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Knowledge, attitude, and practices of pharmacy students in 7 Middle Eastern countries concerning antibiotic resistance

A cross-sectional study

Abdallah Y. Naser, PhD[a,*], Rafat Aboutaleb, MSc[b], Anas Khaleel, PhD[c], Zahra K. Alsairafi, PhD[d], Hassan Alwafi, PhD[e], Sami Qadus, PhD[f], Rania Itani, PhD[g], Faris El-Dahiyat, PhD[h], Ahmed Awaisu, PhD[i], Oriana Awwad, PhD[j], Mervat Alsous, PhD[k], Ghada Mohammad Abdelwahab, MSc[a], Hani M.J. Khojah, PhD[l], Amal Khaleel AbuAlhommos, MSc[m], Alaa A. Alsharif, PhD[n], Aseel Ghazi Alghanemi, MD[o], Ahmed M. Al Rajeh, PhD[p], Jaber S. Alqahtani, PhD[q], Abdulelah M. Aldhahir, PhD[r], Abdullah A. Alqarni, PhD[s], Anan S. Jarab, PhD[h,t,u], Ashraf Saad Hassanin, MSc[a], Mahmoud Jaber, BSc[a], Abdolelah Jaradat, PhD[a], Esra' O. Taybeh, PhD[a], Yosra J. Alhartani, BSc[a], Asaleh El-Qasem, MSc[v], Amer Hamad Issa Abukhalaf, PhD[w], Sara Ibrahim Hemmo, MSc[a], Alyaa Ismael Ahmad, MSc[a], Mohamed Bahlol, PhD[x]

Abstract

Addressing antimicrobial resistance (AMR) stands as a major global health challenge threatening humanity. Resolving this issue can be initiated through emphasizing the significance of AMR education among students in health colleges during their undergraduate studies. Hence, the aim of this study is to assess the pharmacy students' knowledge, attitudes, and practices regarding antibiotic resistance in 7 Middle Eastern countries. A cross-sectional study was conducted among undergraduate pharmacy students at universities in Egypt, Jordan, Saudi Arabia, Lebanon, the United Arab Emirates, Qatar, and Kuwait between March 2021 and January 2022. The first section of the questionnaire gathered demographic information. The knowledge section comprised 7 questions. Subsequently, the questionnaire explored participants' attitudes (6 items) and practices (2 items) concerning antibiotic resistance. Mann-Whitney and Kruskal–Wallis tests were used to compare the median knowledge score between different demographic groups. Logistic regression was used to estimate odds ratios, with 95% confidence intervals (CIs) for being more knowledgeable about antibiotic resistance. A 2-sided $P < .05$ was considered statistically significant. A total of 4265 pharmacy students were involved in this study (Egypt (2249), Jordan (n = 704), Saudi Arabia (n = 531), Lebanon (n = 401), United Araba Emirates (n = 130), Qatar (n = 129), and Kuwait (n = 121)). The median knowledge score for the participating pharmacy students was 5.00 (IQR = 4.00–6.00) out of 7, equals to 71.4% with 4th, and 5th year students and bachelor of pharmacy program students have higher odds of being more knowledgeable about antibiotics resistance compared to other students ($P < .05$). The majority of the students agreed that antibiotic resistance is increasing, they should be more concerned regarding antibiotic consumption and that government should create more awareness of antibiotic resistance, and that they should have enough knowledge to prevent antibiotic resistance. Around 3 quarters of the students (73.0%) confirmed that they take antibiotic only after getting prescription from their physician and almost half (51.7%) reported that they take antibiotic to manage their fever. The study concluded good educational programs in Middle East pharmacy schools with the need for targeted educational interventions promoting responsible antibiotic stewardship practices among future pharmacists.

Abbreviations: AMR = antimicrobial resistance, CI = confidence interval, IQR = interquartile range, KAP = knowledge, attitude and practice, WHO = World Health Organization.

Keywords: antibiotic resistance, attitude, knowledge, Middle East, pharmacy, practice

AYN and RA contributed to this article equally.

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The research ethics committee at Isra University, Amman, Jordan, approved the study protocol (SREC/21/06/006). Informed consent was obtained from the study participants prior to study commencement. This study was conducted in accordance with the World Medical Association (WMA) Declaration of Helsinki.

