Journal of Innovations in Pharmaceutical and Biological Sciences (JIPBS)
ISSN: 2349-2759
Available online at https://jipbs.com/index.php/journal

Research article

A Cross-Sectional Study to Assess Knowledge, Attitudes, and Practices (KAP) Regarding Antibiotic Use in Upper Respiratory Tract Infections in the Central and Western Regions of Saudi Arabia

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Received on: 18/11/2024, Revised on: 13/12/2024, Accepted on: 20/12/2024, Published on: 30/12/2024.

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Keywords: Antibiotics, Resistance, Saudi Arabia, Knowledge, Respiratory infections.

Vol. 11 (4): 01-13, Oct-Dec, 2024.

DOI: http://doi.org/10.56511/JIPBS.2024.11401

Abstract

Antimicrobial resistance (ABr) is a significant global health concern, exacerbated by the inappropriate use of antibiotics. This study aimed to assess the knowledge, attitudes, and practices (KAP) regarding antibiotic use and ABr among the population in the central and the western region of Saudi Arabia. A cross-sectional study was conducted using both face to face interview and an online questionnaire distributed via social media platforms. The questionnaire consisted of four sections: the first gathered sociodemographic characteristics of the participants; the second assessed knowledge of antibiotic use and ABr, while the third and fourth evaluated attitudes and practices related to antibiotics and ABr. Out of 486 participants, 333 (68.5%) were female, and 324 (66.7%) held a college degree. Overall, 186 (38.3%) of respondents demonstrated poor knowledge of antibiotics and ABr. Additionally, 256 (52.7%) reported inadequate attitudes towards antibiotic use. Furthermore, 275 (56.6%) exhibited poor practices concerning antibiotic usage. Factors influencing knowledge levels included gender, age, educational attainment, and occupational status, with those with bachelor's degree showing greater knowledge of antibiotics and ABr compared to individuals in other occupations. Our study identified a concerning suboptimal level of knowledge, unfavorable attitudes, and inadequate practices regarding antibiotics and ABr among participants. To address this issue, educational health campaigns aimed at raising public awareness and promoting responsible practices are essential. Emphasizing the role of healthcare providers in education and enforcing stringent regulations on the non-prescription dispensing of antibiotics will also be crucial. Future research in this area is recommended to further explore these issues.

Introduction

One of the most common diseases, especially in the winter season, is the upper respiratory tract infections (URTIs) [1]. URTIs are included as one of the most common diseases impacting people worldwide, therefore they are significantly affecting public health and healthcare systems as well. The infections include several conditions such as sinusitis, common cold, and laryngitis [2]. They are mostly caused by viruses, but bacterial pathogens are responsible for part of these infections. URTIs are characterized by many symptoms such as cough, sore throat, runny or stuffy nose, and fever, also they can lead to discomfort and disruption in

daily activities [3]. In Saudi Arabia, these infections are intensely common specifically with asthmatic, elder, immunodeficient, hypertensive and diabetic patients. It is undoubtedly that the disease is the most frequent among adults, who usually suffer from severe URTI two to four times per year [4]. Although viral infection is responsible for the majority of URTI cases visiting the health care institutions, antibiotics are wrongly self-used or prescribed for such complaints. Incorrect and unnecessary use of antibiotics is combined with an increasing occurrence of antibiotic resistance [5]. Several factors associated with the misuse and/or the overuse of antibiotics such as patient requests, bad habits, self and cross medication, and inadequate patient education, [6, 7]. The increase in the resistance to many antibiotics has become a worldwide problem that has negative clinical and economic impacts [8]. Antibiotic resistance (ABr) is one of the most significant public health threats of the current century, affecting all age groups and geographical regions, making it a global health crisis. It arises mainly from the inappropriate and irrational use of antibiotics, leading to treatment failures, longer hospital stays, increased healthcare expenses, and more severe infections that can result in death [9].

Saudi Arabia faces a significant burden of infectious diseases, with growing concerns related to antibiotic resistance. In recent years, the country has seen an increase in antibiotic consumption, driven by various factors. The irrational use of antibiotics in Saudi Arabia can be attributed to complex interactions between healthcare providers and patients, incomplete implementation of regulatory policies, gaps in prescriber knowledge, and the availability of antibiotics in some cases without prescriptions. Additionally, patient-related issues such as self-medication, misconceptions about antibiotics, and unrealistic expectations regarding their effectiveness contribute significantly to the rise and spread of ABr [10, 11].

