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Enhancing Leptospirosis Awareness: A Study on Knowledge among Health Undergraduate Students in Pontianak, West Kalimantan

(*KESADARAN TERHADAP LEPTOSPIROSIS: STUDI TENTANG PENGETAHUAN MAHASISWA KESEHATAN DI PONTIANAK, KALIMANTAN BARAT*)

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ABSTRACT

Leptospirosis is a zoonotic infectious disease caused by the *spirochete* bacteria Leptospira, with a high risk of transmission in flood-prone areas such as Pontianak, West Kalimantan. Health undergraduate students play a critical role in preventing and managing infectious diseases, including leptospirosis. Hence, sufficient knowledge is necessary. This study aimed to describe the knowledge of health undergraduate students in Pontianak regarding leptospirosis. A descriptive study with a cross-sectional approach was conducted involving 172 respondents selected through proportionate stratified random sampling. Data were collected using an 18-question questionnaire covering definitions, etiology, epidemiology, clinical manifestations, transmission mechanisms and pathogenesis, diagnosis, prevention, and management. The results show that most health undergraduate students at Universitas Tanjungpura, Pontianak had poor knowledge (57.5%), while 35.5% had moderate knowledge, and only 7% demonstrated good knowledge. Electronic media or the internet was the most frequently used source of information (51.74%), followed by lecture materials (44.18%), journals (22.67%), textbooks (14.53%), and printed media (11.04%). This study concludes that the majority of students lack knowledge of leptospirosis. Improving health literacy and access to accurate information, particularly through electronic media, is essential to enhance their understanding of the disease.

Keywords: health undergraduate students; knowledge; leptospirosis

ABSTRAK

Leptospirosis merupakan penyakit menular zoonosis yang disebabkan oleh bakteri *spirochete* Leptospira, dengan risiko penularan yang tinggi di daerah rawan banjir seperti Pontianak, Kalimantan Barat. Mahasiswa kesehatan memainkan peran penting dalam pencegahan dan penanganan penyakit menular, termasuk leptospirosis. Oleh karena itu, pengetahuan yang memadai sangat diperlukan. Penelitian ini bertujuan untuk mendeskripsikan pengetahuan mahasiswa kesehatan di Pontianak mengenai leptospirosis. Penelitian deskriptif dilakukan dengan pendekatan *cross sectional* dengan melibatkan 172 responden yang dipilih melalui metode proporsional *stratified random sampling*. Data dikumpulkan menggunakan kuesioner yang terdiri atas 18 pertanyaan yang mencakup definisi, etiologi, epidemiologi, manifestasi klinis, mekanisme penularan dan patogenesis, diagnosis, pencegahan, dan manajemen. Hasil penelitian menunjukkan bahwa sebagian besar mahasiswa kesehatan dari Universitas Tanjungpura, Pontianak memiliki pengetahuan yang kurang (57,5%), sedangkan 35,5% memiliki pengetahuan sedang, dan hanya 7% yang menunjukkan pengetahuan baik terhadap leptospirosis. Media elektronik atau internet merupakan sumber informasi yang paling sering digunakan respondens (51,74%), diikuti oleh materi kuliah (44,18%), jurnal (22,67%), buku teks (14,53%), dan media cetak (11,04%). Penelitian ini menunjukkan bahwa mayoritas mahasiswa kesehatan kurang memiliki pengetahuan tentang leptospirosis. Peningkatan literasi kesehatan dan akses terhadap informasi yang akurat, terutama melalui media elektronik, sangat penting untuk meningkatkan pemahaman mereka tentang penyakit leptospirosis.

Kata-kata kunci: mahasiswa calon sarjana kesehatan; pengetahuan; leptospirosis

INTRODUCTION

Leptospirosis is among the most widespread infectious diseases globally, caused by the spirochete bacterium Leptospira. This zoonotic disease is easily transmitted through the urine of infected animals, either directly or via water and soil contaminated by the urine. Common animal carriers include livestock such as cattle, pigs, and horses, as well as wild animals like raccoons, hedgehogs, rats, and even domestic pets such as dogs (Wang and Dunn, 2024; Boey *et al*., 2019). Leptospirosis can range from a mild flu-like illness to severe cases, including Weil's disease, which may progress to multi-organ failure and potentially result in death (Wang and Dunn, 2024). Symptoms can include high fever, jaundice, headache, kidney failure, hemorrhagic fever, meningitis, abdominal pain, and muscle aches (Shafie *et al*., 2021).

