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Article

Attitudes of Medical and Non-Medical Undergraduate Students Toward Antibiotic Use and Herbal Medicines in Sulaimani- Iraq

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Abstract

Background: Misuse of antibiotics and uncritical use of herbal medicines are common among young adults, potentially contributing to public health risks such as antimicrobial resistance and herbal–drug interactions. Evaluating university students' attitudes toward these practices is essential for shaping targeted educational strategies.

Objective: To assess and compare the attitudes of medical and non-medical undergraduate students in Sulaimani, Iraq, toward the use of antibiotics and herbal medicines.

Methods: A descriptive, cross-sectional study was conducted among 301 undergraduate students (195 medical and 106 non-medical) using a structured self-administered questionnaire. Data were analyzed using SPSS (version X), and chi-square tests were used to assess statistical significance, with a p-value of $p<0.05$ considered significant.

Results: Medical students demonstrated significantly greater awareness of antibiotic resistance and were less likely to self-medicate with antibiotics compared to non-medical students. Both groups expressed generally positive attitudes toward herbal medicines; however, non-medical students were more likely to rely on herbal remedies for common ailments. Awareness of potential side effects and interactions of herbal medicines was low across both groups.

Conclusion: Medical students showed better-informed antibiotic use behaviors, while misconceptions about herbal medicines were common in both student groups. Targeted awareness programs are recommended to promote responsible use of both antibiotics and herbal treatments among university students in Iraq.

Keywords: Antibiotic Resistance; Herbal Remedies; Medical vs. Non-Medical Students; Public Health Awareness; Iraq Pharmacy Practice

1. Introduction

In order to effectively cure and/or manage a wide variety of human and animal illnesses, as well as to help contain many infectious diseases, antibiotics and herbal remedies are used either together or independently (Moussaoui & Alaoui, 2016). Antibiotics, which are frequently used to treat and prevent bacterial infections, help to lower the mortality and morbidity brought on by germs globally. Nonetheless, the swift emergence of antibiotic-resistant bacteria is seen as a worldwide health concern that jeopardizes the effectiveness of antibiotics (Iqbal et al., 2020).

According to the World Health Organization (WHO), by 2050, antimicrobial resistance (AMR) will be responsible for 10 million deaths, with a significant financial and clinical cost to both individual and societal health (Haque et al., 2019). Undergraduate students particularly who study at medical sciences should have great knowledge and positive attitudes about current health issues that are emerging. Considering their significant roles as medical practitioners, they must be guided in adopting responsible practices and prescribing antibiotics.

Furthermore, it is advisable to provide thorough training to undergraduate medical students regarding the appropriate use of antimicrobial medications and the issue of resistance. This education aims to mitigate the development of antibiotic resistance (ABR) (Afzal Khan et al., 2013). Nowadays, the increase in bacterial resistance to antibiotics encourage the use of herbal therapy as medical and evaluation of plant-based antimicrobial agents in scientific platform (Bedi & Shenefelt, 2002). The use of herbal medicines against bacterial originated human diseases dates to ancient times which some of them are still in use in traditional medicine (Gyasi et al., 2015); (Li et al., 2017). These herbal remedies have attracted considerable attention due to their physiologically active chemical substances, which are produced by plants as a

significant part of the development of a defense mechanism and to allow interaction with the biotic environment (Rebaz et al., 2019). The use of phyto-based antibiotic treatment is suggested due to the excess use of antibiotics without caution which could lead to the rise of harmful antibiotic resistance. However, it was reported that some indications of bacterial resistance against bio-actives of botanical-based extracts used as antibiotics were recently observed (Gupta & Birdi, 2017); (Vadhana et al., 2015). On the contrary of worldwide, the dispensing of antibiotics is commonplace in Iraqi community pharmacies. We hypothesized that education of undergraduate students in terms of awareness and sensitivity about antibiotic use and proper use of herbal-based antibiotic remedies may help minimize unnecessary antibiotic use. Therefore, we aimed to comparatively investigate the knowledge, attitudes, and practices of antibiotic resistance and herbal treatment among medical and non-medical students to develop appropriate policies regards to community health care.

2. Materials and methods

2.1. Sample size and study population

The study was conducted on 301 undergraduate students from medical and non-medical institutes and faculties. The students were comprised of both males and females who were aged between 17 to 32 years.

2.2. Study tools

A self-administered questionnaire was employed to collect data on two main aspects: participants' perspectives concerning antibiotic and antimicrobial resistance (Table 1 and 2), as well as medicinal plant and herbal antimicrobial drug resistance (Table 3 and Table 4). Additionally, demographic information was gathered. The questionnaire utilized was validated to ensure the reliability and consistency of data collection.