The public's understanding of the optimal uses of antibiotics is vital, especially in Saudi Arabia where many residents and visitors comes from different countries with backgrounds and, health regulation systems, which can lead to increased bacterial resistance and infection spread. Therefore, public engagement is essential for addressing ABr. The World Health Organization (WHO) emphasizes three main areas for public involvement: enhancing access to healthcare, reducing unnecessary antibiotic use, and ensuring proper treatment adherence while discouraging the sharing or saving of leftover antibiotics [12].

Upper respiratory tract infections are among the most common infectious diseases, frequently ranking as one of the top three diagnoses in outpatient settings. Antibiotics are often prescribed for acute URTIs, yet most of these prescriptions represent excessive use, as viruses cause the majority of URTIs, with fewer than 10% being bacterial in nature [11, 13]. A systematic review indicated that URTIs are the most common reason for self-medication with antibiotics in middle Asia, including Saudi Arabia. This inappropriate use of antibiotics for URTI contributes significantly to the increasing spread of ABr, and the public's knowledge about URTI greatly influences overall antibiotic usage.

Many health organizations have reported the regular increase in antibiotic resistance around the globe, and this health problem leads to a rise in morbidity and mortality rates everywhere [14]. Many recent studies have highlighted the significant need for improving public awareness about antibiotic use. For example, Alnasser AH, *et al.* (2021) conducted a cross-sectional study exposing the significant gaps in the public's knowledge and attitudes toward antibiotics, highlighting the need for educational interventions [15]. In addition, Awad AI *et al.* (2015) noticed a strong correlation between the public's misconceptions about antibiotic usefulness and the rising antibiotic resistance, principally regarding respiratory infections [16]. Their research indicated that many individuals falsely believed antibiotics could successfully treat viral infections, leading to improper usage.

Areej Alowfi *et al.* (2022) further explored the KAP (Knowledge, Attitude, Practice) framework and identified prevalent misconceptions that could lead to inappropriate antibiotic use among adults in Saudi Arabia. They reported that a substantial percentage of respondents were unaware of the correct indications for antibiotic therapy, highlighting a critical gap in public health education [17]. Additionally, Karuniawati H *et al.* (2021) provided a comprehensive review of the literature on antibiotic misuse in Saudi Arabia, underscoring the impact of public misconceptions on the management of URTIs. The review noted that the over-prescription of antibiotics by healthcare providers, driven by patient expectations, exacerbates the problem of antibiotic resistance [18]. The study by Sakr S, Ghaddar *et al.* (2020) examined healthcare providers' perspectives on antibiotic prescribing for URTIs, revealing that even among professionals, there is often uncertainty about when to prescribe antibiotics, which can further confuse patients [19].

Moreover, a qualitative study by Hu Y, *et al.* (2018) highlighted the role of cultural beliefs and practices in shaping attitudes toward antibiotic use, suggesting that community-based interventions could be beneficial in addressing these issues. The findings indicated that many individuals rely on traditional remedies or self-medication, which can complicate the treatment landscape for URTIs [20].

The study aims to investigate the knowledge, attitudes, and practices regarding antibiotic use among the general population in the central and western regions of Saudi Arabia, particularly in relation to upper respiratory tract infections (URTIs). Understanding public perceptions and behaviors is essential for addressing the misuse of antibiotics, which contributes to the rising issue of antibiotic resistance—a significant global health challenge. By evaluating the current levels of knowledge and attitudes, this

study seeks to identify gaps and guide strategies for public health education and intervention. Ultimately, enhancing awareness and practices related to antibiotic use will improve patient outcomes and foster responsible medication use within the community.

Methods

Study design

An informative cross-sectional survey was conducted using a validated and approved questionnaire. The survey was administered both through face-to-face meetings and online from 15 October to 30 November 2024. Its aim was to evaluate public knowledge, attitudes, and practices regarding antibiotic use and antimicrobial resistance, particularly in relation to upper respiratory tract infections (URTIs), among residents of the central and western regions of Saudi Arabia. A pilot test was conducted with a small, representative sample of the target population. This pilot test aimed to evaluate the clarity, relevance, and comprehensibility of the questions. Feedback from this test was analyzed, leading to necessary adjustments in the questionnaire to enhance its effectiveness and reliability before the main survey. The surveyors involved in face to face data collection received specialized training to ensure consistency and accuracy in administering the questionnaire. This training included an overview of the study objectives, detailed instructions on how to engage with participants, and guidance on ethical considerations, including informed consent and confidentiality. Additionally, they were trained on how to handle potential questions or issues that might arise during the survey process.