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[a] Department of Applied Pharmaceutical Sciences and Clinical Pharmacy, Faculty of Pharmacy, Isra University, Amman, Jordan, [b] Infectious Disease Control, Södertörn University – School of Natural Sciences, Stockholm, Sweden, [c] Department of Pharmacology and Biomedical Sciences, Faculty of Pharmacy, Petra University, Amman, Jordan, [d] Department of Pharmacy Practice, Faculty of Pharmacy, Kuwait University, Hawalli, Kuwait, [e] Department of Clinical Pharmacology and Toxicology, Faculty of Medicine, Umm Al-Qura University, Makkah, Saudi Arabia, [f] Department of Pharmacy, Faculty of Health Sciences, American University of Madaba, Madaba, Jordan, [g] Pharmacy Practice Department, Faculty of Pharmacy, Beirut Arab University, Riad El Solh, Beirut, Lebanon, [h] College of Pharmacy, Al Ain University, Abu Dhabi, United Arab Emirates, [i] Department of Clinical Pharmacy and Practice, College of Pharmacy, QU Health, Qatar University, Doha, Qatar, [j] Department of Biopharmaceutics and Clinical Pharmacy, The University of Jordan, Amman, Jordan, [k] Department of Pharmacy Practice, Faculty of Pharmacy, Yarmouk

1. Introduction

Antimicrobial resistance (AMR) occurs when bacteria, viruses, fungi and parasites no longer respond to antimicrobial medicines.[1] Worldwide, AMR can negatively impact agriculture, veterinary medicine, and healthcare,[2] and it is declared by the World Health Organization (WHO) that AMR is one of the top 10 global health problems that threaten humanity.[1] The spread and growth of AMR can be attributed to several critical factors, including cultural and social aspects besides over and improper consumption, wrong prescription practices, and self-medication of antimicrobial medications.[3–6] Antimicrobial resistance can also be transmitted or arise as a result of microbial behavior changes, such as genetic mutations that lead to the production of altered membrane proteins or enzymes that influence the effectiveness of drugs. Furthermore, this can develop due to the indiscriminate use of antimicrobials and the absence of antimicrobial stewardship.[1,7]

AMR carries multiple consequences and complications. It complicated the eradication of both simple and serious infections, making it more challenging. Subsequently, this leads to the rising of more severe conditions and eventually to increasing mortality.[1] In 2019, antimicrobial resistance was responsible for about 5 million deaths worldwide, with more than 1.25 million directly caused by bacterial AMR.[8] The urgency surrounding antimicrobial resistance underscores the requirement for a coordinated international action plan to address this problem, as underlined by researchers, numerous groups, and the WHO.[2,9–11] Improving awareness and knowledge of antibiotics among the public and healthcare experts through influential communication, training, and education is among the most essential aspects of addressing antibiotic resistance in the WHO Global Action Plan.[11]

Highlighting the importance of AMR to healthcare students during their university years is a significant initial step. A previous study conducted in Colombia[12] to assess the knowledge, attitude and practice (KAP) regarding antibiotic use and resistance among medical students showed that 16.2% of participants were unaware that some bacterial infections are resistant to all available antibiotics.[12] Another study conducted in Ethiopia to assess the same purpose[13] showed that 55% of participants had a poor level of knowledge regarding AMR.[13] In 2020, in Egypt, a study by Assar et al[14] examined the knowledge and practice gaps in antimicrobial stewardship among Egypt's undergraduate medical students and identified that 96% of the students exhibited satisfactory knowledge and attitude AMR scores. However, the most common misconceptions were that skipping 1 or 2 antimicrobial doses does not contribute to AMR (43%). In Jordan Darwish et al[15] in 2021 examined community pharmacists' knowledge, attitudes, and practices in relation to antibiotic dispensing, antibiotic resistance and antibiotic stewardship. They reported that more than 83.3% perceived antimicrobial resistance as a global problem. Besides, 59.7% of them educate patients about issues of inappropriate antibiotics use. Another recent study by Abu Al-Halawa[16] in 2023 explored Palestinian pharmacists' knowledge, attitudes, and practices concerning antibiotic resistance and reported that 60% of pharmacists dispense antibiotics without a prescription. Besides, 92.1% of the pharmacists agreed that inappropriate use of antibiotics can lead to ineffective treatment.