The incidence of leptospirosis varies by region, influenced by climate and season. In temperate climates, cases typically peak in late summer or early autumn. Conversely, in tropical areas, leptospirosis is more prevalent during the rainy season (Wang and Dunn, 2024). The disease is particularly common in the Asia-Pacific region, including Southeast Asia and Oceania. Its incidence ranges from 0.1 to 1 case per 100,000 people annually in temperate regions to 10–100 per 100,000 in tropical areas and exceeds 100 per 100,000 among high-risk populations during outbreaks. Factors contributing to its high prevalence in Southeast Asia include floods, occupational exposure, recreational activeties, travel to endemic areas, poor sanitation, and inadequate waste disposal systems (Shafie *et al.*, 2021).

According to the International Leptospirosis Society, Indonesia ranks third worldwide in leptospirosis mortality rates, following China and India (Ministry of Health of the Republic of Indonesia, 2023). The World Health Organization (WHO) reported 920 cases in Indonesia in 2019, with 122 fatalities (World Health Organization, 2020). More recent data from the Indonesian Ministry of Health in 2022 documented 1,419 cases across ten provinces, including Jakarta, West Java, Central Java, Yogyakarta, East Java, and several provinces in Kalimantan and Sula-wesi. These cases resulted in 139 fatalities, with a case fatality rate (CFR) of 9.8% (Indonesia

Health Profile, 2022). Notably, no leptospirosis cases have been officially recorded in Pontianak or the broader West Kalimantan region. However, the absence of reported cases may reflect limited awareness and knowledge about the disease rather than its actual absence.

Pontianak, the capital of West Kalimantan Province, is prone to significant flooding. Between 2009 and 2019, there were 161 floods that occurred in West Kalimantan. In Pontianak, the total flood-prone area spans 10,663 ha, classified into high-risk (5,187 ha), moderate-risk (5,196 ha), and low-risk zones (280 ha) (National Board for Disaster Management, 2021). Floods exacerbate the risk of leptospirosis transmission by contaminating water and soil with infected animal urine (Shafie *et al*., 2021).

Health undergraduate students play a pivotal role in educating communities about leptospirosis prevention and control. As future medical professionals, they must be equipped with adequate knowledge about the disease, including its risk factors, clinical symptoms, diagnostic methods, and effective preventive measures (Rathinam *et al*., 2021).

Studies from other regions highlight knowledge gaps among health undergraduate students. In India, it was reported that only 7.4% of students recognized leptospirosis as a zoonotic disease (Rathinam *et al*., 2021). Similarly, research in Malaysia by Shafie *et al*. (2021) revealed varying levels of understanding of disease transmission and risk factors. Another study found that while most students had basic knowledge of leptospirosis, misconceptions about its bacterial etiology persisted (Bakar and Rahman, 2018). However, a lack of local epidemiological data and limited research on health undergraduate students' knowledge of leptospirosis in Pontianak pose challenges to effective prevention efforts. Thus, this study was conducted to assess the knowledge of health undergraduate students in Pontianak regarding leptospirosis. Health undergraduate students are expected to act as change agents, raising community awareness about leptospirosis through educational initiatives.

RESEARCH METHODS

Study Population

This study was a descriptive method with a cross-sectional approach to assess the knowledge of health undergraduate students in Pontianak regarding leptospirosis. Conducted at the Faculty of Medicine, Universitas Tanjungpura, Pontianak, West Kalimantan, from June to November 2024. Active students from the last year of the pre-clinical phase of the Medical, Pharmacy, and Nursing programs; agreed to participate in the research; and had given informed consent were enrolled in the study. Respondents who did not complete the questionnaire fully or took more than 30 minutes to fill it out were excluded. The minimum required sample size was calculated using Slovin's formula with a 5% margin of error, resulting in 171 participants from a total population of 298 students: 100 from Medical, 99 from Pharmacy, and 99 from Nursing programs. The sample was determined using proportionate stratified random sampling with a total of 172 respondents: 58 from Medical, 57 from Pharmacy, and 57 from Nursing programs.