Table 1 Questions about antibiotics (medical students)

	strongly disagree	disagree	moderately	Agree	Strongly agree
Farmers should give fewer antibiotics to plants and their animals	**9.7%**	**14.4%**	**41%**	**25.1%**	**0.097**
People should wash their hands regularly	**0.5%**	**0.0%**	**1.5%**	**15.4%**	**82.6%**
Doctors should only prescribe antibiotics when they are needed	**0.0%**	**1.5%**	**14.9%**	**35.9%**	**47.7%**
Governments should reward the development of new antibiotics	**2.6%**	**4.1%**	**23.6%**	**33.3%**	**36.4%**
Pharmaceutical companies should develop new antibiotics	**2.1%**	**2.1%**	**23.1%**	**34.9%**	**37.9%**
Educational and medical institutions should provide instructions and awareness on antibiotics	**0.0%**	**0.5%**	**2.6%**	**25.1%**	**71.8%**
Pharmacies should not dispense medicines to patients without a prescription	**3.1%**	**4.6%**	**11.8%**	**15.9%**	**64.6%**
Antibiotic resistance is one of the biggest problems facing the world	**0.5%**	**3.6%**	**22.1%**	**36.4%**	**37.4%**
Medical experts will fix this problem before it gets worse	**2.1%**	**3.6%**	**30.3%**	**31.8%**	**32.3%**
Everyone should use antibiotics responsibly	**0.5%**	**1.0%**	**8.2%**	**29.7%**	**60.5%**
Very few people give up taking antibiotics	**3.6%**	**12.3%**	**30.8%**	**34.4%**	**19.0%**
The development of antibiotic resistance on my health and that of my family in the future is a concern.	**2.6%**	**3.6%**	**17.4%**	**30.3%**	**46.2%**
People do not need to store antibiotics for other diseases	**6.2%**	**6.2%**	**17.4%**	**30.3%**	**40.0%**

Table 2 Questions about antibiotics (non-medical students)

	strongly disagree	disagree	Moderately	Agree	Strongly agree
Farmers should give fewer antibiotics to plants and their animals	6.6%	18.9%	40.6%	16.0%	17.9%
People should wash their hands regularly	1.9%	1.9%	1.9%	18.9%	75.5%
Doctors should only prescribe antibiotics when they are needed	1.9%	5.7%	17.0%	45.3%	30.2%
Governments should reward the development of new antibiotics	2.8%	6.6%	27.4%	39.6%	23.6%
Pharmaceutical companies should develop new antibiotics	2.8%	1.9%	22.6%	34.9%	37.7%
Educational and medical institutions should provide instructions and awareness on antibiotics	1.9%	3.8%	3.8%	37.7%	52.8%
Pharmacies should not dispense medicines to patients without a prescription	4.7%	5.7%	17.9%	25.5%	46.2%
Antibiotic resistance is one of the biggest problems facing the world	2.8%	6.6%	32.1%	37.7%	20.8%
Medical experts will fix this problem before it gets worse	2.8%	9.4%	29.2%	40.6%	17.9%
Everyone should use antibiotics responsibly	2.8%	4.7%	10.4%	39.6%	42.5%
Very few people give up taking antibiotics	4.7%	9.4%	42.5%	29.2%	14.2%
The development of antibiotic resistance on my health and that of my family in the future is a concern.	7.5%	8.5%	25.5%	31.1%	27.4%
People do not need to store antibiotics for other diseases	5.70%	14.20%	22.60%	26.40%	30.10%

Table 3 Questions about Medicinal plant (medical students)

	strongly disagree	disagree	Moderately	Agree	Strongly agree
Farmers and poultry owners are required to use herbal medicines appropriately for their animals and poultry.	**2.6%**	**5.1%**	**25.5%**	**41.5%**	**29.1%**
Natural herbal remedies have more side effects than medical remedies.	**13.8%**	**35.4%**	**30.8%**	**13.3%**	**6.7%**
It is better to use several types of herbal medicines in your daily meals.	**11.8%**	**28.2%**	**38.5%**	**16.4%**	**5.1%**
Herbal medicines can be used and are preferred over conventional medicines.	**7.7%**	**13.8%**	**42.1%**	**22.1%**	**14.4%**
The relevant authorities should reward those who develop herbal medicines.	**2.1%**	**5.6%**	**28.2%**	**32.8%**	**31.3%**
Experts and botanists should pay great attention to the development of natural herbal medicines.	**1.0%**	**1.5%**	**19.0%**	**35.4%**	**43.1%**
Educational and medical centers should announce special guidelines, importance and awareness on herbal medicines to citizens.	**1.0%**	**0.0%**	**14.4%**	**34.4%**	**50.3%**
Herbal medicine vendors should not give herbal medicines to anyone without full expertise.	**1.0%**	**2.6%**	**8.7%**	**21.0%**	**66.7%**
Herbal resistance is one of the biggest problems facing the world.	**3.6%**	**12.8%**	**49.7%**	**22.6%**	**11.3%**
Herbalists will treat this problem before it gets worse.	**3.6%**	**5.1%**	**40.0%**	**29.2%**	**22.1%**
Everyone should use herbal medicines responsibly.	**0.5%**	**2.6%**	**18.5%**	**32.8%**	**45.6%**
In Kurdistan, a large number of people give up the use of herbal medicines.	**3.6%**	**16.4%**	**46.2%**	**25.1%**	**8.7%**
The development of resistance to herbal medicines on my health and that of my family in the future is a concern.	**2.60%**	**6.70%**	**35.40%**	**27.20%**	**28.20%**

