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ORIGINAL RESEARCH

Knowledge, Attitude and Practice of Antimicrobial Usage Among Undergraduate Medical Students in Universities and Institutes, Thamar, Yemen

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Background: As future healthcare providers, medical students play a crucial role in the community. They are expected to prescribe antibiotics responsibly and educate patients about their proper use, which is essential in combating antibiotic resistance.

Objective: Our aim was to evaluate how undergraduate medical students in Thamar Governorate understand, perceive, and use antibiotics. This includes their knowledge of antibiotic resistance and their practices related to antibiotic use.

Methodology: Sample of 1000 medical students participated in a cross-sectional descriptive study. Which involved the use of a semi-structured survey questionnaire? Which featured both open-ended and closed-ended (multiple-choice) questions. The research team's modified questionnaire was completed by medical students themselves.

Results: Out of the total of 1000 participants, 600 provided information on their antibiotic usage. Females constituted 51.7% and 60.3% had completed undergraduate education. A 52.2% of participants showed a good understanding of antibiotic usage and 63% used antibiotics as antibacterial, while smaller percentages used them as antivirals (18%), antifungals (13%), or antiparasitic (6%). However, 65.8% identified the indiscriminate administration of antibiotics as the primary catalyst for bacterial resistance and 61.7% reported using the full dose of antibiotics as prescribed, and only 65% dispensed antibiotics with a prescription. However, 70.7% admitted to taking antibiotics based on a pharmacist's recommendation without a prescription.

Conclusion: This study showed that medical students have an overall positive attitude and very good awareness, knowledge, and practice regarding antibiotic usage, resistance, and dispensing. However, high percentage of the participants admitted obtaining the antibiotic without a prescription.

Keywords: knowledge, attitude, practice, antibiotics, medical students, Yemen

Introduction

Antibiotics (ABs) are among the most commonly prescribed and purchased drugs worldwide particularly in developing countries.[1] Medical students (MS) typically exhibit differences from the general population due to their exposure to knowledge about diseases and drugs.[2] As primary care staff and providers, medical students play an important role in serving the community. As prospective prescribers, they are at the forefront of the battle against antibiotic resistance. By prescribing antibiotics rationally and promoting patient awareness, they contribute to the fight against anti-biotics resistance.[3,4] The insufficient training provided during the medical degree program may be regarded as a contributing factor to antibiotic resistance.[4] Recent research has primarily focused on students in medical, pharmacy, and health science fields. Al-Qassim University in Saudi Arabia conducted a study that exclusively examined male participants.[5] Antibiotic resistance (ABR) has been a significant concern since the second half of the 19th century. The use of antimicrobial agents has greatly impacted contemporary medicine, leading to the saving of countless lives from deadly microbial infections and alleviating

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suffering in patients.[6,7] This remarkable achievement led to a misleading perception of infectious disease elimination in the late 1960s and early 1970s. However, it is important to note that as recently as 2010, approximately 15 million individuals lost their lives due to infections. Furthermore, the report predicts that the World Health Organization (WHO) will attribute 10 million fatalities to antibiotic resistance (ABR) by 2050.[7] The way physicians prescribe antibiotics and patients' comply with treatment has a significant impact on the increase in antibiotic resistance. This pharmaceutical industry's lack of new drug development further exacerbates this issue.[8,9] Others studied the use of medication without a medical prescription.[10,11] It is common to observe inappropriate prescribing and dispensing of antibiotics in Yemen Al-Akydy et al and Al Akhali et al.[12,13] It is crucial for medical students to acquire the skill of prescribing medications safely and effectively, as they will routinely engage in this practice once they graduate and obtain their medical licenses, often with minimal oversight.[7,14] Effective prescribing skills foster rational and judicious medication practices, thereby improving patient outcomes, treatment adherence, and reducing healthcare expenditures. Nonetheless, antibiotics are frequently misused due to the perception that they are harmless and that patient satisfaction is contingent upon their prescription.[15] Yemen is a developing country where the health system is not organized neither controlled. The antibiotics usually are being prescribed with a proper prescription. This resulted in elevated levels of antibiotic resistance in the common infections. This underscores the significance of this study in assessing the knowledge, attitudes, and practices regarding antibiotic use among a crucial segment of society, specifically medical students.