Data were collected directly from respondents through a questionnaire developed by the researcher, which was piloted on 30 students (10 from each program) not included in the main samples. The questionnaire is divided into three sections: demographics, knowledge, and sources of information. The demographics section gathered data on respondents' profiles, such as gender, age, and academic program. The knowledge section included 18 questions covering topics: definition and etiology, epidemiology, clinical manifestations, transmission mechanisms and pathogenesis, diagnosis, prevention, and management of leptospirosis, scored as 1 for correct answers and 0 for incorrect ones. The information sources section identified media of information used by respondents, such as lecture materials, textbooks, journals, electronic media/internet, or print media. The validity and reliability of the

questionnaire were tested, showing a calculated r-value greater than the table value (0.361) at a 5% significance level ($p<0.05$) and a Cronbach's Alpha value of 0.716. The knowledge was categorized into three categories: Good (76-100%), Moderate (56-75%), and Poor (≤55%).

Data Analysis

Data analysis was conducted using Statistical Product and Service Solutions (SPSS) version 26, comprising steps like editing for completeness, coding variables, data entry, and systematic tabulation. Des-criptive analysis was used to present the frequency distribution of knowledge, and the Kolmogorov-Smirnov test was performed for normality assessment. Data was analyzed using Chi-Square and Fisher's Exact tests with a significance level of 0.05 ($p<0.05$ was considered significant). Results were display-ed in tables and graphs for easier interpre-tation.

Ethical Clearance

The study received approval from the Ethics Committee of the Faculty of Medicine, Universitas Tanjungpura, with Ethical Clearance No. 9346/UN22.9/PG/2024, ensuring compliance with prevailing health research ethics.

RESULT AND DISCUSSION

As previously described in the method section, the study included 172 respondents from Medical, Pharmacy, and Nursing programs. The respondents' ages ranged from 20 to 23 years old, with 21 years old being the most common age group, represented by 110 respondents (64%). Univariate analysis revealed a median age of 21 years old. The majority of respondents were female, accounting for 131 respondents (76.2%), while male respondents totaled 41 respondents (23.8%). Each program had more female respondents than male (Table 1). The study found that respondents ranged in age from 20 to 23 years old, with a median age of 21. These findings align with research by Abdul-Azeez and Muktar (2022) on Reserve Officer Training Unit (ROTU) students, which reported an average age of 19.95 years. Their study also showed no significant relationship between age and knowledge of leptospirosis ($p = 0.396$). Therefore, age was not explored further in this study because of the respondents' relatively homogeneous age range. The respondents' ages ranged from 20 to 23 years, with a median age of 21, which falls within the early adulthood phase (Pieter, 2017). This is consistent with the findings of Abdul-Azeez and Muktar (2022) on ROTU students, who had an average age of 19.95 years and showed no significant association between age and leptospirosis knowledge ($p = 0.396$). Although this result derives from another study, the relatively homogeneous age range in this research justified the exclusion of further age analysis. Nevertheless, early adulthood is a critical stage in psychosocial development, as individuals in this phase generally possess well-developed cognitive and emotional capacities, such as the ability to recognize, understand, and regulate emotions, along with strong perceived social support. These factors collectively support their potential role as agents of change in social and public health issues.(Rodríguez-Sáez *et al.*, 2025). In addition, the majority of respondents in this study were female (76.2%). This predominance of female participants may also contribute to their potential as change agents, as previous research has suggested that women often demonstrate higher engagement in health-related knowledge and behaviors, which could enhance their effecttiveness in pro-moting public health initiatives (Tan *et al*., 2022). A significant number of respondents, namely 99 respondents (57.5%), had poor knowledge. Respondents with moderate knowledge comprised 35.5% (61 respondents), and only 7% (12 respondents) demonstrated good knowledge. Results showed that the median knowledge of respondents was 55.56%, indicating a poor knowledge category. The highest score achieved was 88.89% (good knowledge), while the lowest score was 27.78% (poor knowledge) (Table 2).

