FAKULTAS FARMASI
UNIVERSITAS MUHAMMADIYAH PURWOKERTO

PHARMACY: Jurnal Farmasi Indonesia
(Pharmaceutical Journal of Indonesia)

Journal homepage: https://jurnalnasional.ump.ac.id/index.php/PHARMACY

Received 23-09-2023 Accepted 07-11-2024 Available online 31-12-2024

Evaluating Knowledge and Attitudes Toward Antibiotic Use Among Pharmacy Students at Three Universities in Bali

Evaluasi Pengetahuan dan Sikap terhadap Penggunaan Antibiotik pada Mahasiswa Farmasi di Tiga Universitas di Bali

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ARTICLE INFO

Keywords:
Antimicrobial resistance, infectious diseases, patient behavior, pharmacy practices

ABSTRACT

Antimicrobial resistance poses a significant threat to global health, making the understanding of antibiotic use among healthcare students critical. This study aimed to assess the knowledge, attitudes, and practices regarding antibiotic use among pharmacy students in Bali. A quantitative descriptive approach with a cross-sectional design was employed, involving 105 pharmacy students. Data were collected through a questionnaire distributed via Google Forms and analyzed using SPSS version 15.0. The findings indicated that most of the respondents were aged 19-24 years (96.2%), predominantly female (85.7%), and enrolled in undergraduate programs (77.1%). A substantial proportion (84.8%) obtained antibiotics with a doctor's prescription, while health workers served as the primary source of information for self-treatment (74.3%). Amoxicillin emerged as the most commonly used antibiotic (71.4%), with fever being the most reported complaint (55.2%). The questionnaire results revealed high levels of knowledge (41.9%), a positive attitude towards antibiotic use (94.3%), and good practice (99.0%) among pharmacy students. Statistical analysis showed a significant relationship between knowledge and attitudes toward antibiotic use practices, with a correlation coefficient of r = 0.306 (p = 0.001). Additionally, the correlation between attitudes and practices was stronger, with r = 0.385 (p < 0.000). The study concludes that pharmacy students in Bali exhibit a high level of knowledge and a positive attitude toward antibiotic use, which correlates significantly with their practices. However, the study underscores the need for continuous education on responsible antibiotic use to combat antimicrobial resistance effectively.

1. Introduction

Antibiotics have fundamentally changed the landscape of modern medicine by providing effective treatment options for infectious diseases (Cook and Wright, 2022). We are at the epicenter of an antimicrobial resistance (AMR) crisis, driven by a diminishing pipeline of antibiotic discovery and the uncontrolled proliferation of resistant microorganisms (Lewis, 2020). Resistance is the ability of pathogens to withstand and diminish the effectiveness of antibiotics, which impacts morbidity, and mortality, as well as economic and social factors (Vicentini et al., 2022).

Every year, 23,000 people die in the United States due to resistance, and two million people experience resistance to antibiotics. It is estimated that in about 30 years, there will be antibiotic resistance, affecting around 4.7 million people from Asia (WHO, 2019). The unnecessary and improper use of antibiotics can increase the risk of antibiotic resistance and reduce the effectiveness of antibiotics in treating infections caused by bacteria (Hu, Logue and Robinson, 2020).

The Minister of Health Regulation No. 28 of 2021 establishes guidelines for the mandatory management of antibiotics within medical procedures in Indonesia (Menkes RI, 2021). Despite this regulatory framework, self-medication with antibiotics remains prevalent in Indonesia, often perceived by individuals as a convenient and cost-effective alternative to obtaining prescriptions (Ocktaviana Saputri et al., 2022). Prior research has identified the use of antibiotics without appropriate medical supervision as a significant global health issue, including in Indonesia, where it exacerbates the risk of antimicrobial resistance (Widowati et al., 2021). This ongoing challenge highlights the need for enhanced public awareness and stricter adherence to regulatory guidelines to ensure responsible antibiotic use.