Table 4 Questions about Medicinal plant (non-medical students)

	strongly disagree	disagree	moderately	Agree	Strongly agree
Farmers and poultry owners are required to use herbal medicines appropriately for their animals and poultry.	**4.7%**	**9.4%**	**31.1%**	**32.1%**	**22.6%**
Natural herbal remedies have more side effects than medical remedies.	**11.3%**	**33.0%**	**28.3%**	**16.0%**	**11.3%**
It is better to use several types of herbal medicines in your daily meals.	**6.6%**	**28.3%**	**33.0%**	**20.8%**	**11.3%**
Herbal medicines can be used and are preferred over conventional medicines.	**4.7%**	**13.2%**	**34.0%**	**24.5%**	**23.6%**
The relevant authorities should reward those who develop herbal medicines.	**1.9%**	**6.6%**	**26.4%**	**33.0%**	**32.1%**
Experts and botanists should pay great attention to the development of natural herbal medicines.	**2.8%**	**2.8%**	**21.7%**	**36.8%**	**35.8%**
Educational and medical centers should announce special guidelines, importance and awareness on herbal medicines to citizens.	**3.8%**	**4.7%**	**15.1%**	**33.0%**	**43.6%**
Herbal medicine vendors should not give herbal medicines to anyone without full expertise.	**3.8%**	**4.7%**	**13.2%**	**27.4%**	**50.9%**
Herbal resistance is one of the biggest problems facing the world.	**4.7%**	**18.9%**	**43.4%**	**17.9%**	**15.1%**
Herbalists will treat this problem before it gets worse.	**3.8%**	**7.5%**	**35.8%**	**31.1%**	**21.7%**
Everyone should use herbal medicines responsibly.	**6.6%**	**3.8%**	**21.7%**	**32.1%**	**35.8%**
In Kurdistan, a large number of people give up the use of herbal medicines.	**10.4%**	**10.4%**	**46.2%**	**19.8%**	**13.2%**
The development of resistance to herbal medicines on my health and that of my family in the future is a concern.	**5.70%**	**16.00%**	**32.10%**	**23.60%**	**22.60%**

2.3. Data collection and analysis

The data analysis followed a systematic approach to ensure the reliability and validity of the findings. Descriptive statistics, including percentages and frequencies, were used to summarize the data. The normality of data distribution was evaluated using the Shapiro-Wilk test, while Levene's test was employed to assess homogeneity of variance. In cases where the data exhibited a non-normal distribution, the Kruskal-Wallis test was applied to determine statistical significance. If a significant difference was identified, it suggested that at least one sample group differed from the others, warranting further analysis through the Mann–Whitney U test. The association between categorical variables was examined using the Chi-square test. Furthermore, Spearman's correlation was utilized to explore the relationship between attitudes toward antibiotics and medicinal plants among both medical and non-medical students. A p-value of less than 0.05 was considered the threshold for statistical significance.

Multiple linear regression analyses were conducted to identify independent predictors of total antibiotic and herbal attitude scores. Scores were computed by summing 13 Likert-scale items (1 = strongly disagree to 5 = strongly agree). Predictors included gender, age group, economic status, and study program. This approach allowed adjustment for multiple factors simultaneously and enabled quantification of the independent contribution of each predictor to students' attitudes.

To account for the increased risk of Type I error due to multiple hypothesis testing, we applied multiple comparisons correction procedures to the reported p-values. Specifically, the Bonferroni, Holm-Bonferroni, and Benjamini–Hochberg false discovery rate (FDR) methods were used where appropriate. This adjustment ensured that the interpretation of significance was not biased by the number of tests performed.

To assess overall attitude toward antibiotics, a composite attitude score was computed by summing responses from five Likert-scale attitude items (Q1 to Q13). Internal consistency was evaluated using Cronbach's alpha, which indicated good

reliability (α = 0.82). This composite score was treated as a continuous variable and used in further analyses.

2.4. Ethical consideration:

Prior to collecting data, a thorough description of the study's purpose and goals was provided for students, and anonymity was guaranteed. The study participants were made aware that participation would be entirely voluntary, and that the data collected would be anonymized.

3. Results and Discussion

3.1. Demographic Data and Scores

The study was conducted with the participation of 301 undergraduate students. The majority of the participants were female (n = 208, 69.1%), while male participants constituted a smaller proportion (n = 93, 30.9%). Participants were categorized into four age groups, ranging from 17 to 32 years. Medical students comprised the majority of the sample (n = 195, 64.8%), representing approximately twice the number of non-medical students (n = 106, 35.2%). Regarding the socio-economic status of the participants, 56.8% (n = 171) were classified as belonging to the "good" or "very good" category (Table 5).