The Middle East faces unique challenges regarding antibiotic resistance; a prior study performed to assess the prevalence of nosocomial infection and antibiotic resistance in the Middle East demonstrated significant resistance to cephalosporins, carbapenems, penicillin, and fluoroquinolones antibiotics.[17] Pharmacists must perform crucial roles in diminishing antibiotic resistance, as informed by the WHO and the International Pharmaceutical Federation.[18] Moreover, examination of KAP on a university student can be an influential tool to assist in enhancing the utilizing of antibiotics.[19] Understanding KAP for pharmacy students about AMR is critical for developing targeted educational interventions and implementing effective antibiotic stewardship programs in the Middle East. Therefore, this study aims to examine knowledge, attitude, and practices of pharmacy students concerning antibiotic resistance in 7 Middle Eastern countries.

2. Methods

2.1. Study design and settings

Between March 2021 and January 2022, a cross-sectional study was conducted utilizing an online survey tool at universities in Egypt, Jordan, Saudi Arabia, Lebanon, the United Arab Emirates, Qatar, and Kuwait.

2.2. Sampling procedure

The research sample was collected using convenience sampling technique. This type of sampling is a form of nonprobability sampling. This study comprised eligible students who met the inclusion criteria and were available and willing to participate. On the first page of the questionnaire, a consent form was displayed, and students were advised that they could continue or leave. Students were made aware of the significance of their participation by providing them with a clear statement of the study's aims. In the research invitation letter, the inclusion criteria were specified.

University, Irbid, Jordan, [l] Department of Clinical and Hospital Pharmacy, College of Pharmacy, Taibah University, Madinah, Kingdom of Saudi Arabia, [m] Pharmacy Practice Department, Clinical Pharmacy College, King Faisal University, Alhasa, Saudi Arabia, [n] Department of Pharmacy Practice, College of Pharmacy, Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia, [o] Family Medicine Department, Faculty of Medicine, King Abdulaziz University, Jeddah, Saudi Arabia, [p] Department of Respiratory Care, College of Applied Medical Sciences, King Faisal University, Al-Ahsa, Saudi Arabia, [q] Department of Respiratory Care, Prince Sultan Military College of Health Sciences, Dammam, Saudi Arabia, [r] Respiratory Therapy Department, Faculty of Applied Medical Sciences, Jazan University, Jazan, Saudi Arabia, [s] Department of Respiratory Therapy, Faculty of Medical Rehabilitation Sciences, King Abdulaziz University, Jeddah, Saudi Arabia, [t] AAU Health and Biomedical Research Center, Al Ain University, Abu Dhabi, United Arab Emirates, [u] Department of Clinical Pharmacy, Faculty of Pharmacy, Jordan University of Science and Technology, Irbid, Jordan, [v] Faculty of Pharmacy, University of Jordan, Amman, Jordan, [w] Nieri Department of Construction, Development and Planning, Clemson University, Clemson, SC, [x] Department of Pharmacy Practice and Clinical Pharmacy, Specialty of Pharmaceutical Management and Economics, Egyptian Russian University, Cairo, Egypt.

** Correspondence: Abdallah Y. Naser, Department of Applied Pharmaceutical Sciences and Clinical Pharmacy, Faculty of Pharmacy, Isra University, Amman, Jordan (e-mail: abdallah.naser@iu.edu.jo).*

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2.3. Study population

We solicited participation from pharmacy students enrolled in the school of pharmacy at the participating universities. The study population was comprised of all undergraduate pharmacy students from participating universities. The inclusion criteria for this study was to be pharmacy students who are currently studying in one of the participating countries. There were no restrictions on their gender, academic year, or degree program. Students who are currently studying other subjects were excluded.

2.4. Study tool

This study examined pharmacy students' understanding of antibiotic resistance via a questionnaire tool (Supplement 1, Supplemental Digital Content, http://links.lww.com/MD/N480). The questionnaire gathered information regarding country, gender, academic year, and program of study of the students. The knowledge section consists of 7 yes/no questions. Each accurate answer is worth one point, while incorrect answers are worth zero. The higher the score, the greater the knowledge. As there were 7 questions in the knowledge part, the expected maximum score is also 7. The last section of the questionnaire explored participants' attitude (6 items) and practices (2 items) related to antibiotic resistance using multiple choice question format.