Materials and Methods

Study Design

An observational study was conducted from January to April 2021, utilizing a design aimed at gathering information and data regarding the knowledge, attitude, and practice (KAP) associated with antibiotic use and the emergence of antibiotic resistance. The data were gathered through a semi-structured questionnaire survey. The questionnaire included 24 questions, that consisted of both open-ended and closed-ended (multiple-choice) questions. Previous validations had proven this questionnaire to be an effective and efficient method for gathering data. The sources (provide further information on the validation of this questionnaire.[16]

Study Area

The study was conducted in Thamar province, which encompasses Thamar University, Al-Saeeda University, Al-Hikma University, Thamar University Institute for Continuing Education, Higher Institute of Health Sciences, and Applied College of Science and Technology.

Study Population and Sample Size

The questionnaire was distributed to 1000 randomly selected students from each departments of [(Pharmacy, Clinical Pharmacy, Medicine College, D. Pharm (Diploma of Pharmacy)]. The total number of the students is the entire sample that includes all students in the above-mentioned departments, universities and colleges.

Inclusion Criteria

The study is open to all medical students (second, third and fourth year), irrespective of gender, who are between the ages of 19 and 26.

Exclusion Criteria

The study did not include students who were absent throughout the study period.

Development of Questionnaire

The research team designed and developed a structured questionnaire in English, which they then translated into Arabic. The research team distributed the questionnaire to the study population, adapting it based on previous studies and including all of the research topic's key points.

The final version of the questionnaire was divided into four sections:

Section 1: Socio-demographic Characteristics This section of the questionnaire consisted of three questions aimed at gathering information about the socio-demographic characteristics of the students, including age, gender, and education level.

Section 2: The dataset included 10 questions about AB's expertise and five questions about antibiotic utilization. The ABs of the local factory display a sense of assurance. The discourse centers on the management of diseases and infections, with a specific emphasis on the efficacy of powder-based remedies for UTI, malaria, and skin wounds. Furthermore, there are five inquiries pertaining to understanding antibiotic resistance, encompassing the ramifications of bacterial resistance, the causes underlying the emergence of antibiotic resistance, the transmission of antibiotic resistance between individuals, and the particular challenges encountered in Yemen.

Section 3: This provides information on the attitude toward antibiotic use. It consists of eight questions that focus on the instructions given before purchasing a prescription. This study examines the impact of price on the utilization of antibiotics obtained from friends or family members. Please consult with a medical professional to obtain a prescription for antibiotics if you have contracted a cold. Consider the average number of at-bats you have had in the past year. Ensure that you complete the prescribed course of antibiotics as directed by your doctor. It is critical to follow the specific instructions provided and maintain a responsible approach to personal antibiotic consumption.

Section 4: The study focused on the practice of dispensing antibiotics without a medical prescription. It included three questions regarding the frequency and circumstances in which individuals took antibiotics without consulting a healthcare professional. Providing antibiotics without a medical prescription cannot be justified but it might be due to lack of organized health system in Yemen. Purchase or consumption of antibiotics for self-medication is very common.

Analysis of the Questionnaire

The KAP questionnaire designed a scoring system to compare the three specialties. We have highlighted some significant questions and summarized the correct answers.[17]

Study Participants

The university and institutes were randomly selected a sample of one thousand participants from pharmacy, clinical pharmacy, medicine college, Higher Institute of Health Sciences, and Applied College of Science and Technology. A total of 600 students, representing 60% of the total sample size of 1000, answered the questionnaire. The respondents were divided into a single group based on their respective majors, with 100% (n = 600) pursuing medical majors.

Study Procedure

While distributing the questionnaire to the students in the chosen medical majors, the research's objective was explained and assured participants of their privacy. Additionally, we secured both verbal and signed consent from the students. All participants received guidance on how to complete the questionnaire. We collected the completed questionnaires from the students and organized their results into tables for statistical analysis.

Statistical Analysis

The data were analysed using the Statistical Package for the Social Sciences (SPSS) version 25.0. The findings were presented in terms of frequencies, percentages, and mean variables. The study utilized one-way ANOVA for continuous data and Chi-Square (x2) tests to determine significant level differences, with a threshold of P-value< 0.05. Spearman's rank-order correlation coefficient was employed to analyze the relationship between the responses to the KAP questions.

Results

The distribution of 600 questionnaires yielded slightly more female respondents (n = 310, 51.7%) than male respondents (n = 290, 48.3%). The majority of the respondents in the age group of 20–25 years were 449 (74.8%). The majority of respondents had a bachelor's degree. (362 respondents, 60.3%), while a smaller percentage had a diploma (238 respondents, 39.7%), respectively. Table 1 displays the data.