Table 5. Demographics and scores

Variables	Number of Participants	Percentage (%)
Gender:		
Female	208	69.1%
Male	93	30.9%
Residence:		
City	232	77.1%
Suburban	56	18.6%
Village	13	4.3%
Age:		
17-20	110	36.5%
21–24	159	52.8%
25-28	23	7.6%
29-32	9	3.0%
Economic status:		
Very good	27	9.0%
good	144	47.8%
medium	123	40.9%
bad	7	2.3%
Study program:		
Medical	195	64.8%
Non-medical	106	35.2%

3.2. Correlation between antibiotic and herbal attitudes

Table 6 illustrates the relationship between attitudes toward antibiotics and herbal remedies among medical and non-medical students. A statistically significant positive correlation was observed among non-medical students ($r = 0.423^{**}$, $p < 0.01$), indicating a consistent attitude toward both treatment approaches. Similarly, medical students also demonstrated a significant positive correlation ($r = 0.404^{**}$, $p < 0.01$) between their views on antibiotics and herbal remedies. These findings suggest that students who hold favourable attitudes toward one form of treatment are likely to exhibit similar attitudes toward the other, regardless of their academic background.

Spearman's rho (ρ), a non-parametric measure of correlation, was used to assess the strength and direction of monotonic relationships between antibiotic and herbal medicine attitudes. As a rank-based measure, Spearman's rho also serves as an effect size, with values closer to ±1 indicating stronger associations.

Confidence intervals were calculated using Fisher's Z approximation, and all correlations were statistically significant at $p < 0.01$.

In the adjusted model for antibiotic attitudes, being a medical student (β = 2.86, 95% CI: 1.42–4.30, $p < 0.001$), female gender (β = 1.73, 95% CI: 0.20–3.25, $p = 0.027$), and age 21–24 years (β = 1.73, 95% CI: 0.24–3.23, $p = 0.023$) were significant independent predictors of higher scores. Economic status showed no significant association. For herbal attitudes, none of the predictors reached statistical significance after adjustment.

Table 6. Correlation between antibiotic and herbal attitudes among medical and non-medical students

Correlations						
		AB attitudes (non-medical students)	Herbal attitudes (non-medical students)	AB attitudes (medical students)	Herbal attitudes (medical students)	95% Confidence Interval (CI)
Effect Size (Sperman's rho) (ρ)	Correlation Coefficient					
	AB attitudes (non-medical students)	1.000	0.423**	-	-	(0.326,0.512)
	Herbal attitudes (non-medical students)	0.423**	1.000	-	-	
	AB attitudes (medical students)	-	-	1.000	0.404**	(0.305,0.494)
	Herbal attitudes (medical students)	-	-	0.404**	1.000	

Note: AD= Antibiotic; *Correlation is significant at the $p<0.05$ level (2-tailed). **Correlation is significant at the $p<0.01$ level (2-tailed).

3.3. Attitudes of respondents about antibiotics and antimicrobial resistance (AMR):

Potential actions to mitigate antibiotic resistance were presented to participants through thirteen attitude statements designed to assess their perspectives on antibiotic

use and AMR. These were evaluated separately for medical students (Figure 1-a) and non-medical students (Figure 1-b).

Analysis of Likert-scale responses revealed that medical students demonstrated more optimistic, informed, and internally consistent attitudes toward antibiotics than their non-medical counterparts. Medical students expressed significantly greater concern about both *personal* (76.5% vs 48.5%, $p < 0.001$) and *global* (73.8% vs 58.5%, $p < 0.001$) impacts of resistance, likely reflecting their clinical exposure to real-world AMR consequences. This pattern is consistent with the Health Belief Model, which predicts that perceived threat increases with domain-specific training.