2.5. Piloting of the questionnaire tool

The questionnaire instrument was evaluated and validated by clinical pharmacists at Isra University, Petra University, and Sodertorn University. They were questioned regarding the clarity and comprehensibility of the questions, as well as their face validity and whether any were difficult to comprehend. Additionally, they were asked if any of the questions offended or disturbed them. They reported that the questionnaire was easy to comprehend and complete. In addition, prior to applying the questionnaire on a broader scale, a pilot study was done with a small number of pharmacy students to examine its clarity; the results verified that it is straightforward.

2.6. Ethical approval

The research ethics committee at Isra University, Amman, Jordan, approved the study protocol (SREC/21/06/006). Informed consent was obtained from the study participants prior to study commencement. This study was conducted in accordance with the World Medical Association Declaration of Helsinki.

2.7. Statistical analysis

Descriptive statistics were used to describe participants' demographic characteristics. Continuous data were reported as mean (standard deviation) for normally distributed variables and median (interquartile range [IQR]) for not-normally distributed variables. Categorical data were reported as percentages (frequencies). Mann–Whitney and Kruskal–Wallis tests were used to compare the median AMR knowledge score between different demographic groups. Logistic regression was used to estimate odds ratios, with 95% confidence intervals (CIs) for being more knowledgeable about antibiotic resistance. Logistic regression was carried out using median knowledge score as the cutoff point (a median score of 5.00 and above) after confirming the data is not normally distributed using histogram and skewness measure. Participants' demographic characteristics (country, year of study, gender, and program of study) were defined as the independent variables for the logistic regression analysis. A 2-sided $P < .05$ was considered statistically significant. The statistical analyses were carried out using SPSS for Windows (version 29).

3. Results

A total of 4265 pharmacy students were involved in this study (Egypt (2249), Jordan (n = 704), Saudi Arabia (n = 531), Lebanon (n = 401), United Araba Emirates (n = 130), Qatar (n = 129), and Kuwait (n = 121)). About 3 quarters of the participating students were females (75.2%; n = 3201). More than half of the students (69.7%; n = 2959) were studying bachelor of pharmacy degree program. For further details on the demographic characteristics of study participants refer to Table 1.

3.1. Students knowledge about antibiotics resistance

The median AMR knowledge score for the participating pharmacy students was 5.00 (IQR = 4.00–6.00) out of 7, which is equal to 71.4%. There was statistically significant difference in the median AMR knowledge score between students based on their countries, gender, years of study, and program of study ($P < .05$). For further details on students' knowledge score stratified by demographic characteristics, refer to Table 2.

Table 1

Demographic characteristics of study participants.

Demographic variable	Overall (n = 4265)	Frequency (%)						
		Egypt (n = 2249)	Jordan (n = 704)	Saudi Arabia (n = 531)	Lebanon (n = 401)	United Arab Emirates (n = 130)	Qatar (n = 129)	Kuwait (n = 121)
Year of study								
1st year	213 (5.0%)	31 (1.4%)	26 (3.7%)	47 (8.9%)	73 (18.2%)	19 (14.6%)	4 (3.1%)	13 (10.7%)
2nd year	411 (9.7%)	145 (6.5%)	66 (9.4%)	76 (14.3%)	98 (24.4%)	9 (6.9%)	7 (5.4%)	10 (8.3%)
3rd year	700 (16.4%)	296 (13.2%)	149 (21.2%)	107 (20.2%)	53 (13.2%)	7 (5.4%)	54 (41.9%)	34 (28.1%)
4th year	955 (22.4%)	486 (21.7%)	172 (24.4%)	104 (19.6%)	62 (15.5%)	65 (50.0%)	30 (23.3%)	36 (29.8%)
5th year	1779 (41.8%)	1284 (57.3%)	233 (33.1%)	92 (17.3%)	90 (22.4%)	30 (23.1%)	32 (24.8%)	18 (14.9%)
6th year	190 (4.5%)	0	58 (8.2%)	105 (19.8%)	20 (5.0%)	0 (0.0%)	2 (1.6%)	5 (4.1%)
7th year	10 (0.2%)	0	0 (0.0%)	0 (0.0%)	5 (1.2%)	0 (0.0%)	0 (0.0%)	5 (4.1%)
Gender								
Female	3201 (75.2%)	1654 (73.7%)	504 (71.6%)	412 (77.6%)	305 (76.1%)	90 (69.2%)	126 (97.7%)	110 (90.9%)
Program of study: (n = 4240)								
Bachelor of Pharmacy	2959 (n = 69.7%)	1601 (71.8%)	564 (80.1%)	116 (21.8%)	331 (82.5%)	122 (93.8%)	126 (97.7%)	99 (81.8%)
Pharmacy Doctor	1281 (30.2%)	629 (28.2%)	140 (19.9%)	415 (78.2%)	70 (17.5%)	8 (6.2%)	3 (2.3%)	22 (18.2%)