Table 1 Distribution of the Respondents' Socio-Demographic Factors (N = 600)

Socio-Demographic Characteristics	N	%
Age Years:		
<20	130	21.7%
20–25	449	74.8%
>25	21	3.5%
Sex:		
Male	290	48.3%
Female	310	51.7%
Education level:		
Diploma	238	39.7%
Bachelor	362	60.3%

Figure 1 displayed a clear distribution of the substances' properties: 63% exhibited antibacterial effects, 18% demonstrated antiviral properties, 13% showed antifungal activity, and 6% acted as antiparasitic agents.

In Figure 2, the data shows that the majority of students have a low level of confidence at local factor 51.5%.

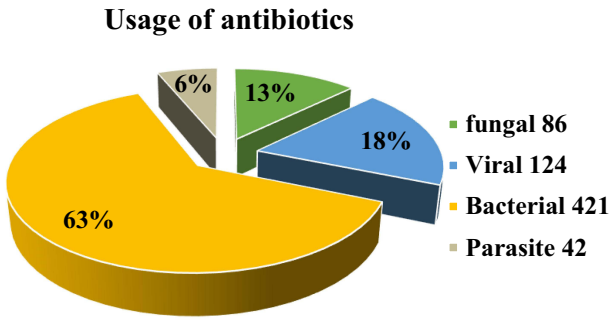

Figure 1 Usage associated with antibiotics.

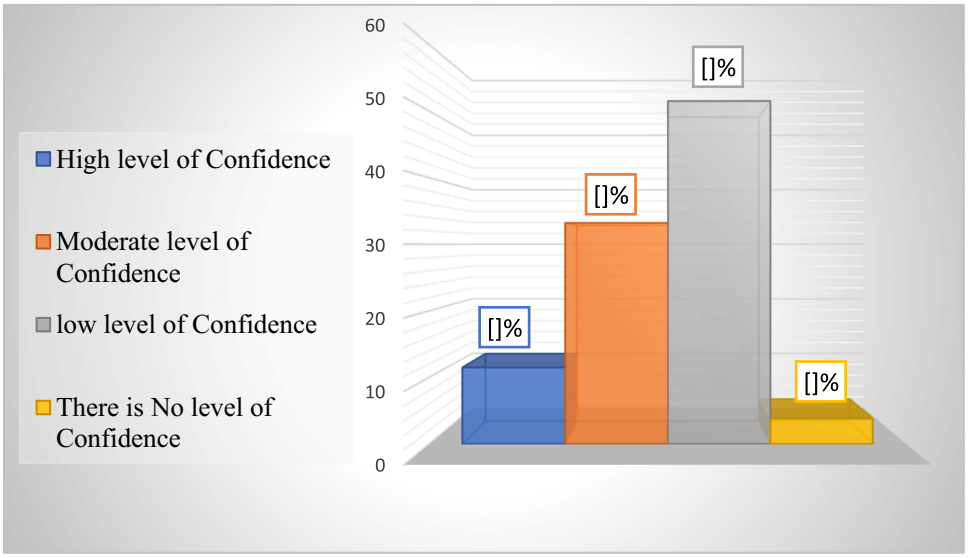

Figure 2 The confidence of antibiotics the local factor.

Table 2 shows the respondents' knowledge about the effectiveness of antibiotics for treating specific conditions in Urinary Tract Infection 48.6% believe antibiotics are effective, 13.7% do not, and 37.7% are unsure. While in Skin Infection 42.3% believe antibiotics can treat skin infections quickly by pouring powders on wounds, 38.5% do not, and 19.2% are unsure. The Mean and the P-value indicate the statistical significance of the responses.

Table 3 displays a range of participants' grades based on their level of knowledge of antibiotic usage and resistance. P-value (0.154) suggests no significant difference between genders.

Table 4 explores respondents' awareness of antibiotic resistance: Heard about bacterial resistance: 77.2% yes, 12.6% no, 10.2% unsure. (Random use of antibiotics as a reason for resistance) 65.8% yes, 20.5% no, 13.7% unsure. Insufficient knowledge contributes to resistance: 65% yes, 15.8% no, 19.2% unsure. Resistance spreads from person to person: 38.3% yes, 36.5% no, 25.2% unsure. Antibiotic resistance is a problem in Yemen: 74.3% yes, 13% no, 12.7% unsure. The Mean and P-value indicate the statistical significance of responses.