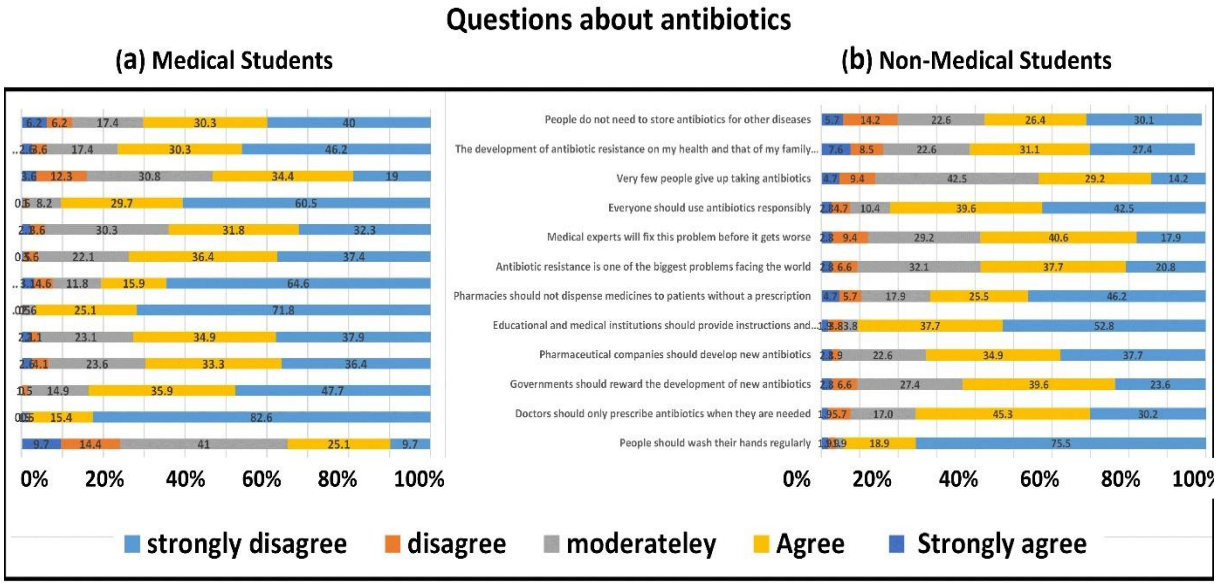

Figure 1. Thirteen-point Likert scale results from (a) medical and (b) non-medical student feedback concerning potential actions that would help address antibiotic resistance.

Support for restrictive policies was also stronger among medical students (prescription requirement: 80.5% vs 71.7%, $p = 0.04$), in line with previous findings by Malli et al. (2023) on the role of education in fostering stewardship attitudes. The near-universal endorsement of regular handwashing (98.0% vs 94.4%, $p = 0.03$)

among medical students may reflect both formal infection-control training and informal "hidden curriculum" reinforcement during clinical placements.

Despite these differences, both groups showed similarly low concern for agricultural antibiotic use (34.8% vs 33.9%), revealing a potential curricular blind spot. This aligns with Manyi-Loh et al. (2018), who advocate for broader One Health educational integration across disciplines.

Correlation matrix analysis (Figure 2-a and 2-b) provided deeper insight into the *internal coherence* of attitudes within each group. The heatmap for medical students showed uniformly high positive correlations between many attitude statements, indicating a structured and coherent belief system in which agreement with one statement strongly predicted agreement with others. In contrast, the non-medical students' correlation matrix displayed more variable and weaker correlations, suggesting a more fragmented attitude structure influenced by diverse and possibly inconsistent information sources.

The composite attitude score showed good reliability (Cronbach's $\alpha = 0.82$). In linear regression analysis, *medical background* emerged as a significant positive predictor of attitude score ($\beta = 2.4$, $p < 0.001$), while *age* was a small but significant negative predictor ($\beta = -0.05$, $p = 0.04$).

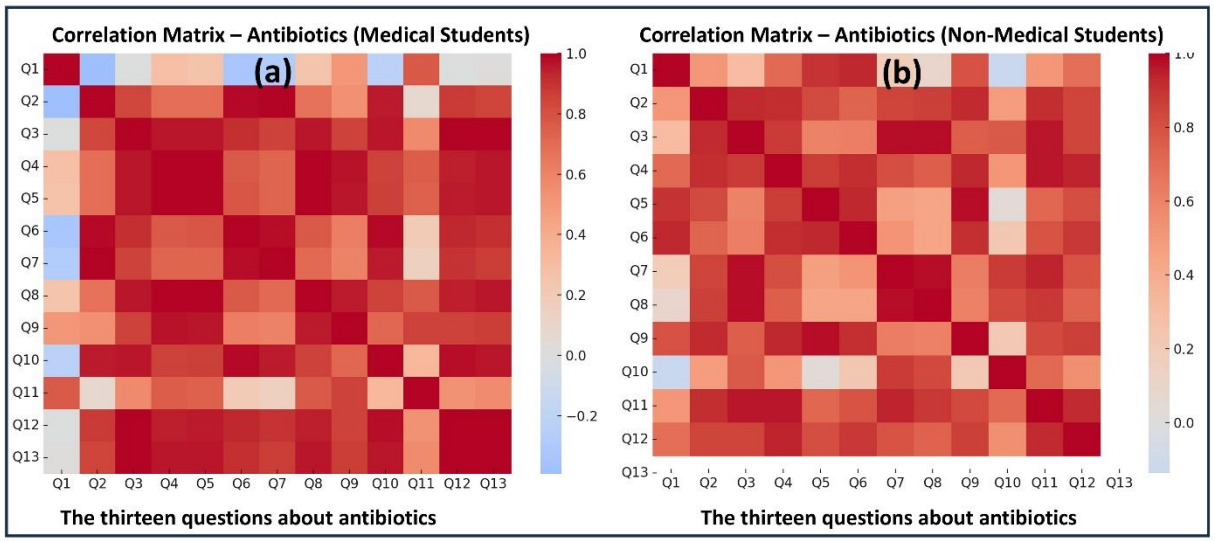

Figure. 2 Medical student (a) and non-medical students (b) feedback correlation matrix concerning potential actions to address antibiotic resistance

Medical students not only exhibit more positive and informed attitudes toward antibiotic use and AMR but also display greater internal consistency in their responses, reflecting the reinforcing effect of formal health sciences education. Non-medical students, while showing some alignment with stewardship principles, present more heterogeneous attitudes and lower awareness of personal AMR risk. This suggests that tailored AMR education targeting non-medical students could improve both knowledge and coherence of beliefs. Furthermore, both groups would benefit from increased emphasis on the agricultural dimension of AMR within a One Health framework.