Table 1. Respondents' characteristics of leptospirosis awareness research among health undergraduate students in Pontianak, West Kalimantan

Variable	Study Program			Total
	Medical	Pharmacy	Nursing	
Age (years old)				
20	13	10	11	34
21	38	35	37	110
22	7	12	8	27
23	0	0	1	1
Gender				
Male	28	8	5	41
Female	30	49	52	131

Our results revealed that 55.97% of respondents had poor knowledge of leptospirosis. Given that leptospirosis is endemic in Indonesia, healthcare professionals must prioritize knowledge about this disease. Although competency standards differ across professions, healthcare workers must stay updated with science and technology to address health issues requiring interpro-fessional collaboration. Respondents' knowledge was lower than that reported in Rathinam *et al.* (2021) study; 49% of Indian medical students had moderate knowledge. Table 2 highlights knowledge by study program. Most respondents with good knowledge are from the medical program (12.1%), while those with moderate knowledge were also dominant in the medical program (62.1%). Respondents with poor knowledge were the majority from the Pharmacy program (84.2%). The median knowledge for medical program respondents was in the moderate knowledge (56-75%), while Pharmacy and Nursing program respondents fell into the poor knowledge (≤55%). The Medical program recorded the highest median score (61.11%), while the Pharmacy program had the lowest (50%). This pattern aligns with Pujiyanti *et al.* (2020) research report, which found that doctors had higher knowledge than nurses regarding leptospirosis. These results indicate a substantial knowledge gap among students from different health-related academic programs. Basic knowledge of leptospirosis, such as modes of transmission, early symptoms, risk factors, and preventive measures, is essential for all health science students, as it forms the foundation for their promotive and preventive roles in the community. Without this foundational understanding, students may be inadequately prepared to recognize cases early, deliver health education, or participate in community-based control efforts. A study among medical students in India also revealed a significant lack of knowledge regarding risk factors and clinical management of leptospirosis, despite their generally good overall knowledge (Rathinam *et al.*, 2021). This reinforces the concern that limited knowledge, even among health students, can hinder their future roles as healthcare professionals responsible for infectious disease prevention and control at the community level.

Statistical analysis shows a significant relationship between study programs and respondents' knowledge ($p<0.05$). This disparity likely results from differences in curricula and exposure to infectious disease topics. The Medical program includes a 5-credit Infection and Immunology module in the sixth semester, providing a more comprehensive understanding of infectious diseases like leptospirosis. In contrast, the Pharmacy program offers only a general discussion on infections through a 2-credit Pharmacotherapy of Infectious Diseases

course in the fifth semester. The Nursing program includes a 3-credit course on Tropical Diseases and West Kalimantan Culture in the seventh semester, though it had not yet been taught at the time this study was performed. Although the difference in credit hours among study programs is evident, it does not necessarily reflect the depth of students' knowledge acquisition. Findings by Pardos *et al*. (2023) indicate that academic credit hours account for only a small portion of the variation in students' learning outcomes. Instead, factors such as assignment load, course structure, and the depth of content contribute more significantly to students' understanding. Therefore, the knowledge gap observed in this study is likely influenced not only by the number of credits allocated, but also by the quality and intensity of leptospirosis-related material delivered in each program.

The Medical program's curriculum aligns with the Indonesian Medical Council's 2019 National Standards for Medical Education, which classifies uncomplicated leptospirosis as a hematological and immunological disease requiring a competency level of 4. Medical graduates are expected to independently diagnose and manage the disease (Wahid, 2019). The national competency standards for pharmacists and nurses do not explicitly address leptospirosis. However, pharmacists play a role in identifying high-risk drugs, providing education on side effects, and monitoring therapy (Ministry of Health of the Republic of Indonesia, 2023). Nurses are expected to identify common symptoms of leptospirosis as part of their competencies (Ministry of Health of the Republic of Indonesia, 2020). These curriculum differences underscore the need for curricular adjustments to improve healthcare professionals' preparedness for managing tropical diseases like leptospirosis.

Furthermore, these findings contradict the study by Pujiyanti *et al*. (2020), which showed no significant difference between doctors and nurses in knowledge scores, both at the baseline and post-training stages. This indicates that differences in professional background do not significantly influence the level of knowledge about leptospirosis. Thus, the variations observed across study programs are more likely due to differences in curricula rather than differrences in professional roles. None-theless, fully standardizing curricula across all health study programs is not necessarily the ideal approach, considering that each profession has distinct scopes of practice, responsibilities, and learning objectives. A more relevant strategy would be to ensure that essential topics related to infectious disease control, such as leptospirosis, are proportionally integrated into each program's curriculum according to the targeted graduate profile and intended competencies. The literature in BioMed Central Medical Education supports this approach by emphasizing that competency-based curriculum development must take into account the specific context of each health profession. This enables each study program to accommodate relevant and applicable educational needs without compromising the distinct characteristics and roles of each profession within the healthcare system (Karlsson *et al.*, 2024).

