.083 with a p-value of 0.014 was obtained. This p-value was smaller than the significance level of 0.05, indicating a statistically significant relationship between fishermen's personal hygiene and the presence of dermatophyte fungi on their feet. In other words, poor hygiene was significantly associated with a higher likelihood of dermatophyte fungal infections. These results confirm that improving personal hygiene can be an important factor in the prevention of fungal infections in fishermen's feet and is a concern in efforts to improve the health of the fishing community in the village.

Discussion

Dermatophytosis is a fungal infection affecting keratinized tissues such as the stratum corneum of the epidermis, hair, and nails, caused by dermatophyte fungi belonging to the family *Arthrodermataceae*. More than 40 species of dermatophytes are grouped into three genera: *Trichophyton*, *Microsporum*, and *Epidermophyton*. One common manifestation of dermatophytosis is *tinea pedis*, an infection that typically affects the interdigital spaces and soles of the feet.[2] The most frequent causative agents of *Tinea pedis* are anthropophilic species such as *Trichophyton rubrum*, *T. mentagrophytes*, and *Epidermophyton floccosum*, while less common agents include *Microsporum canis* and *T. tonsurans.*[3]

The results of this study showed that nearly half (46%) of fishermen respondents in Karang Serang Village, Tangerang Regency, were found to have dermatophyte fungi on their feet. This high prevalence may be attributed to poor personal hygiene among the fishermen, which can lead to symptoms such as itching and macerated skin. According to Irianto (2013)[13], maceration of the skin can be exacerbated by prolonged exposure to water or sweat. Personal hygiene is crucial for fishermen to prevent skin infections, and it includes awareness of hygiene practices, such as washing hands and feet after work, bathing with clean water before going home, changing into clean clothes regularly, and using personal protective equipment (PPE) while working.

Other studies have also shown a significant relationship between PPE use and the occurrence of dermatitis among fishermen. PPE serves as a protective barrier that minimizes the risk of direct contact with physical, chemical, or biological agents. Cahyawati (2011)[14] reported that 85% of fishermen with dermatitis did not use PPE while working, thereby increasing their exposure to irritants and allergens. Conversely, 54% (26 respondents) of the study participants tested negative for dermatophyte fungi, likely due to their good personal hygiene habits, such as wearing footwear and washing hands and feet after activities at sea. According to Harini and Sitorus (2017)[7] proper hygiene prevents the entry of pathogenic microorganisms that may cause infection.

The study also found that 57% (26 respondents) exhibited poor personal hygiene, likely due to a lack of awareness about health issues that can arise from inadequate cleanliness. Interviews revealed that many fishermen regarded symptoms such as redness and itching as minor and self-limiting, thus ignoring the need for treatment. However, if left untreated, fungal infections can spread to other parts of the body and cause more serious complications. This finding aligns with Sarfiah (2016)[15], who noted that some fishermen perceived skin issues such as dryness, redness, itching, and thickening of the skin on their feet as normal and unworthy of attention because these symptoms were not disruptive to their activities and were expected to resolve on their own.

Meanwhile, 43% (20 respondents) demonstrated good personal hygiene, and no dermatophyte fungi were detected in this group. Based on the questionnaire, these individuals practiced hygiene by using footwear and routinely washing hands and bathing after activities at sea, thereby avoiding skin diseases. Beyond personal hygiene, adopting a healthy lifestyle—such as consuming nutritious food, using clean water for bathing and drinking, and seeking medical attention when symptoms appear—can help prevent more serious infections.

This result is consistent with that of a study by Wibisono et al. (2018)[16], which found a significant relationship between personal hygiene and the incidence of skin disorders among fishermen. Poor hygiene was linked to a lack of awareness in maintaining cleanliness, particularly in washing hands and feet thoroughly with soap after fishing. That study reported that 33.3% of respondents had skin problems, while 66.7% did not.

Similar findings were reported by Noviana (2018), as cited in Noviana and Yasir (2019)[9] in *AVERROUS Journal*, who found that fishermen with poor personal hygiene had a 76.9% likelihood of contracting dermatophytosis, while those with good hygiene had a 66.7% chance of avoiding the disease, with a statistically significant relationship confirmed; the transmission occurred both through direct skin contact and indirectly via shared items such as towels and clothing, as also supported by Djuanda (2013)[17] in *Ilmu Penyakit Kulit dan Kelamin*.

Microscopic examination of the 46 samples revealed characteristic features of dermatophyte fungi, such as spiral-shaped hyphae, smooth thin-walled macroconidia with 2–4 septa, cotton-like colonies with pale black to yellow-green surfaces, and fibrous white undersides—findings consistent with those reported by Amanah et al. (2021)[18] in their study on *Tinea pedis* lesions, and further supported by descriptions from Choi et al. (2018)[19] in the *Journal of Mycology and Infection* and the University of Adelaide's Mycology Online, which describe *Epidermophyton floccosum* as producing coarse spiral hyphae, smooth club-shaped macroconidia, rare microconidia, and flat colonies with yellow pigmentation and fibrous white reverses.