Study population

The study targeted Arabic and English-speaking adults living in the central and western regions of Saudi Arabia either citizens or residents, utilizing both online and face-to-face questionnaires. Individuals who did not speak either language or who resided outside these regions were excluded from participation.

Sampling methodology

A stratified random sampling method was applied for this study. This approach was chosen to ensure that different subgroups within the population (e.g., age, gender, socio-economic status) were adequately represented. Stratified sampling allows for more precise estimates of the population parameters and enhances the generalizability of the findings, as it reduces sampling bias. Data collection occurred from 15 October to 30 November, among the public in both the Central and Western Regions of Saudi Arabia. Questionnaire was conducted based on face-to-face interview by trained data collection team or through online questionnaires. The online questionnaire was disseminated through different social media platforms; both face to face and online questionnaires were included four sections of closed-ended questions followed by four choices, in both Arabic and English.

Sociodemographic characteristics

The first section contained five items gathering demographic information, such as gender, age, place of residence, marital status, education level, employment status, and monthly income.

Knowledge assessment

The second section comprised eleven items designed to evaluate participants' knowledge of antibiotic use, antimicrobial agents' resistance, and URTi treatments.

Attitude evaluation

The third section comprised eleven items assessing attitudes toward antibiotic use and antimicrobial resistance (AMR), using a Likert scale based on five-points (ranged between strongly agree, and strongly disagree).

Practice assessment

The final section focused on participants' practices regarding antibiotic use and ABr, consisting of ten questions measured on a five-point Likert scale (never, rarely, sometimes, often, always). Data were collected from participants who met the eligibility criteria, ensuring that no identifiable information was included in the electronic forms to protect their privacy. The data were automatically entered into an Excel spreadsheet (Microsoft, Redmond, Washington). Following a thorough verification process, the data were transferred to SPSS software (IBM Inc., Armonk, New York) for comprehensive analysis. This methodical approach is designed to provide valuable insights into public perceptions and behaviors regarding antibiotic use. Ultimately, these insights will contribute to improved health outcomes and inform effective strategies for combating antimicrobial resistance in the region.

Data analysis

Once the data was obtained, it goes through a comprehensive revision and coding process before being entered into SPSS version 22 for statistical analysis. Results were presented as frequencies and percentages. A scoring system based on the methodology of Awad and Aboud (2015) was utilized. Descriptive statistics were calculated for sociodemographic variables, and knowledge, attitudes, and practices (KAP) scores were computed as continuous variables by summing the correct responses in each category. Each correct answer received a score of one point, while incorrect responses were scored as zero. Scores of 80% and above were categorized as good, whereas scores below 80% were classified as poor. Descriptive analyses were conducted for all variables, including participants' age, gender, education level, marital status, occupation, and income. Additionally, participants' knowledge, attitudes, and practices were tabulated and displayed in graphical format.

Cross-tabulation was employed to investigate factors associated with knowledge levels regarding antibiotics and antimicrobial resistance. The Chi-squared test of independence was used to assess associations among the variables.

Ethical considerations and confidentiality section

The objectives of the research were clearly communicated to participants through face-to-face interactions and were explicitly stated at the beginning of the online version. Participants were informed that their involvement was entirely voluntary and that no personal information would be collected. All identities were kept anonymous and confidential, with access to responses restricted to the research investigators. Ethical approval (R123-101) for the study was obtained from the Biomedical Ethics Committee of Riyadh Elm University.