Female respondents were more likely to have good knowledge (8.4%) compared to male respondents (2.44%). However, a higher percentage of males (53.66%) had moderate knowledge compared to females (29.77%). Among those with poor knowledge, female was 61.83%, while males were 43.9%. The median knowledge for males was 61.11%, higher than the median for females, which was 55.56% (Table 2). In this study, there was a significant relationship between gender and knowledge ($p<0.05$).

Our findings are different from the study by Abdul-Azeez and Muktar (2022) which showed no significant relationship between gender and knowledge ($p= 0.409$). However, those studies also showed that male respondents had better knowledge, similar to our results. On the other hand, Azhari *et al*. (2019) found that female respondents had higher knowledge. These differences observed may be due to learning strategies. Males often have better skills in processing information, identifying key points, and using effective exam techniques,

Table 1. Respondents' Knowledge about Leptospirosis of leptospirosis awareness research among health undergraduate students in Pontianak, West Kalimantan

Variable	Good		Moderate		Poor		Median	Max	Min	Total	p value
	n	%	n	%	n	%	(%)	(%)	(%)		
All Respondents	12	7	61	35.5	99	57.5	55.56	88.89	27.78	172	-
Study Program											
Medical	7	12.1	36	62.1	15	25.8	61.11	88.89	33.33	58	
Pharmacy	3	5.3	6	10.5	48	84.2	50	77.78	27.78	57	0.000**
Nursing	2	3.5	19	33.3	36	63.2	55.56	77.78	27.78	57	
Gender											
Male	1	2.44	22	53.66	18	43.9	61.11	88.89	33.33	41	0.015*
Female	11	8.4	39	29.77	81	61.83	55.56	83.33	27.78	131	
Information Sources											
Lecture Materials	8	10.53	38	50	30	39.47	-	-	-	76	
Textbooks	1	4	12	48	12	48	-	-	-	25	
Journals	2	5.13	14	35.9	23	58.97	-	-	-	39	
Electronic/Internet	7	7.87	35	39.33	47	52.81	-	-	-	89	-
Printed Media	1	5.26	4	21.05	14	73.68	-	-	-	19	
Others	1	2.7	7	18.92	29	78.38	-	-	-	37	
Number of Information Sources											
No Source	0	0	2	50	2	50	-	-	-	4	
1 Source	8	8.51	25	26.6	61	64.89	-	-	-	94	
2 Sources	2	4.55	20	45.45	22	50	-	-	-	44	
3 Sources	0	0	12	63.16	7	36.84	-	-	-	19	0.05**
4 Sources	2	22.22	1	11.11	6	66.67	-	-	-	9	
5 Sources	0	0	1	50	1	50	-	-	-	2	

Note: Max: maximum respondent's score; Min: minimum respondent's score; *: p value based on Chi-square test; **: p value based on Fisher's Exact test

Table 2. Respondents correct answers per question topic by study program

Question	Study Program		
	Medical	Pharmacy	Nursing
Definition and Etiology			
Leptospirosis in Indonesia is predominantly spread through exposure to the urine of infected animals, namely?*	98.3%	89.5%	96.5%
Epidemiology			
Leptospirosis cases frequently occur in environmental conditions such as?	96.6%	70.2%	78.9%
Areas prone to leptospirosis are associated with the following risk factors, except?	94.8%	66.7%	77.2%
Factors that generally influence the magnitude of leptospirosis in each country include?	27.6%	19.3%	49.1%
Clinical Manifestations			
The clinical manifestations of leptospirosis may appear in how many phases?	53.4%	45.6%	56.1%
The incubation period of leptospirosis typically lasts for?	46.6%	47.4%	61.4%
Common symptoms often observed during the early phase of leptospirosis are?	79.3%	71.9%	71.9%
Mild leptospirosis shows the following symptoms, except?	58.6%	68.4%	61.4%
Complications in leptospirosis that may increase mortality rates include	56.9%	28.1%	15.8%
Transmission Mechanism and Pathogenesis			
Leptospirosis transmission occurs through?*	100%	94.7%	94.7%
Animals at risk of being reservoirs for Leptospira bacteria as infection sources include?	24.1%	31.6%	10.5%
Coinfections in leptospirosis frequently occur with pathogenic agents of diseases such as?	25.9%	24.6%	17.5%
Diagnosis			
Early detection of leptospirosis cases can be carried out using examinations such as?	43.1%	47.4%	28.1%
The Rapid Diagnostic Test aims to detect specific antibodies against Leptospira, namely?	55.2%	28.1%	50.9%
Criteria for confirming a case can be established with the following indicators?	65.5%	49.1%	47.4%
Prevention			
Prevention of leptospirosis involves three main methods, namely?	75.9%	40.4%	61.4%
Control measures for leptospirosis focus on vulnerable populations, which include?	91.4%	71.9%	75.4%
Management			
Therapy for mild leptospirosis cases involves?	50%	7%	21.1%