The irrational use of antibiotics, such as not completing treatment, missing doses, using leftover medication, and excessive use of antibiotics, can lead to antibiotic resistance. Antimicrobial resistance occurs when standard treatment doses of antimicrobial drugs are unable to cure infections caused by fungi, bacteria, parasites, and viruses. This leads to the emergence of antibiotic resistance, which specifically refers to the inability of antibacterial drugs to treat bacterial infections (Gyssens, 2020). In Indonesia, the high rate of antimicrobial resistance (AMR) is primarily due to the inappropriate use of antimicrobials in the health sector, as well as in the livestock and fisheries sectors (Setiabudy et al., 2023).

Misunderstandings in the use of antibiotics greatly influence behavior related to their usage. This can happen not only among the general public but also among health students, which in turn can affect the way they convey information to the community when they work in the healthcare field (Hamdani, Nuari and Rahayu, 2021; Lubwama et al., 2021). A minimal level of knowledge can lead to mismanagement, as it can result in the risk of side effects (Anggraini et al., 2020). A comprehensive approach is needed, as outlined in the National Action Plan for Controlling Antimicrobial Resistance (Menko RI, 2024).

Pharmacy students have a significant impact on the fight against antibiotic resistance by educating the public about responsible antibiotic

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usage (Hayat et al., 2021). They can then evaluate antibiotic prescriptions and offer guidance on the best course of action in clinical practice, in addition to researching resistance. Aside from advocating for health policies that encourage resistance control, pharmacy students can collaborate with other health professionals in interdisciplinary teams. Their engagement will not only help them develop into qualified professionals but also position them to spearhead initiatives aimed at promoting prudent antibiotic usage. Controlling antibiotic resistance thus depends in large part on the knowledge, attitudes, and behavior of pharmacy students.

2. Research Method

This is a cross-sectional study conducted at three (3) universities in Bali that have bachelor program of pharmacy, using a structured questionnaire derived from previous studies. (Higuita-Gutiérrez, Roncancio Villamil and Jiménez Quiceno, 2020; Karuniawati *et al.*, 2021; Lubwama *et al.*, 2021). Data collection occurred over a two-month, from March to April 2024, utilizing Google Forms for distribution. Participants were recruited purposively to ensure relevant representation. The purposive sample selection technique was deliberately chosen by considering certain factors. This is suitable for use in quantitative research, or research that does not make generalizations (Andrade, 2021). In this study, the sample was selected only for pharmacy students, not for other health students.

The questionnaire was developed from similar previous research (Widowati *et al.*, 2022; Jayanthi *et al.*, 2023; Dewi *et al.*, 2024). The questionnaire comprised four parts, covering demographic data, knowledge, attitudes, and antibiotic use practices of participants. The first section collected data on age, gender, education, antibiotic acquisition, information sources, complaints experienced, types of antibiotics, and duration of use. The second section consisted of 7 knowledge questions using the Guttman scale, with answer choices of Yes/Correct (score 1) and No/Wrong (score 0). The total score is calculated and categorized as follows: low knowledge with a score ≤3, medium 4-5, high ≥6. The third part consisted of 7 attitude questions using a Likert Scale. The fourth section consisted of 5 practice questions with a Likert scale. The total score was calculated based on the statements strongly agree (4), agree (3), disagree (2), and strongly disagree (1). Respondents' attitudes and practices were categorized as poor if <60% of the total score, while ≥60% is classified as good.The data were presented descriptively. The Spearman Rank Test was used to analyze the relationship between variables.

To assess the validity of the instrument, the Pearson Correlation method was used on 30 respondents. A research instrument was said to be valid if r count ≥ r table (sig. 2-tailed = 0.05). In this study, the correlation coefficient was > 0.349, which indicates that all items were valid. Reliability refers to an understanding that the instruments used in research to obtain the information can be trusted as data collection tools and can reveal actual information in the field. High reliability was indicated by an rxx value close to 1. In general, reliability is considered satisfactory if it is ≥ 0.700. They were testing the reliability of the instrument using the Alpha-Cronbach formula. In this study, Cronbach's Alpha value = 0.753, which confirmed that all questions are consistent.