3.4. Attitudes of respondents about medicinal plant and herbal antimicrobial drug resistance

The contributors' attitudes toward herbal remedies were assessed among both medical students (Figure 3-a) and non-medical students (Figure 3-b) using thirteen attitude statements. Across most statements, medical students demonstrated more cautious and evidence-aligned perspectives than their non-medical counterparts.

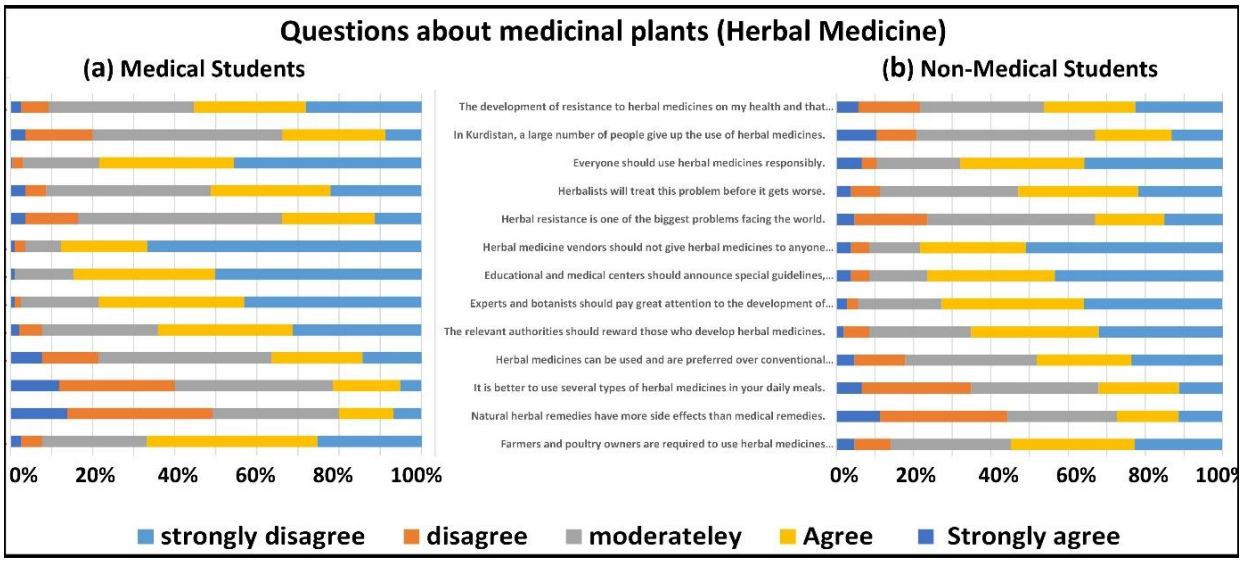

Figure 3. Thirteen-point Likert scale results from (a) medical, and (b) non-medical student feedback concerning potential actions that would enhance and aware student in using medicinal plant and their resistance.

Figure 3 shows that medical students were more likely to support appropriate agricultural use of herbal medicines (70.6% vs 54.7%, $p < 0.001$) and to endorse expert oversight for vendors (87.7% vs 78.3%, $p = 0.008$). They also showed greater awareness of potential side effects (44.3% vs 27.3%, $p < 0.001$) and were less inclined to prefer herbal medicines over conventional options (36.5% vs 48.1%, $p = 0.01$). While 78.4% of medical students vs 67.9% of non-medical students advocated responsible herbal use ($p = 0.01$), both groups similarly supported incentives for

herbal medicine development (64.1% vs 65.1%, p = 0.84, NS) and increased research focus from botanists (78.5% vs 72.6%, p = 0.12, NS).

Medical students also reported higher concern about the impact of herbal resistance on their families (55.4% vs 46.2%, p = 0.04), though recognition of herbal resistance as a global problem was comparable (33.9% vs 38.4%, p = 0.33).

Correlation matrix analysis (Figure 4) revealed differences in the *internal coherence* of attitudes.

- For medical students (Figure 4-a), the correlation matrix displayed several strong positive associations between statements, suggesting that their attitudes toward herbal medicines form a more structured belief system. Agreement with one statement (e.g., the need for expert oversight) was likely to coincide with agreement on others (e.g., responsible use, institutional education).
- For non-medical students (figure 4-b), correlations were generally positive but less uniform, indicating more variability in how individual statements align within their overall attitude framework. This reflects a less integrated perspective, possibly influenced by a wider variety of informal information sources.