Table 5 shows the attitudes toward antibiotic usage: Follow prescription instructions: 78.7% yes, 20.2% no, 1.2% unsure. Use antibiotics given by friends/family: 33.2% yes, 60.8% no, 6% unsure. Ask doctors to prescribe antibiotics for a cold: 46.7% yes, 48.5% no, 4.8% unsure. Frequency of antibiotic use in the last year: 32.8% never, 42.2% 1–3 times, 13.5% 3–5. Frequency of antibiotic use in the last year: 32.8% never, 42.2% 1–3 times, 13.5% 3–5 times, 11.5% more than 5 times. The Mean and P-value indicate the statistical significance of responses.

Figure 3 illustrates the responses concerning attitudes towards personal use of ABs. The accurate responses provided by the participants for different statements were:

"Do you usually take ABs for runny nose and cough?" (33.6%);

"Do you usually take ABs for sore throat with fever?" (32.9%);

"Do you use ABs when you have body aches with fever?" (30.2%);

"Do you usually take ABs when nasal congestion?" (24.9%);

"Do you use ABs when you have body nausea, vomiting and diarrhea?" (16.9%);

"Do you use ABs when you have fever more than 39 °C?" (10.2%);

Table 2 The Knowledge and Understanding of Antibiotics Usage

Question of Knowledge of Uses of Antibiotics		N	%	Mean	P=0.05
Antibiotics effective for treating urinary tract infection?	Yes	292	48.6%	1.89	0.040
	NO	82	13.7%		
	I do not know	226	37.7%		
Antibiotics effective for treating malaria?	Yes	268	44.7%	1.9033	0.001
	NO	122	20.3%		
	I do not know	210	35%		
A skin infection be treated quickly by pouring ABs powders on wound?	Yes	254	42.3%	1.7683	0.468
	NO	231	38.5%		
	I do not know	115	19.2%		

Table 3 The Knowledge and Understanding of Antibiotic Resistance

Knowledge Level	Male (N & %)		Female (N & %)		Total (N & %)		P=0.05
Excellent	65	22.4%	47	15.2%	112	18.7%	0.154
Very Good	143	49.3%	170	54.8%	313	52.2%	
Good	74	25.5%	84	27.1%	158	26.3%	
Poor	8	2.8%	9	2.9%	17	2.8%	
Total	290	100%	310	100%	600	100%	

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Table 4 Knowledge Level of Antibiotics Usage and Resistance

Question About Knowledge of Antibiotic Resistance		N	%	Mean	P=0.05
Have you heard about bacterial resistance to ABs?	Yes	463	(77.2%)	1.33	0.273
	NO	76	(12.6%)		
	I do not know	61	(10.2%)		
Randomly use of ABs main reason for bacteria resistance to them?	Yes	395	(65.8%)	1.4783	0.402
	NO	123	(20.5%)		
	I do not know	82	(13.7%)		
Does insufficient knowledge of ABs contribute to the development of bacterial resistance to them?	Yes	390	(65%)	1.5417	0.038
	NO	95	(15.8%)		
	I do not know	115	(19.2%)		
Resistance of bacteria to ABs spread from one person to another?	Yes	230	(38.3%)	1.8683	0.00029
	NO	219	(36.5%)		
	I do not know	151	(25.2%)		
Antibiotic resistance a problem in Yemen?	Yes	446	(74.3%)	1.3833	0.077
	NO	78	(13%)		
	I do not know	76	(12.7%)		

Table 5 Attitude and Understanding of Antibiotic Usage

Question About Attitude of Antibiotics		N	%	Mean	P=0.05
Do you strictly follow the prescription instructions when purchasing the ABs?	Yes	472	(78.7%)	1.2250	0.918
	NO	121	(20.2%)		
	I do not know	7	(1.2%)		
Does the price of ABs affect when you buy them?	Yes	306	(51%)	1.6200	0.0004
	NO	216	(36%)		
	I do not know	78	(13%)		
Usage ABs that were gives to a friend or a member of your family that were uses to treat the same infection that you have?	Yes	199	(33.2%)	1.7283	0.087
	NO	365	(60.8%)		
	I do not know	36	(6%)		
Do you ask the doctor to prescribe ABs when you catch a cold?	Yes	280	(46.7%)	1.5817	0.066
	NO	291	(48.5%)		
	I do not know	29	(4.8%)		
How many times have you taken an ABs in the last year?	0 times	197	(32.8%)	2.0367	0.016
	1–3 times	253	(42.2%)		
	3–5 times	81	(13.5%)		
	>5 times	69	(11.5%)		
Do you use the full dose of ABs?	Yes	370	(61.7%)	1.3833	0.978
	No	230	(38.3%)		
Do you use the daily dose of ABs at the same time specified by the doctor?	Yes	437	(72.8%)	1.2750	0.609
	No	163	(27.2%)		