This study has received ethical clearance from the Research Ethics Commission of Bali International University, under approval number 02.0387/UNBI/EC/III/2024. This approval ensures that the research adheres to ethical standards for the protection of participants' rights and welfare throughout the study process.

3. Result and Discussion

Characteristics

The characteristics of the respondents in this study comprised 105 participants, as detailed in the table 1.

Table 1. Characteristics (n=105)

Characteristic		n	%
Age (years)			
	19-24	101	96.2
	>24	4	3.8
Gender			
	Female	90	85.7
	Male	15	14.3
	Education		
	Bachelor	81	77.1
	Diploma	24	22.9
Purchase			
	Prescription	89	84.8
	Self-medication	12	11.4
	Remaining usage	3	2.9
	Given by someone	1	1.0
Sources of information			
	Health professional	78	74.3
	Social media	8	7.6
	At lecture	7	6.7
	Family	7	6.7
	Friend	5	4.0
Type of antibiotics			
	Penicillin	75	71.4
	Cephalosporin	19	18.1
	Fluoroquinolone	6	5.7
	Clindamycin	2	1.9
	Macrolide	2	1.9
	Tetracycline	1	1.0
Symptoms			
	Fever	58	55.2
	Infection	17	16.2
	Cough and cold	12	11.4
	Inflammation	10	9.5
	Toothache	4	3.8
	Painful	3	2.9
	Wound	1	1.0
Length of use (days)			
	3	26	24.8
	4	8	7.6
	5	39	37.1
	>5	32	30.5

This demographic information provides insights into the composition of the study population, which is essential for contextualizing the findings. The demographic characteristics of the respondents in this study are consistent with trends observed in previous studies. Most participants were aged 19 to 24 years (96.2%) and were predominantly female (85.7%), consistent with findings from several studies focusing on pharmacy students, where this age group typically constitutes the majority of respondents (Karuniawati *et al.*, 2021). The high percentage of students (84.8%) who reported using antibiotics only after obtaining a doctor's prescription reflects a positive trend toward responsible antibiotic use, often highlighted in educational programs aimed at pharmacy students (Higuita-Gutiérrez, Roncancio Villamil and Jiménez Quiceno, 2020).

However, the reliance on healthcare providers as the primary source of information (74.3%) raises questions about the adequacy of the educational intervention. While this reliance can be seen as beneficial, it also highlights the need for ongoing education on antibiotic stewardship. The dominance of amoxicillin (71.4%) as the most commonly used antibiotic is consistent with findings from other studies showing this antibiotic is frequently prescribed for common infections (Lubwama *et al.*, 2021).

The primary complaint of fever (55.2%) is in line with existing literature, which shows that self-medication practices often originate from symptoms such as fever or mild infections (Widowati *et al.*, 2021).

Table 2. Knowledge, attitude, and practice

		n	%
Knowledge			
High		44	41.9
Fair		43	41.0
Poor		18	17.1
Attitude			
Positive		99	94.3
Negative		6	5.7
Practice			
Good		104	99.0
Poor		1	1.0
		Knowledge	
	Sig. (2 tailed)	p	Correlation
	0.001	<0.05	0.306
Practice		*Attitude*	
	Sig. (2 tailed)	p	Correlation
	0.000	<0.05	0.385

The five-day treatment duration reported by 37.1% of respondents is in line with guidelines that recommend shorter antibiotic courses if needed. It also raises concerns about potential variations in treatment practices and adherence to clinical guidelines.

Knowledge. Attitude, and Practice

The table below shows respondents' knowledge, attitudes, and practices about antibiotic use. These findings are crucial for assessing the overall efficacy of educational initiatives and identifying areas for improvement in antibiotic prescribing behavior.