3.2. Predictors of better knowledge about antibiotics resistance

Using binary regression analysis to predict which demographic variable is associated with higher odds of being knowledgeable about antibiotics resistance, we found that 4th, and 5th year students and bachelor of pharmacy program students have higher odds of being more knowledgeable about antibiotics resistance compared to other students ($P < .05$). Besides, students from Egypt showed higher odds of being knowledgeable ($P < .001$). For further details on predictors of better knowledge about antibiotics resistance, refer to Table 3.

3.3. Attitude and practice towards antibiotics resistance

Table 4 below presents pharmacy students' attitude and practices related to antibiotic resistance. The vast majority of the students (89.2%) agreed that antibiotic resistance is increasing. More than 93.0% of them agreed that they should be more concerned regarding antibiotic consumption and that government should create more awareness of antibiotic resistance. Similar percentage (95.2%) of the students agreed that enough knowledge should be generated to prevent antibiotic resistance. A total of 78.6% of the students confirmed that the use of antibiotics in poultry and dairy industries should be strictly monitored. More than half of them (58.4%) agreed that physicians often prescribe antibiotics unnecessarily. Around 3 quarters (73.0%) of the students confirmed that they take antibiotic only after getting prescription from their physician. Almost half of the students (51.7%) reported that they take antibiotic to manage their fever.

4. Discussion

Our study revealed that the median knowledge score for the participating pharmacy students was 5.00 (IQR = 4.00–6.00) out of 7 (this is equal to 71.4%), indicating a good level of understanding regarding antibiotic resistance. However, our findings underscore the presence of significant disparities in the knowledge of antibiotic resistance among pharmacy students, as revealed by statistically significant differences in the median antibiotic knowledge score between students based on demographic factors including country, gender, years of study, and program of study ($P < .05$). These emphasize that developing educational programs to meet the specific necessities of students at different education stages while considering demographic factors may help encourage comprehensive knowledge and awareness of antibiotic resistance among pharmacy students.

The results of our study are consistent with similar studies in East Africa (at 3 universities),[20] Zambia,[21] Pakistan,[22] Trinidad and Tobago,[23] and the UK,[24] where there was good knowledge of AMR among undergraduate pharmacy students. On the other hand, knowledge of AMR was moderate among undergraduate pharmacy students in Malaysia, Indonesia, Sudan, Nigeria, and Pakistan.[25–27] Furthermore, Australian pharmacy students exhibited a higher level of knowledge regarding AMR.[28] However, a lower level of AMR knowledge was noted among Sri Lankan undergraduate pharmacy students.[28] These disparities can result from distinctions in the degree of practical training of students and distinctions in university curricula. These may also explain our findings that 5th-year students and bachelor of pharmacy program students demonstrated significantly higher odds of knowledge about antibiotic resistance compared to other students ($P < .05$). Moreover, regarding demographic factors, in Pakistan, a study of pharmacy technicians working in ambulatory care settings revealed a significant connection ($P < .05$) between awareness of AMR, antibiotic use, and AMR-related terms and particular demographics (training, female, experience, junior).[29]

Other factors that may have induced significant differences in mean AMR knowledge scores include students' interest in infectious disease pharmacy and the field of pharmacy practice they selected post-graduation, as reported in a previous study.[25] It was observed that students who were interested in infectious disease pharmacy showed significantly more elevated knowledge scores regarding AMR compared to those who did not have this interest.[25] Moreover, knowledge of antibiotic resistance was significantly higher among students who

Table 2

Students knowledge score stratified by demographic characteristics.