Results & Discussion

A total of 609 participants completed the study questionnaire. Among them, 98 were excluded for not being from the central or western regions, and 26 were excluded for being under the age of seventeen. Consequently, 486 participants met the inclusion criteria and were included in the analysis. Table 1 presents the demographic characteristics of the sample (n=486), which comprised 333 females (68.5%) and 153 males (31.5%). The largest age group represented was 25-34 years, with 219 respondents (45.1%). Additionally, a significant portion of the participants (324, or 66.7%) held a college degree. Among the respondents, 222 (25.7%) were students, 249 (51.3) are currently employed, and 197 (40.5%) reported a monthly income between 5,000 and 10,000 SAR. The sample consisted predominantly of females (68.5%), indicating a significant representation of women in this research, which may reflect their greater engagement in health-related issues or their willingness to participate in surveys. The gender distribution highlights the need for further investigation into whether there are differences in KAP between males and females, as these differences could inform targeted educational interventions. The age distribution revealed that the largest group of respondents fell within the 25–34-year range (45.1%). This age bracket is often characterized by increased health awareness and engagement with healthcare services, suggesting that this population may be more likely to seek information about antibiotic use [21]. However, it is also essential to consider that younger individuals might have different perceptions and practices regarding antibiotics, which could influence their health outcomes. Additionally, a notable 66.7% of participants held a college degree, suggesting that the sample was relatively well-educated. This level of education could positively impact their understanding and attitudes towards antibiotic use [22]. However, despite this educational background, the results should still be interpreted cautiously, as high educational attainment does not always equate to appropriate knowledge and practices regarding antibiotics. The employment status of participants also provides context for the findings. With 51.3% currently employed and 25.7% identifying as students, the combined data reflect a diverse socioeconomic background, which may influence access to healthcare information and resources. Furthermore, the reported monthly income levels—particularly the 40.5% of participants earning between 5,000 and 10,000 SAR—suggest a middle-income demographic, which can play a role in their healthcare choices and access to antibiotics. Overall, these demographic insights reveal a well-educated and predominantly young population in the central and western regions of Saudi Arabia. However, the significant proportion of the sample still deserves attention regarding their knowledge related to antibiotic use [24].

Table 2 shows the number and percentage of responses to each of the eleven questions measures the knowledge of the populations in central and western region towards the use of antibiotics in URT diseases. The survey results reveal key insights regarding public understanding and attitudes towards antibiotics. For the question on antibiotic usage, the highest response was "Treat bacterial infections," with 400 counts and 82.3%. In evaluating the effectiveness of antibiotics for upper respiratory infections, 366 respondents (75.4%) indicated "No." A significant misconception was highlighted in the question about antibiotic effectiveness, where 380 individuals (78.1%) recognized that overuse can lead to resistance. The primary source of information about antibiotics was healthcare providers, noted by 250 respondents (51.5%). Notably, 400 (82.3%) identified strep throat as a bacterial condition, while 200 (41.1%) indicated that a high fever would lead them to believe antibiotics are necessary. Awareness of misuse consequences was also high, with 370 (76.1%) acknowledging resistance as a risk. When asked about antibiotic duration, 300 respondents (61.7%) felt antibiotics should be taken for 7-10 days, whereas 250 (51.5%) believed antibiotics could not be purchased over the counter. Lastly, 300 (61.7%) believed better education would significantly change antibiotic usage. This is in comparison to a previous study that was done in Indonesia reported that only 52.98% of respondents demonstrated good knowledge about antibiotics. This research revealed that only 61.61% understood that leftover antibiotics should not be reused, and only 37% recognized the importance of completing their antibiotic course even if their symptoms improved. Startlingly, just 12.91% acknowledged that antibiotics are ineffective against viral infections, while around 63.35% mistakenly believed that antibiotics could reduce fever [18]. Similarly, a study conducted in Kuwait highlighted significant gaps in antibiotic knowledge, with only 66.5% of participants correctly identifying antibiotics as effective against bacteria [16]. Furthermore, only 29.8% agreed that antibiotics should not be used for viral illnesses, and about half (49%) were aware that unnecessary antibiotic use could lead to resistance [24].

Table 1. Sociodemographic characteristics (n=609).

Demographic Characteristics	Response Option	Number (n)	Percentage (%)
Total Participants		609	100
Excluded Participants			
Not from Central or Western Regions		98	16.1
Under 17 Years Old		26	4.3
Included Participants		486	79.9
Age	17–24 years	100	20.6
	25–34 years	219	45.1
	35–44 years	80	16.5
	45–54 years	50	10.3
	55–64 years	17	3.5
	65 years and older	0	0
Gender	Male	153	31.5
	Female	333	68.5
Education Level	No formal education	20	4.1
	High school	50	10.3
	Bachelor's degree	324	66.7
	Postgraduate degree	92	18.9
Occupation	Currently employed	249	51.3
	Student	172	35.4
	Currently non-employed	65	13.4
Monthly Income (SAR)	< 5000	100	20.6
	5,000 up to 10,000	197	40.5
	> 10,000	89	18.3

Table 2. Knowledge questions related to antibiotic use in Upper respiratory tract infections.