Table 6 categorizes respondents' attitudes toward antibiotic usage: Poor: 25% (19% male, 30.7% female) Good: 63.5% (68.6% male, 58.7% female) Very Good: 10.5% (11% male, 10% female) Excellent: 1% (1.4% male, 0.6% female) The P-value (0.01) suggests a significant difference between genders.

Table 7 shows the correlation between respondents' knowledge and attitude levels:

Excellent knowledge: Mostly correlated with good attitude (74 out of 112).

Very Good knowledge: Mostly correlated with good attitude (202 out of 313).

Good knowledge: Mostly correlated with good attitude (97 out of 158).

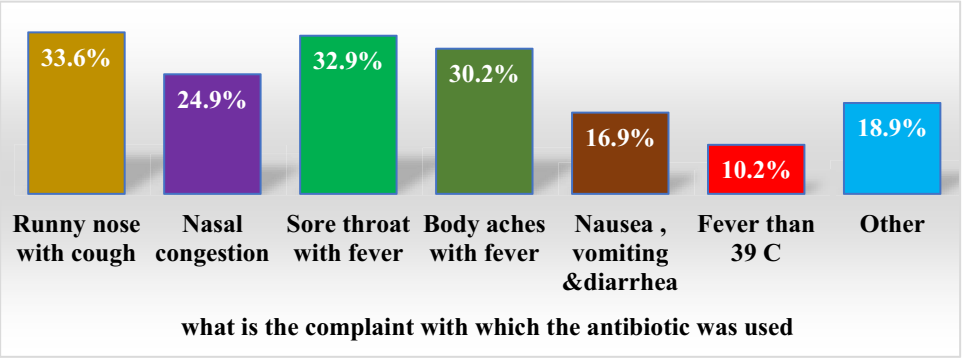

Figure 3 Attitudes regarding personal consumption of antibiotics.

Poor knowledge: Mostly correlated with poor attitude (8 out of 17).

According to Figure 4, the percentage of antibiotic dispensing with a prescription was 65%, which was higher than the percentage without a medical prescription.

The survey results indicated a relatively low level of awareness regarding ABR, with 49% of respondents lacking knowledge and 44% lacking control. The remaining 7% cited other reasons. As shown in Figure 5

Figure 6 shows that out of a total of 600 students, 70.7% obtained ABs without a medical prescription, based on a pharmacist's recommendation; another 8.4% obtained ABs from a website, 24.6% from a previous prescription, and 3.3% from advertisements.

Table 8 categorizes the practice level of dispensing antibiotics:

Excellent: 33.33% (30.3% male, 36.1% female)

Very Good: 55% (59.7% male, 50.7% female)

Good: 11.33% (10% male, 12.6% female)

Poor: 0.33% (0% male, 0.6% female)

The P-value (0.091) suggests no significant difference between genders.

Table 9 shows the correlation between respondents' knowledge and practice levels:

Table 6 Attitude Level of Antibiotics Usage

Attitude Level	Male (N & %)		Female (N & %)		Total (N & %)		P=0.05
Poor	55	(19%)	95	(30.7%)	150	(25%)	0.01
Good	199	(68.6%)	182	(58.7%)	381	(63.5%)	
Very Good	32	(11%)	31	(10%)	63	(10.5%)	
Excellent	4	(1.4%)	2	(0.6%)	6	(1%)	
Total	290	(100%)	310	(100%)	600	(100%)	

Table 7 Correlation Between Knowledge and Attitude

Correlation		Attitude				Total
		Excellent	Very Good	Good	Poor	
Knowledge	Excellent	1	13	74	24	112
	Very Good	4	32	202	75	313
	Good	1	17	97	43	158
	Poor	0	1	8	8	17
Total		6	63	381	150	600