Demographic variable	Median score (interquartile range)	Mean (standard deviation)	*P* value
Country			
Jordan	5.00 (2.00)	4.7 (1.2)	≤.001
Saudi Arabia	5.00 (2.00)	4.6 (1.2)	
Lebanon	5.00 (2.00)	4.7 (1.2)	
United Arab Emirates	5.00 (2.00)	4.7 (1.2)	
Qatar	5.00 (2.00)	4.8 (1.0)	
Kuwait	5.00 (1.00)	4.4 (1.2)	
Egypt	6.00 (1.00)	5.3 (1.0)	
Year of study			
1st	4.00 (2.00)	4.0 (1.5)	≤.001
2nd	4.00 (2.00)	4.4 (1.4)	
3rd	5.00 (1.00)	4.7 (1.3)	
4th	5.00 (2.00)	5.1 (1.0)	
5th	5.00 (1.00)	5.3 (1.0)	
6th	5.00 (2.00)	5.0 (1.0)	
7th	5.00 (1.25)	5.1 (1.0)	
Gender			
Male	5.00 (2.00)	4.9 (1.2)	.011
Female	5.00 (2.00)	5.0 (1.1)	
Program of study			
Bachelor of pharmacy	5.00 (1.00)	5.1 (11)	≤.001
Pharmacy doctor	5.00 (2.00)	4.8 (1.3)	

Table 3

Binary logistic regression analysis.

Demographic variable	Odds ratio (95% CI)
Country	
Lebanon (reference category)	1.00
Saudi Arabia	0.85 (0.65–1.12)
Jordan	0.91 (0.70–1.18)
Kuwait	0.53 (0.35–0.81)*
Qatar	1.13 (0.74–0.81)
United Arab Emirates	0.93 (0.61–1.41)
Egypt	2.43 (1.92–3.08)**
Year of study	
1st (reference category)	1.00
2nd	0.35 (0.29–0.43)**
3rd	0.59 (0.50–0.71)**
4th	1.18 (1.00–1.40)*
5th	2.84 (2.42–3.31)**
6th	1.02 (0.73–1.43)
7th	1.38 (0.29–6.51)
Gender	
Male (reference category)	1.00
Female	1.11 (0.95–1.30)
Program of study	
Bachelor of pharmacy (reference category)	1.00
Pharmacy doctor	0.65 (0.56–0.75)**

*$P < .05$.
**$P < .001$.

Table 4

Pharmacy students' attitude and practices related to antimicrobial resistance.

Attitude section	Frequency (%)
1. Do you think antibiotic resistance is increasing?	
a. Agree	89.2
b. Disagree	2.7
c. Uncertain	8.1
2. Do you think we should be more concerned regarding antibiotic consumption?	
a. Agree	93.5
b. Disagree	2.1
c. Uncertain	4.4
3. Government should create more awareness of antibiotic resistance	
a. Agree	95.2
b. Disagree	1.5
c. Uncertain	3.3
4. Enough knowledge should be generated to prevent antibiotic resistance	
a. Agree	92.9
b. Disagree	2.2
c. Uncertain	4.9
5. The uses of antibiotics in poultry and dairy industries should be strictly monitored	
a. Agree	78.6
b. Disagree	3.2
c. Uncertain	18.2
6. Do you think physicians often prescribe antibiotics unnecessarily?	
a. Agree	58.4
b. Disagree	16.7
c. Uncertain	24.9
Practice section	
1. How do you generally take antibiotics?	
a. Physician's prescription	72.9
b. Suggested by pharmacists	14.1
c. Self-medication	6.9
d. According to previous prescription	4.2
e. Suggested by friends/relatives	1.9
2. When do you generally take antibiotics (clinical indication, check as required)	
a. Fever	51.7
d. Surgery	43.5
e. Wound/fracture	35.2
b. Cough/cold	28.4
c. Any kind of pain	6.7

decided to practice in a community or hospital pharmacy post-graduation compared to their counterparts.[25] These findings might be supported by earlier studies revealing a significant association between community pharmacists' knowledge of AMR and their years of experience in different regions. In Sudan, a considerable association was observed between community pharmacists' knowledge of AMR and their years of practice; those with more experience showed significantly better knowledge.[30] Likewise, among community pharmacies in Zambia, individuals with at least 1 year of work experience revealed a significantly higher level of AMR knowledge.[31] Furthermore, compared to healthcare professionals with 1 to 5 years of experience, those with over 11 years of experience showed significantly superior knowledge of AMR (more than 3-fold) at Gondar University Hospital.[32] These findings underscore the essential role of professional expertise in increasing awareness and understanding of AMR among healthcare providers. It underlines the necessity of continuing education and tailored training programs for healthcare professionals, particularly pharmacists and pharmacist students who are in the early stages of their careers and studies. Accordingly, effectively addressing the growing AMR challenge.