Question	Response Option	Count	Percentage
1. Understanding Antibiotics: What are antibiotics used for? (Select all that apply)	Treat bacterial infections	400	82.3%
	Treat viral infections	30	6.2%
	Treat fungal infections	20	4.1%
	Prevent infections	40	8.2%
	I do not know	20	4.1%
2. Upper Respiratory Infections: Are antibiotics effective in treating upper respiratory tract infections (e.g., colds, flu)?	Yes	100	20.6%
	No	366	75.4%
	Unsure	20	4.1%
3. Common Misconceptions: Which of the following statements do you believe is true? (Select all that apply)	Antibiotics can cure the common cold	40	8.2%
	Antibiotics are effective against viral infections	30	6.2%
	Overuse of antibiotics can lead to antibiotic resistance	380	78.1%
	I do not know	36	7.4%
4. Sources of Information: Where do you primarily get your information about antibiotics? (Select all that apply)	Healthcare providers	250	51.5%
	Internet	150	30.9%
	Family and friends	50	10.3%
	Social media	20	4.1%
	Printed materials (e.g., brochures, magazines)	16	3.3%
	Other (please specify)	0	0.0%
5. Recognizing Infection Types: Which of the following conditions do you believe are caused by bacteria? (Select all that apply)	Inflammed throat	400	82.3%
	Sinusitis	60	12.3%
	Common cold	10	2.1%
	Flu	10	2.1%
	Ear infections	6	1.2%
	I do not know	0	0.0%
6. Symptoms Indicating Antibiotic Use: What symptoms would lead you to believe that antibiotics are necessary? (Select all that apply)	High fever	200	41.1%
	Persistent cough	150	30.9%
	Thick, colored nasal discharge	120	24.7%

	Symptoms lasting more than a week	10	2.1%
	I do not know	6	1.2%
7. Antibiotic Misuse Awareness: Have you heard of any consequences related to the misuse of antibiotics? (Select all that apply)	Development of antibiotic resistance	370	76.1%
	Increased side effects	80	16.5%
	Allergic reactions	30	6.2%
	No consequences	6	1.2%
	I do not know	0	0.0%
8. Antibiotic Course Duration: How long do you think you should take antibiotics once prescribed?	Until symptoms improve	100	20.6%
	3-5 days	40	8.2%
	7-10 days	300	61.7%
	As long as prescribed by the healthcare provider	40	8.2%
	I do not know	6	1.2%
9. Over-the-Counter Availability: Do you believe antibiotics can be purchased over the counter without a prescription in your country?	Yes	200	41.1%
	No	250	51.5%
	Unsure	36	7.4%
10. Understanding Labels: How often do you read the label when taking antibiotics?	Always	80	16.5%
	Often	150	30.9%
	Sometimes	200	41.1%
	Rarely	50	10.3%
	Never	6	1.2%
11. Impact of Antibiotic Education: Do you think better education about antibiotics would change how people use them?	Yes, significantly	300	61.7%
	Yes, somewhat	150	30.9%
	No, not really	20	4.1%
	No, not at all	10	2.1%
	Unsure	6	1.2%