These results suggest that medical students' herbal medicine attitudes are shaped by evidence-based training, which fosters both caution toward unregulated use and coherent agreement across multiple stewardship-related items. Non-medical students' perspectives, while supportive of certain oversight and education measures, tend to be more fragmented and include a stronger inclination toward herbal alternatives. This is consistent with Krenn & Burkart (2024), who reported that medical education tends to increase skepticism toward complementary and alternative medicine (CAM) while reinforcing regulatory support.

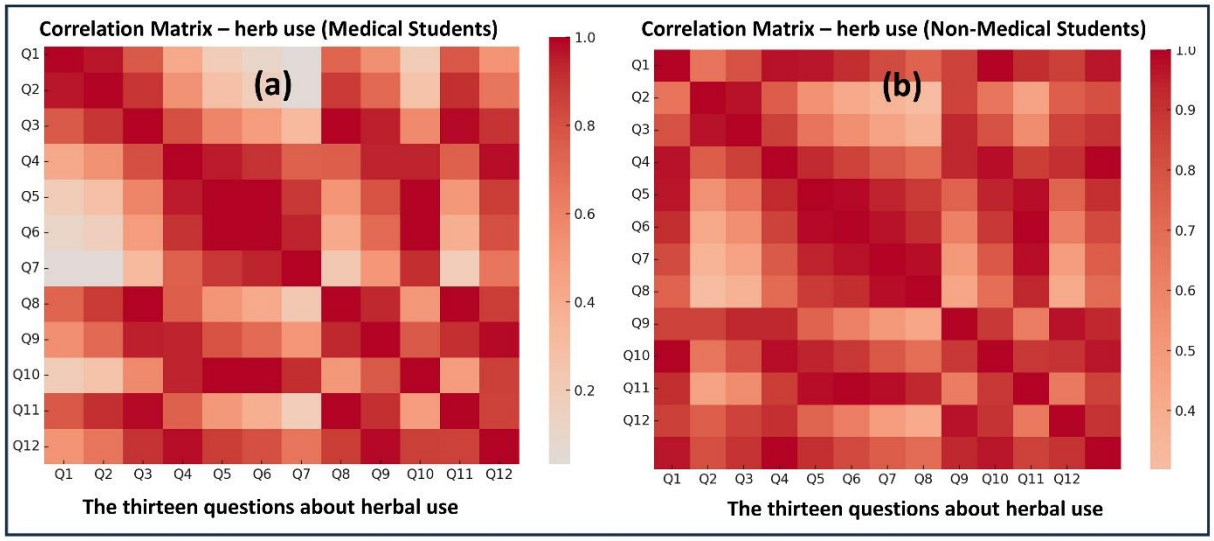

Figure. 4 Medical student (a) and non-medical students (b) feedback correlation matrix concerning potential actions that would enhance and aware student in using medicinal plant and their resistance.

The similarity in support for research incentives between the two groups suggests common interest in evidence-based herbal medicine advancement. However, the difference in coherence (as reflected in the correlation matrices) indicates that medical students may be better positioned to integrate such advancements into a responsible use framework.

3.5. Limitations

Regional focus may limit generalizability, lack of data on actual herbal use frequency, and potential social desirability bias in responses (He et al., 2020).

The insufficient investigation into the escalation of antimicrobial resistance (AMR) in Iraq, which seems to be extending to neighboring regions and even globally, highlights a significant research gap. There is an increasing need for comprehensive studies encompassing clinical, microbiological, historical, ethnographic, and environmental aspects. These studies are essential to definitively determine how war

and conflict contribute to the emergence of multidrug-resistant pathogens (Abou Fayad et al., 2023). In terms of attitudes towards antibiotic use, most of the non-medical students strongly agreed (30.2%) and agreed (45.3%) that doctors should prescribe antibiotics only when necessary. However, this statement was strongly agreed by 47.7% and agreed by 35.9% of the medical students. This disparity suggests the higher awareness of the proper antibiotic use among medical students. Comparatively, pharmacists and medical students exhibited superior knowledge and positive attitudes compared to lower-level practice students in different study years (Zulu et al., 2020) (Al-Qerem 2022.). However, a recent study applied among non-medical college students at Wasit University revealed the high awareness and positive attitudes towards antibiotic use (Ghaffoori Kanaan et al., 2021). Similarly, a study conducted in Pakistan found minimal differences between medical and non-medical students in terms of the awareness of the antibiotic use and the development of antimicrobial resistance against antibiotics (Iqbal et al., 2020). Although the dispensing of antibiotics is commonplace in Iraqi community pharmacies which is contrary to other parts of the world (Alkadhimi et al., 2020), a significant majority of both medical and non-medical students (over 70%) from Iraq disagreed with the dispensing of antibiotics by pharmacists without prescriptions which is coherent to the fundamental role of pharmacists across the world. The World Health Organization (WHO) considers AMR among the top 10 global health threats. Recent estimates attribute 1.27 million deaths in 2019 to drug-resistant infections worldwide. By 2050, it was projected that annual deaths from drug-resistant infections could reach up to 10 million (WHO, 2015). The current study revealed high awareness among non-medical (strongly agreed = 20.8% and agreed=37.7%) and medical (strongly agreed=37.4% and agreed=36.4%) students regard to the antibiotic resistance as a significant global challenge. Furthermore, the majority of participants (58.5% of the non-medical and 76.5% of the medical students) reported the antibiotic resistance as one of the major problems when the body develops resistance to medications. Solely, a small part of the non-medical (16%) and medical (6.2%)