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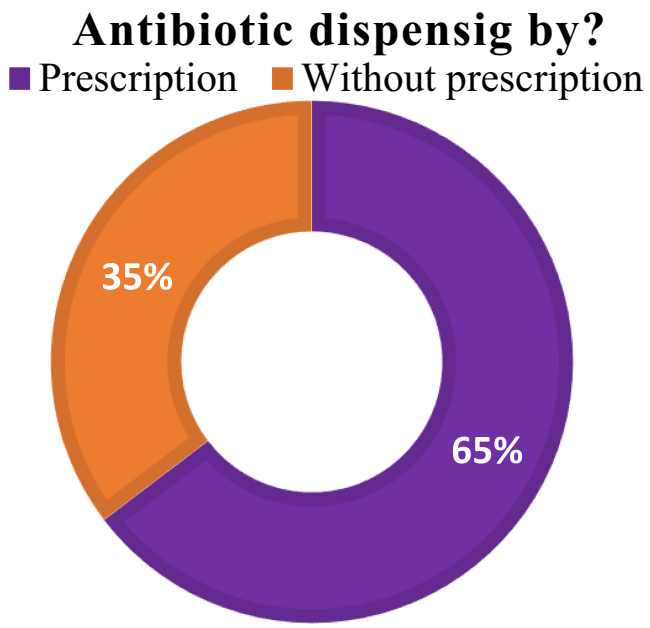

Figure 4 Antibiotics dispensing.

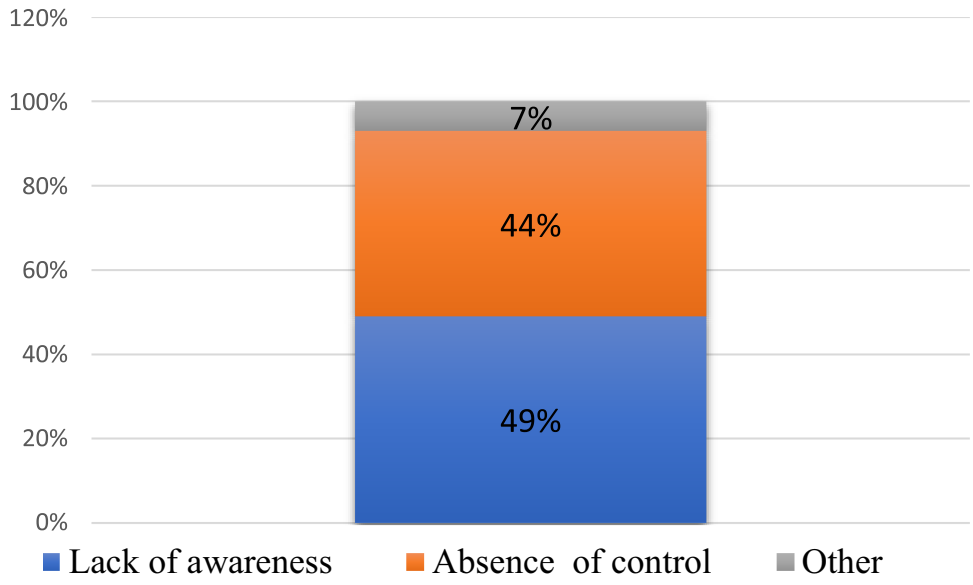

Figure 5 Dispensing antibiotics without medical prescription reason.

Excellent knowledge: Mostly correlated with very good practice (64 out of 112).
Very Good knowledge: Mostly correlated with very good practice (175 out of 313).
Good knowledge: Mostly correlated with very good practice (82 out of 158).
Poor knowledge: Mostly correlated with excellent practice (6 out of 17).

Discussion

This study assesses KAP toward uses of antibiotics among medical students in Universities and Institutes, Thamar Province. Pharmaceuticals frequently use ABs, especially in developing nations worldwide. The global issue of bacterial