Microscopic analysis revealed smooth, straight hyphae, and teardrop-shaped microconidia. Macroscopically, the colonies exhibited a white velvety texture with a distinct wine-red pigment on the reverse side, accompanied by abundant spore production. These morphological features align with findings from Septiyani's (2018) study on dermatophyte identification among poultry farm workers in Tangerang Regency, which reported grape-like clustered microconidia, macroconidia with 2-5 septa, and uneven white cottony colonies–characteristic traits of Trichophyton mentagrophytes.[20,21]

Further microscopic examination revealed spiral-shaped hyphae with wax drop-like formations and macroconidia containing 2–5 septa, tapering at their basal attachment points. The septate mycelium and cigar-shaped macroconidia were accompanied by macroscopic colony features, including white velvety textures, aerial mycelia, and a wine-red pigment on the

reverse side. These morphological characteristics align with Trichophyton rubrum identification, as described by Wulan (2018) in a study on motorcycle steam workers in Tangerang City, where smooth hyphae, pencil-shaped macroconidia, and reddish-white velvety colonies were observed, consistent with T. rubrum.[22,23]

The presence of microconidia serves as a key distinguishing feature between Trichophyton and Epidermophyton, because Epidermophyton does not produce microconidia.[21] Multiple colonies were observed in several samples, which may have resulted from airborne contamination during sampling or inadequate media sterilization processes.[24]

In addition to dermatophyte colonies, other fungal species were also identified in samples that tested negative for dermatophytes. Colonies with dark green centers and white margins, bright-colored colonies with cotton-like mycelium, and diameters ranging from 1–2 cm were identified as *Aspergillus fumigatus*. According to Gandi (2019)[25], *Aspergillus fumigatus* is ubiquitous and grows rapidly in air, soil, and various environments, which explains its presence in the samples.

Another colony observed displayed velvety, black textures with white edges, creamy reverse surfaces, and irregular borders. Microscopically, the fungi had semi-spherical shapes with dark rounded conidia. Initially white, these colonies turned yellowish-green with white margins and reverse surfaces transitioning from yellow to brown. Prominent, non-pigmented, and rough conidiophores identified the species as *Aspergillus niger*. According to Widowati (2017)[26], *A. niger* is a cosmopolitan fungus prevalent in tropical and subtropical regions and is commonly isolated from soil, air, water, and spices.

Another fungal species identified was Penicillium, characterized by colonies that were initially white and later turned green with velvety-white margins. Microscopic examination revealed septate hyphae, branched conidiophores, and metulae-bearing phialides, which produced spherical conidia. Penicillium is a cosmopolitan genus commonly found in soil and decaying plant material and is frequently associated with food spoilage. This fungus can colonize diverse environments, including human skin, food products, fruits, and textiles.[27,28]

Colonies with white, cottony surfaces, lacking radial lines and exudates, showed grayish hyaline mycelium and chlamydospores, with smooth spores identified as *Mucor*. *Mucor* is a contaminant fungus that is parasitic to plants and cosmopolitan in natural environments.[29]

According to Kumar et al. (2011)[3], the etiological agents responsible for *Tinea pedis* include anthropophilic species such as *Trichophyton rubrum* (60%), *Trichophyton mentagrophytes* (20%), and *Epidermophyton floccosum* (10%), while *Microsporum canis* and *Trichophyton tonsurans* are rarely involved. *Tinea pedis* can infect the heel, interdigital spaces, and soles of the feet and may spread to other areas, including the nails, which can become a secondary source of infection.[30]

Exposure to high-salinity- seawater acts as a primary irritant causing chronic dermatitis in fishermen, while repeated contact with moist conditions—especially around the feet—combined with fungal agents (e.g., dermatophytes) and marine biota, increases susceptibility to infections like tinea pedis, making protective footwear essential to reduce dermatophytosis risk and maintain personal hygiene.[31,32]

Dermatophytosis, including *Tinea pedis*, is a fungal skin infection that typically affects the feet, with symptoms such as maceration, itching, and scaling. The incidence of *Tinea pedis* is influenced by tropical climates, excessive sweating, and humidity. This condition is prevalent among individuals with limited hygiene awareness who work in hot environments. Fishermen are particularly at risk due to prolonged exposure to humid and wet conditions. As noted by Kumar et al. (2011)[3], increased moisture from sweat, mechanical damage to the skin, and fungal exposure are predisposing factors for *Tinea pedis*. Additionally, fishermen often endure prolonged sun exposure (6–8 hours per day), further increasing their risk of developing various skin conditions.

Conclusion

This study shows that the personal hygiene of fishermen in Karang Serang Village is still a factor that needs attention, considering that the majority of fishermen have poor hygiene habits. The high prevalence of dermatophyte fungal infections in fishermen's feet indicates that such infections are quite common in this community. The results of the analysis showed that there is a significant relationship between personal hygiene and the presence of dermatophyte fungi; therefore, increasing awareness and personal hygiene behavior is very important to reduce the risk of skin infections in fishermen.

Conflict of interest

The authors declare no conflicts of interest.

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