The results of our study highlighted the strong awareness among pharmacy students regarding the growing antibiotic resistance, with a vast majority (89.2%) recognizing this concern. Furthermore, there was agreement (>93.0%) among students regarding the importance of being more concerned about antibiotic consumption and the imperative of the government to create more awareness. This indicates a proactive attitude among students towards addressing this problem and supporting public education activities. In addition, the agreement (about 95.2%) on the importance of generating adequate knowledge to prevent antibiotic resistance underscores the recognition of education as an essential tool in diminishing this global health threat.

Consistent with these findings, it is established that AMR is among the leading global public health problems, and antibiotic resistance continues to increase globally.[1] Moreover, a prior study conducted among pharmacy students at the University of Zambia found that the students were aware that the improper utilization of antibiotics and growing consumption in humans and animals has exacerbated AMR, a critical global public health concern.[21] Other studies conducted in South Africa and Rwanda demonstrated awareness of this global danger among healthcare students.[33,34]

Our results are consistent with existing literature on AMR and antibiotic use practices. Previous studies confirm the urgent global need to address antimicrobial resistance, especially in regions with high antibiotic consumption rates.[8] Furthermore, the critical need to enhance drug development efforts to combat antimicrobial resistance was emphasized,[35–37] besides the vital role that well-educated pharmacists play in lessening unreasonable antimicrobial use.[18,38] Concerns arise regarding absent pharmacy students from participation in antibiotic awareness campaigns,[21] implying a requirement for increased educational activities to enhance antibiotic use awareness and practices.[39–43] As future pharmacists, pharmacy students should participate in events that aim to advance rational antibiotic use.[21] Government strategies for the rational use of antibiotics were also underscored, besides focusing on the critical pharmacist's role and the significance of regulations and policies in encouraging responsible antibiotic use.[44,45] Finally, educational interventions for medical and pharmacy students, like the antimicrobial stewardship curriculum, have shown promising outcomes in enhancing student implementation of the stewardship strategy.[46]

Although a majority of our participants (78.6%) confirmed strictly monitored antibiotic use in poultry and dairy industries, previous studies demonstrate that despite monitoring efforts, the concern about access to antibiotics among poultry farmers is persistent and often without prescriptions.[47,48] This unrestricted access to antibiotics within the poultry industry exacerbates the problem of bacterial AMR, posing a significant public health threat.[47,48] These highlight the continuous challenge of managing these problems.

The results of our study highlight significant attitudes and practices regarding antibiotic prescription and use among students, with more than half (58.4%) agreeing that physicians often prescribe antibiotics unnecessarily, and only 73.0% of students confirmed that they take antibiotics after getting a prescription from their physician. Likewise, previous studies demonstrate that this practice is widespread among university students in diverse countries. In Brazil,[49] China,[50] India,[51] Nigeria,[52] Pakistan,[53] and Palestine,[54] the prevalent use of antibiotics without prescription is due to the misuse and overuse of antibiotics, which increases the spread and growth of antibiotic resistance. Contrarily, among pharmacy students at Australian universities,[28] the use of over-the-counter antibiotics is restricted, which suggests the effectiveness of limiting access to antibiotics[28] in diminishing related practices and attitudes. These differences between countries could be due to different antibiotic dispensing approaches. The WHO recommended surveillance to monitor any elevation in AMR, then enable the development of appropriate use of antibiotics and enhance awareness among healthcare providers and the public.[11,55]

Additionally, the Acknowledgments that about half of the students (51.7%) informed that they take antibiotics to manage their

fever in our study indicates a potential misunderstanding about appropriate indications for antibiotic treatment. In comparison, in previous research conducted among pharmacy students at the University of Zambia, a lower percentage, 40.8%, reported taking antibiotics to manage fever.[21] Furthermore, another study involving final-year undergraduate pharmacy and medical students across East Africa revealed an obvious situation with up to 15.5% of students expressing that they would prescribe antibiotics to a child with mild fever and particular symptoms indicating viral pneumonia.[20] These findings underscore potential disparities in antibiotic use attitudes between student groups across regions, highlight constant misunderstandings regarding antibiotic prescribing practices, and emphasize the necessity for additional education on the rational use of antibiotics.