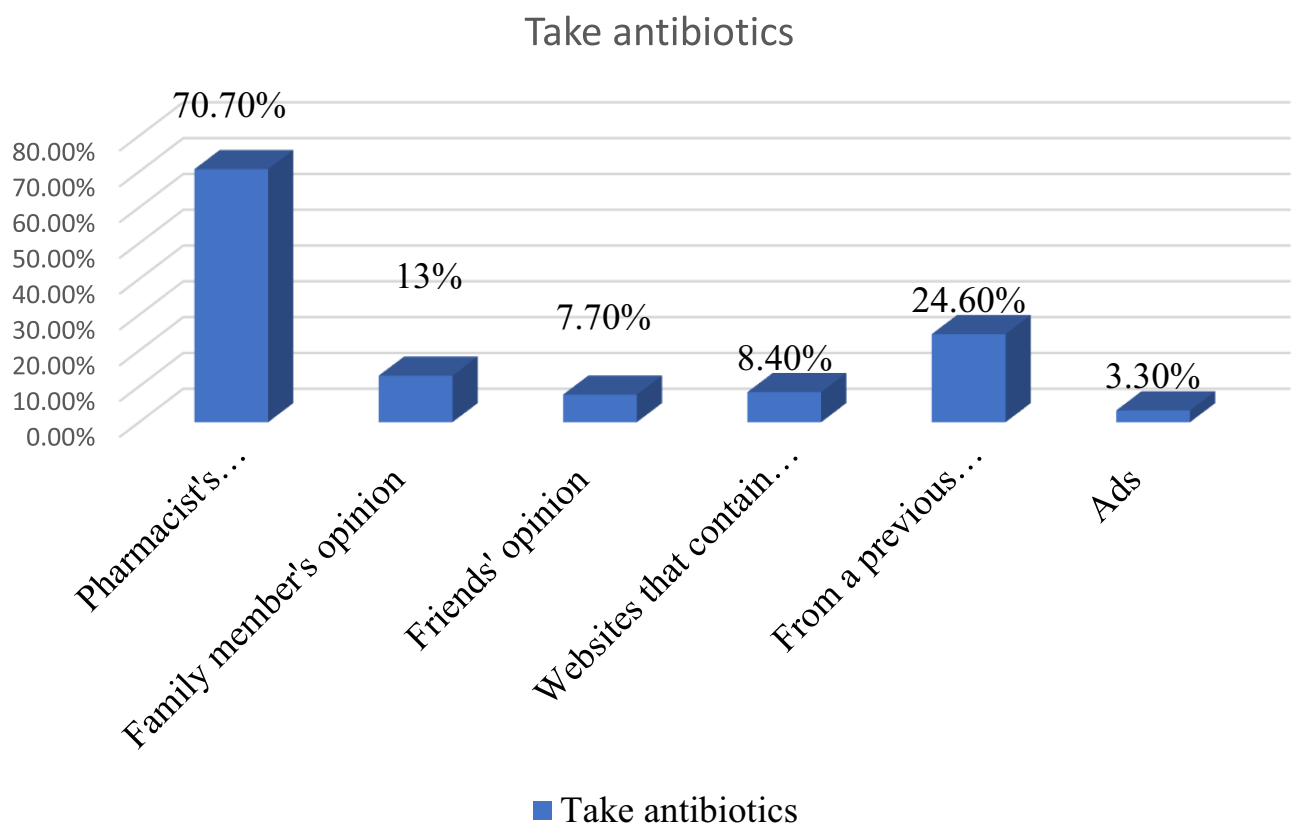

Figure 6 Source to take antibiotics.

resistance to antibiotics is extensive. Prescribers, pharmacists, and patients closely link the effectiveness of antibiotics to their proper utilization.

In the Thamar study, only 18.7% of medical students demonstrated an exceptional level of knowledge about antibiotics, with 52.2% classified as very good and 26.3% as good. In contrast, a study in Lebanon found that 80.2%

Table 8 Level Practice of Dispensing Antibiotics

Practice Level	Male (N & %)		Female (N & %)		Total (N & %)		P=0.05
Excellent	88	(30.3%)	112	(36.1%)	200	(33.33%)	0.091
Very Good	173	(59.7%)	157	(50.7%)	330	(55%)	
Good	29	(10%)	39	(12.6%)	68	(11.33%)	
Poor	0	0	2	(0.6)	2	(0.33%)	
Total	290	(100%)	310	(100%)	600	(100%)	

Table 9 Correlation Between Knowledge and Practice

Correlation		Practice				Total
		Excellent	Very Good	Good	Poor	
Knowledge	Excellent	34	64	14	0	112
	Very Good	109	175	27	2	313
	Good	51	82	25	0	158
	Poor	6	9	2	0	17
Total		200	330	68	2	600

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of Medical students demonstrated an understanding of the effectiveness of antibiotics in addressing bacterial infections. Due to the quality and depth of medical education may vary between regions. In Lebanon, medical students might receive more comprehensive training on antibiotic use and resistance compared to students in Thamar Province.[16]

The present study shows 77.2% of students were aware of bacterial resistance, while in Lebanon 93.3% of participants were familiar with antibiotic resistance.[16] Similarly, in Nepal 88.6% of respondents recognized antibiotic resistance as a significant global issue. The reason shows that countries with higher awareness levels may have more robust public health campaigns and educational programs focused on antibiotic resistance.[18] In contrast, Thamar Province may lack such initiatives. As well as students in regions with greater access to global health information (eg, through the internet, medical journals, or international conferences) may be more aware of antibiotic resistance.