*: The most frequently correct answered > 75% in all study program

which help them understand and apply medical knowledge more easily. In addition, lower levels of anxiety in males may help them stay more focused during studying and exams (Saxena *et al*., 2024). Supporting this, recent literature has indicated that female students generally report significantly higher levels of anxiety compared to their male counterparts, potentially impairing academic performance, concentration, and retention of information (Trapp *et al*., 2022). Furthermore, a cross-cultural study involving first-year university students in Italy and Russia found that females were more likely to adopt emotion-focused coping strategies, while males tended to prefer task-oriented coping, which has been associated with better academic outcomes (Cabras *et al*., 2023). These findings provide a broader context for understanding variations in knowledge between genders and underscore the importance of implementing adaptive and responsive learning approaches that address both emotional needs and learning strategies of students.

Regarding the source of information, among 172 respondents, 4 (2.32%) reported no prior exposure to information on leptospirosis. Table 2 shows that most respondents (51.74%) relied on electronic media or the internet, with varying knowledge: 7.87% good, 39.33% moderate, and 52.81% poor. Lecture materials were the second most common source (44.18%), associated with 10.53% good, 50% moderate, and 39.47% poor knowledge. Most respondents relied on a single source (54.65%). In this group, 8.51% had good knowledge, 26.6% had moderate knowledge, and 64.89% had poor knowledge. The most utilized single source was electronic media or the internet, used by 34 respondents (36.2%). Despite these variations, statistical analysis showed no significant relationship between the number of information sources used and knowledge about leptospirosis ($p = 0.05$).

Of 51.74% relied on electronic media or the internet as their primary information source. However, only 7.87% of these respondents demonstrated good knowledge. This finding suggests that while the internet provides broad access to information, its effectiveness in improving knowledge remains limited, often due to poor digital literacy and the varying quality of online resources (O'Doherty *et al*., 2019). Efforts to enhance digital literacy and provide reliable medical content are needed to maximize the internet's educational potential. Lecture materials were the second most common information source (44.18%), with 10.53% of respondents exhibiting good knowledge. Despite being more effective than the internet, lecture materials often fall short due to limited coverage and time constraints (Lisiswanti *et al*., 2022). To enhance understanding of leptospirosis, efforts are needed to ensure that the material provided is better comprehended, both through lectures and other information sources.

Among respondents with poor knowledge, a considerable proportion (64.89%) reported relying solely on a single source of information. This suggests that depending on just one source of information, particularly when it is of questionable quality, may not adequately address the issue of poor knowledge, which remains high even among those who reported using multiple sources, indicating that simply increasing the number of sources is insufficient if the quality and comprehension of the information remain low. Interestingly, respondents who reported using lecture materials as a source had a lower proportion of poor knowledge (39.47%) compared to those relying on the internet (52.81%), printed media (73.68%), or other media (78.38%), further supporting the importance of structured and high-quality educational content. Of the 2.32% of respondents, none had ever heard of leptospirosis, highlighting a lack of awareness among the general population. Guidelines from the Republic of Indonesia Ministry of Health (Ministry of Health of the Republic of Indonesia , 2023), educational modules (Sara *et al*., 2020), and gamification (Azhari *et al*., 2019) can enhance public understanding by making learning more engaging and accessible.

Table 3 presents a summary of the percentage of correct responses from respondents for each question based on the topic. The data in the table indicate that most respondents answered correctly on the topics of the definition and etiology of leptospirosis. However, the majority of respondents were less accurate in answering questions related to epidemiology, clinical manifestations, transmission mechanisms, pathogenesis, diagnosis, prevention, and management.