Table 2 presents the distribution of knowledge, attitudes, and practices related to antibiotic use among respondents. The table shows that a significant percentage of respondents had a high level of understanding on antibiotic use, with 44 (41.9%) categorized as having good knowledge. Also, attitudes about antibiotic use were positively reflected, with 99 (94.3%) respondents reporting positive attitudes. Furthermore, 104 respondents (99.0%) determined antibiotic use as good, indicating that this community conforms to appropriate antibiotic consumption standards.

These findings are consistent with previous studies showing that health science students have high levels of knowledge, attitudes, and practices on antibiotics, which is associated with the inclusion of relevant courses in their academic curriculum (Wisudanti, Setyaningrum and Efendi, 2023). However, the presence of a large proportion of respondents with inadequate expertise suggests an opportunity for improvement. In contrast, a survey of final-year pharmacy students found significantly lower results in knowledge of antibiotic resistance and its application in clinical situations (Lubwama *et al.*, 2021). This gap reveals a significant gap in practical training and emphasizes the need for improved pedagogical approaches. The findings suggest that, despite having academic understanding, students may lack the practical ability to use this knowledge effectively in real-world contexts. This gap allows educational institutions to enrich the curriculum by integrating new learning modules on antibiotic management and resistance.

The correlation findings in this study reveal important insights into the relationship between knowledge, attitudes, and practices regarding antibiotic use among pharmacy students. The correlation coefficient of r = 0.306 between knowledge and antibiotic use practices suggests a relatively low but significant relationship (Sig. 2-tailed = 0.001). This aligns with previous research that has demonstrated a positive, albeit weak, association between knowledge levels and appropriate antibiotic practices. For instance, previous studies similarly found that while increased knowledge correlated with better practices, the influence of additional factors such as external pressures, misconceptions, and peer behaviors was notable. Also, this is consistent with prior studies, which showed a significant correlation between knowledge and the use of antibiotics practice (Hamdani, Nuari and Rahayu, 2021; Dewi *et al.*, 2024).

In contrast, the stronger correlation identified between views toward antibiotic usage and actual behaviors (r = 0.385, p-value = 0.000) implies a moderate relationship, consistent with previous research. Previous research found a high correlation between attitudes and antibiotic awareness (Lubwama *et al.*, 2021; Dewi *et al.*, 2024). Lubwama et al. (2021) found that positive attitudes significantly affected students' willingness to follow suggested antibiotic use procedures. This shows that encouraging positive attitudes may be a significant strategy for improving practical antibiotic stewardship among pharmacy students.

The differences in the impact of knowledge and attitudes underscore the complexities of behavior modification in healthcare settings. While knowledge is essential for making correct choices, attitudes tend to be a more immediate motivator of behavior. It indicates that educational interventions should not only represent knowledge but also influence attitudes through experiential learning, role-playing, and exposure to real-life settings (Sutema *et al.*, 2023; Widowati *et al.*, 2023).

Overall, these findings highlight the importance of diverse educational approaches that consider both knowledge and attitudes. Future research ought to investigate other factors that may influence antibiotic usage behaviors, such as social effects, practical experiences, and the impact of clinical training. Understanding these dynamics allows academics to better prepare pharmacy students for the challenges of promoting responsible antibiotic use in clinical practice.

4. Conclusions

The results of this study demonstrate a statistically significant correlation between antibiotic knowledge, attitudes, and practices. The study has considerable limitations. First, the cross-sectional design restricts the ability to demonstrate a causal relationship between the variables studied. Second, relying on self-reported statistics may introduce bias, as respondents may provide socially desirable responses rather than their actual practices. Finally, the sample size was limited to pharmacy students in Bali, which may reduce the findings' applicability to a larger population. Future research should use longitudinal designs to better understand the causal effects of antibiotic knowledge and attitudes across time.

Acknowledgment

The authors would like to express gratitude to the pharmacy students who have taken the time to fill out the questionnaire and to all parties involved in this research.

Conflict of interest

The authors stated there is no conflict of interest in this study.

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