In this study, only 1% of students had an exceptional attitude toward antibiotic use, while 63.5% had a decent attitude, and 25% had a poor attitude. In contrast, a study in Sudan found that 33.3% of individuals had excellent attitudes toward antibiotic use.[19] The reason behind that is in some regions, there may be a cultural tendency to self-medicate or use antibiotics without a prescription, which could influence students' attitudes. In Thamar, traditional practices (eg, using leftover antibiotics) may contribute to poorer attitudes. Additionally, the quality of clinical training and mentorship may vary. In regions where students are taught to critically evaluate the need for antibiotics, attitudes may be more positive.

Our study illustrates 49% of medical students dispensed antibiotics without a prescription. However, in Lebanon the rate of non-prescription antibiotic use was much lower. In countries with strict pharmacy regulations, dispensing antibiotics without a prescription is less common.[16] In Thamar, the lack of government oversight may contribute to higher rates of non-prescription dispensing. And In developing nations, the cost of healthcare and antibiotics may drive individuals to self-medicate or seek antibiotics without a prescription. This economic pressure may influence medical students' practices.

The study conducted shows 78.7% of participants reported following prescription instructions, which is higher than the 51.5% adherence rate found in Sudan.[19] However, in Nepal 78.9% of participants completed the entire treatment regimen.[18] In Thamar, medical students may be more diligent in educating patients about the importance of completing antibiotic courses, leading to higher adherence rates. Also, in some regions, cultural practices (eg, stopping medication when symptoms improve) may lead to lower adherence rates. In Thamar, cultural factors may be less influential in this regard. The structure of the healthcare system (eg, follow-up mechanisms, patient monitoring) may influence adherence rates. In Thamar, better follow-up systems may contribute to higher adherence.

In our study, 60.8% of students disagreed with using leftover antibiotics for friends or family, compared to 40.9% in India.[20] As Thamar may have more effective educational interventions that discourage the use of leftover antibiotics, leading to higher disagreement rates.

Conclusions

This study demonstrated a generally positive attitude, strong knowledge, and effective practices regarding antibiotic usage, resistance, and dispensing among medical university students. The student exhibits limited confidence regarding antibiotics. The female's knowledge regarding antibiotic utilization and resistance was superior to that of the male. The majority of students adhered to the prescribed instructions, taking the full dosage at the designated times as directed by their physician while disregarding the impact of antibiotic prices during the purchasing process. Without a physician's prescription, most students obtained antibiotics directly from commercial pharmacies, a significant result ($P = 0.001$). The positive attitude was more prevalent in males than females regarding antibiotic utilization, with a significance level of $P = 0.01$. The relationship between responses to knowledge and attitude questions demonstrates a significant disruption in understanding antibiotic use. Males exhibited good practice behaviour more frequently than females, with females demonstrating superior antibiotic dispensing practices compared to males. The relationship between knowledge answers and practice questions demonstrated significant disruption in excellent performance, moderate disruption in outstanding performance, and no disruption in poor practice.

Data Sharing Statement

All data presented in the manuscript can be obtained upon request.

Ethical Approvals

Thamar University, Yemen's Faculty of Medicine and Health Science's Institutional Review Board of the Ethics Committee approved this study (REC-48-2021), which followed all guidelines laid out in the Declaration of Helsinki.

Patient Consent

During the distribution of the questionnaire to students in the specified medical majors, an explanation of the research's goal is given. All individuals who participated in the study provided verbal informed consent. We invited everyone to complete the questionnaire. We manually gathered the completed questionnaire from the students and translated the data into tables for statistical analysis. After receiving complete information regarding the publication of their data in the journal, each and every participant provided their consent to continue with the study.

Acknowledgments

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Author Contributions

The data analysis, the composition or revision of the manuscript, the final approval of the publishing version, and the accountability for all elements of the work were all contributions made by all of the authors.

Disclosure

The authors report no conflicts of interest in this work.

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