students were found as disagreed with the statement. Antibiotic misuse, a global health concern, is particularly alarming in Iraq due to the rise of self-medication with antibiotics, contributing to the emergence of resistant organisms. This could negatively impact both health and the economic systems. A review of articles from 2014-2020 revealed a high prevalence of antibiotic misuse (45%-92%) in the Iraqi population, coupled with inadequate knowledge and unfavorable attitudes among pharmacists and physicians (Saadoon Salim et al., 2021). Antibiotics are often wrongly recommended for viral infections, fever, sore throat, and various aches, reflecting misconceptions about proper medical practices (Ortega-Paredes et al., 2022).

The discovery of new antibiotics can help address antibiotic resistance challenges (AL-QEREM et al., 2022); (Ghaffoori Kanaan et al., 2021). Over 90% of contributors from both groups agreed that pharmaceutical companies should develop new antibiotics, with governments rewarding such efforts. In developing nations, the role of pharmacists in patient care is limited, while in developed countries, it has expanded to provide diverse patient care services, leading to improved health outcomes and reduced costs. Successful cases of pharmacist-led initiatives against antimicrobial resistance highlight the potential of skilled pharmacists to contribute to the global AMR challenge. They can assist patients about appropriate use of antibiotic agents and offer guidance to healthcare colleagues on proper prescription practices (Sakeena et al., 2018). Antibiotic resistance presents a significant global health threat, prompting attention from health agencies and governments. Despite increasing resistance rates, pharmaceutical companies hesitate to develop new antibiotics due to scientific, regulatory, and financial challenges. Some nations propose financial incentives for innovation. In Canada, a subscription-based reward system to stimulate antibiotic development and combat resistance was invented which encourage Canada to prioritize antibiotic research and development to counter resistance (Dutescu & Hillie, 2021). Self-medication with antibiotics without medical

prescriptions is a major concern in our community such practice contributes to antibiotic resistance (Al-Tukmagi et al., 2022).

Within the European Union, traditional herbal remedies categorized as "reasonably safe, though lacking acknowledged effectiveness" are placed in a distinct drug classification known as "traditional herbal medicine products." These products are subject to less stringent demands for non-clinical and clinical investigations (Moreira et al., 2014). In this study, the majority of the participants preferred herbal medicine than conventional medicine. About 33% of non-medical and 35.4% of medical students believed that herbal medicine had fewer side effects than antibiotics. The majority of the herbal remedies assessed in the systematic reviews had predominantly mild or less severe side effects (Posadzki et al., n.d.). Regarding the opinions about the use of different types of herbs in daily diet, both groups had similar positive responses (30%) can be explained by the presence of several traditional dishes that include many types of seasonal and dried herbs. The majority of contributors expressed positive attitudes toward the statement that herbal medicine vendors should not provide herbal medicines to individuals without proper expertise. Moreover, they agreed that educational and medical centers should disseminate special guidelines, emphasize the importance, and raise awareness about herbal medicines among citizens. Many medical professionals lack training on herbal medicine's impact, especially when patients use other medications. Adequate knowledge is crucial for diagnosis and treatment decisions. Non-herbal healthcare providers are often uninformed about these products and should inquire about their patients' herbal medicine use. Poison center and health information staff also require herbal medicine knowledge (WHO, 2004).

4. Conclusion

This study investigated the attitudes of medical and non-medical undergraduate students in Sulaymaniyah City, Iraq, toward antibiotic use and herbal remedies.

Using thirteen identical attitude statements for both groups, the survey revealed that while medical students demonstrated heightened awareness particularly in advocating for responsible antibiotic use and expressing greater personal concern about resistance, both groups shared gaps in understanding its agricultural implications. Similarly, medical students approached herbal remedies with clinical caution, emphasizing regulation and side-effect awareness, whereas non-medical students favored natural alternatives. However, both groups supported further research and education on herbal therapies, highlighting opportunities for collaborative, evidence-based policy development. The findings underscore the critical role of pharmacists, the need for integrated educational interventions (e.g., reconciling traditional herbal use with scientific scrutiny), and the potential of innovative strategies to combat antimicrobial resistance (AMR). By addressing knowledge-attitude disparities, this study contributes actionable insights to the global AMR mitigation effort.

Conflict of Interest

The authors confirm that they have no conflict of interest with respect to the work described in this manuscript.

Ethics Statement

The corresponding author confirms that all ethical considerations relevant to this research have been duly observed. The manuscript is original, has not been published previously, and is not under consideration for publication elsewhere. Furthermore, the co-author has reviewed and approved the final version of the manuscript for submission.

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