The low percentage of correct responses was particularly evident in the question related to the animal reservoir of *Leptospira*, which was correctly answered by only 10.5% of nursing programs. This may be attributed to the fact that the "Tropical Disease and West Kalimantan Culture" course had not yet been delivered at the time the study was conducted. This course generally covers topics on zoonotic diseases, including the transmission mechanisms of leptospirosis. Therefore, their knowledge of this topic remains limited.

On definitions and etiology, respondents correctly identified that rats are the primary carriers of leptospirosis in Indonesia (Ministry of Health of the Republic of Indonesia, 2017). Other animals, such as cattle, pigs, horses, dogs, and hedgehogs, were also recognized as potential carriers (Wang and Dunn, 2024; Boey *et al.*, 2019; Ministry of Health of the Republic of Indonesia, 2017). Regarding epidemiology, most respondents correctly noted that leptospirosis frequently occurs in tropical regions during the rainy season (Ministry of Health of the Republic of Indonesia, 2017). Since the 21st century, advancements in globalization and technology have enhanced epidemic responses, promoting more coordinated and efficient efforts (Judijanto *et al*., 2024). For healthcare workers, understanding epidemiology supports preventive measures to curb disease progression (Sari *et al*., 2021).

On clinical manifestations, respondents recognized that high fever and muscle pain are early symptoms of leptospirosis (Schafer *et al*., 2024). However, they struggled to identify kidney failure as a complication associated with higher mortality rates (Goering *et al*., 2021). The disease's non-specific symptoms often lead to misdiagnosis as other infections, such as dengue fever, influenza, typhoid, or hepatitis (Chacko *et al*., 2021; Ministry of Health of the Republic of Indonesia, 2017; Sari, 2021). On transmission and pathogenesis, respondents understood that Leptospira is transmitted through soil and water contaminated with infected animal urine. However, they lacked knowledge about co-infections with malaria and other pathogens, which complicate diagnosis and management. Co-infections are rare but critical to identify and address appropriately to avoid misdiagnosis (Md-Lasim *et al*., 2021).

Regarding diagnosis, respondents demonstrated poor understanding of diagnostic methods. The diverse clinical spectrum of leptospirosis makes diagnosis challenging (Gancheva, 2022). Delayed diagnosis increases mortality risk, emphasizing the need for early detection (Philip *et al*., 2020). Studies have shown that combining molecular detection Polymerase Chain Reaction (PCR) with serological methods enhances diagnostic sensitivity (Sreevalsan and Chandra, 2024). On prevention, respondents correctly noted that controlling leptospirosis involves targeting vulnerable populations in high-density environments. However, they lacked understanding of key prevention strategies, including addressing animal reservoirs, controlling transmission pathways, and implementing human protecttive measures. The One Health approach is a promising solution, integrating multidisciplinary efforts to comprehensively address leptospirosis risk. This includes using personal protective equipment, proper hand hygiene after exposure to contaminated environments, and controlling rodent habitats (Pham and Tran, 2022). On treatment, respondents were generally unaware of doxycycline's use for mild leptospirosis treatment. Limited clinical research on leptospirosis contributes to misconceptions about antibiotic therapy (Guzmán-Pérez *et al*., 2021).

The study contributes valuable insights to public health by identifying a significant knowledge gap and offering direction for targeted interventions. Recommendations include incorporating leptospirosis-specific modules into health-related curricula, promoting continuous education on tropical diseases, and encouraging students to actively access existing health information platforms, such as the Ministry of Health's website. These measures can ensure students are equipped with the necessary skills and knowledge to address this public health concern effectively. Regional and local governments are encouraged to strengthen community outreach programs to raise public awareness about leptospirosis prevention, particularly in flood-affected areas. Collaborative efforts between educational institutions and public health authorities are crucial to building a more informed and prepared society.

CONCLUSION

The study revealed that the overall knowledge of health undergraduate students in Pontianak regarding leptospirosis is predominantly poor, with a median knowledge score of 55.56%. These results highlight a critical need for improving awareness and understanding of leptospirosis among future healthcare professionals, especially in flood-prone regions where the risk of outbreaks is high, like Pontianak. Enhancing their knowledge is vital to preparing them for the challenges of managing zoonotic diseases like leptospirosis.

SUGGESTION

Future research should explore the effectiveness of innovative educational strategies, such as gamification and interactive learning, in increasing knowledge retention and application among health undergraduate students.

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