Engaging in self-medication might result in severe consequences, particularly when relying on prior prescriptions (using leftover medications) or guidance from friends. An example of a prevalent malpractice is the unauthorized use of remaining medication without seeking guidance from a healthcare practitioner. This can lead to inaccurate dosing, drug interactions, or the concealment of symptoms of a more severe ailment. Dependence on friends or individuals without professional expertise for medical guidance might pose a risk, as it may result in incorrect diagnosis or treatment. A previous study in Jordan examined medications disposal and medications storage and found that 58.1% of the participants reported that they had unused, leftover or expired medications in their homes.[56] The participants most frequently cited 3 reasons for having unused or leftover medication at home: change or discontinuation by the doctor (29.4%), self-discontinuation due to improvement or resolution of sickness symptoms (28.2%), and forgetfulness (25.1%).[56] Prior to self-medicating, it is imperative to seek guidance from a healthcare professional to guarantee both the safety and efficacy of the treatment.

This study has several limitations. The cross-sectional design restricts the ability to infer causality among the variables, limiting the strength of the conclusions that can be drawn about their relationships. Furthermore, the use of a convenience sampling technique to recruit participants via an online survey may affect the generalizability of the findings, as the sample may not be representative of the broader population. Additionally, desirability bias in the KAP study could have influenced the responses, leading participants to provide answers they perceive as more socially acceptable rather than those that reflect their true beliefs and behaviors. However, the broad participation of pharmacy students from the 7 countries and preserving their anonymity might decrease the possibility of the aforementioned limitations.

5. Conclusion

The study revealed that a significant proportion of pharmacy students possess good knowledge of antibiotic resistance, particularly in their senior years, indicative of a promising foundation that empowers students to make informed decisions regarding antibiotic use after graduation. Moreover, the majority exhibited positive attitudes toward antibiotics and antibiotic resistance although it is concerning that some participants reported engaging in malpractices regarding antibiotic use, highlighting the need for targeted educational interventions to promote responsible antibiotic stewardship practices among students.

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Author contributions

Conceptualization: Abdallah Y. Naser, Rafat Aboutaleb.
Formal analysis: Abdallah Y. Naser.
Investigation: Anas Khaleel, Zahra K. Alsairafi, Hassan Alwafi, Sami Qadus, Rania Itani, Faris El-Dahiyat, Ahmed Awaisu, Oriana Awwad, Mervat Alsous, Ghada Mohammad Abdelwahab, Hani M.J. Khojah, Amal Khaleel AbuAlhommos, Alaa A. Alsharif, Aseel Ghazi Alghanemi, Ahmed M. Al Rajeh, Jaber S. Alqahtani, Abdulelah M. Aldhahir, Abdullah A. Alqarni, Anan S. Jarab.
Methodology: Abdallah Y. Naser, Rafat Aboutaleb.
Project administration: Anas Khaleel, Zahra K. Alsairafi, Hassan Alwafi, Sami Qadus, Rania Itani, Faris El-Dahiyat, Ahmed Awaisu, Oriana Awwad, Mervat Alsous, Ghada Mohammad Abdelwahab, Hani M.J. Khojah, Amal Khaleel AbuAlhommos, Alaa A. Alsharif, Aseel Ghazi Alghanemi, Ahmed M. Al Rajeh, Jaber S. Alqahtani, Abdulelah M. Aldhahir, Abdullah A. Alqarni, Anan S. Jarab, Ashraf Saad Hassanin, Mahmoud Jaber, Abdolelah Jaradat, Yosra J. Alhartani.
Supervision: Abdallah Y. Naser, Rafat Aboutaleb.
Writing – original draft: Abdallah Y. Naser, Rafat Aboutaleb, Anas Khaleel, Zahra K. Alsairafi, Hassan Alwafi, Sami Qadus, Rania Itani, Faris El-Dahiyat, Ahmed Awaisu, Oriana Awwad, Mervat Alsous, Ghada Mohammad Abdelwahab, Hani M.J. Khojah, Esra' O. Taybeh, Yosra J. Alhartani, Asaleh El-Qasem, Amer Hamad Issa Abukhalaf, Sara Ibrahim Hemmo, Alyaa Ismael Ahmad, Mohamed Bahlol.
Writing – review & editing: Abdallah Y. Naser, Rafat Aboutaleb, Esra' O. Taybeh, Amer Hamad Issa Abukhalaf, Sara Ibrahim Hemmo, Alyaa Ismael Ahmad, Mohamed Bahlol.

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