On the other hand, a 2021 study conducted across all five regions of Saudi Arabia found that 88% of respondents had good knowledge of antibiotic use, which is significantly higher than the 82.3% observed in our study. This earlier research indicated that 76.5% of participants understood that antibiotics are used for bacterial infections, while 74.9% recognized that antibiotic resistance can result from not completing prescribed courses. Additionally, 67.5% acknowledged that antibiotics might kill beneficial bacteria that normally inhabit the skin or intestines [25]. However, only 56.9% were aware that antibiotics should not be used to treat viral infections. These findings collectively emphasize the need for improved educational efforts to enhance public understanding of antibiotic use and the potential consequences of misuse across different populations. The survey results offer an in-depth exploration of public perceptions and attitudes toward antibiotics among 486 respondents (Figure 1). A substantial majority, 200 individuals (41.1%), regard antibiotics as (very important) in the treatment of infections, while 150 responders (30.9%) consider them important. This indicates a widespread recognition of the critical role antibiotics play in healthcare. Concerns regarding antibiotic resistance are particularly pronounced, with 250 respondents (51.5%) expressing they are very concerned and an additional 150 of the answers (30.9%) being somewhat concerned [26]. This highlights a growing awareness of the implications of antibiotic overuse and misuse, which is crucial for fostering responsible prescription practices. Trust in healthcare providers emerges as a vital factor influencing antibiotic use. 220 respondents (45.3%) indicated they trust the advice of healthcare professionals very much, while 180 of responders (37.0%) trust it somewhat. This level of trust is essential for enhancing patient compliance with prescribed treatments and for encouraging conversations about the appropriate use of antibiotics. The importance of completing prescribed antibiotic courses is underscored by 300 respondents (61.7%) who deem it very important to follow through with the full course. This awareness is critical, as incomplete treatment can contribute to the development of antibiotic-resistant bacteria. Moreover, the impact of education on antibiotic resistance is significant. 300 respondents (61.7%) reported that learning about antibiotic resistance has changed their attitudes toward antibiotic use, suggesting that educational initiatives are effectively shaping public understanding and behavior. The willingness to consult healthcare providers before taking antibiotics is also noteworthy. 250 respondents (51.5%) expressed they are very willing to seek professional advice, indicating a proactive approach to healthcare decisions. When assessing the seriousness of upper respiratory infections, 200 individuals (41.1%) labeled them as very serious, which influences their decision-making regarding antibiotic usage. Additionally, the opinions of friends and family hold considerable sway; 210 respondents (42.0%) acknowledged that peer influence significantly impacts their choices about

antibiotics. Concerns about the potential consequences of antibiotic misuse are widespread, with 238 respondents (48.97%) expressing they are very concerned. This reflects a solid understanding of the risks associated with improper use, which is vital for promoting responsible behavior. In contrast, a previous Saudi study reported that 92.55% of participants trusted their physicians' decisions regarding antibiotic prescriptions, with 91.87% believing that antibiotics should not be given if not required [26]. Moreover, 91.33% disagreed with the idea of obtaining antibiotics without a prescription. However, about two-thirds (66%) did not believe that antibiotics could prevent illnesses from worsening, and 63.7% thought that natural remedies were not more effective than antibiotics. The overall positive attitude score in that study was notably high, with 76.80% of respondents demonstrating favorable attitudes toward antibiotic use. Our findings, however, revealed significantly lower levels of positive attitudes, with only 49.52% of participants in our study exhibiting good attitudes toward antibiotic use. The situation was similarly troubling in an Indonesian study, where around 45% of respondents believed that antibiotics could speed up recovery from a cold, and nearly 30% felt dissatisfied if they did not receive antibiotics from their physicians when they expected. Additionally, approximately 35% of respondents had no qualms about purchasing antibiotics from pharmacies without a prescription, and half (50%) would stop taking antibiotics as soon as they felt better. Alarmingly, a quarter (25%) admitted to storing leftover antibiotics for future use [27, 28].

Table 3 shows the survey results on how respondents use and perceive antibiotics. 300 individuals (61.7%), while 120 said they complete their prescribed antibiotic courses, many do not, which is essential for preventing antibiotic resistance. Additionally, 90 respondents (18.5%) often try to self-diagnose their conditions, which can lead to inappropriate antibiotic use. While 130 (26.8%) sometimes use alternative treatments, 200 (41.1%) wait for their symptoms to worsen before seeking antibiotics, potentially delaying necessary care. Concerns about side effects are significant, with 180 (37.0%) feeling hesitant to use antibiotics again due to past adverse effects. Finally, 100 respondents (20.6%) have shared leftover antibiotics with others, a practice that poses risks for resistance. Figure 2 shows overall results of KAP study towards antibiotics use among the participants, the results shows that most of the respondents had good knowledge (301, 61.7%), inappropriate attitude (230, 47.3%), and inadequate practice (211, 43.5%) related to the use of antibiotics. (24.7%) admitted to taking antibiotics without a prescription, raising concerns about misuse. Only 100 respondents (20.6%) always consult a healthcare provider before taking antibiotics for upper respiratory infections, indicating a gap in seeking professional advice.

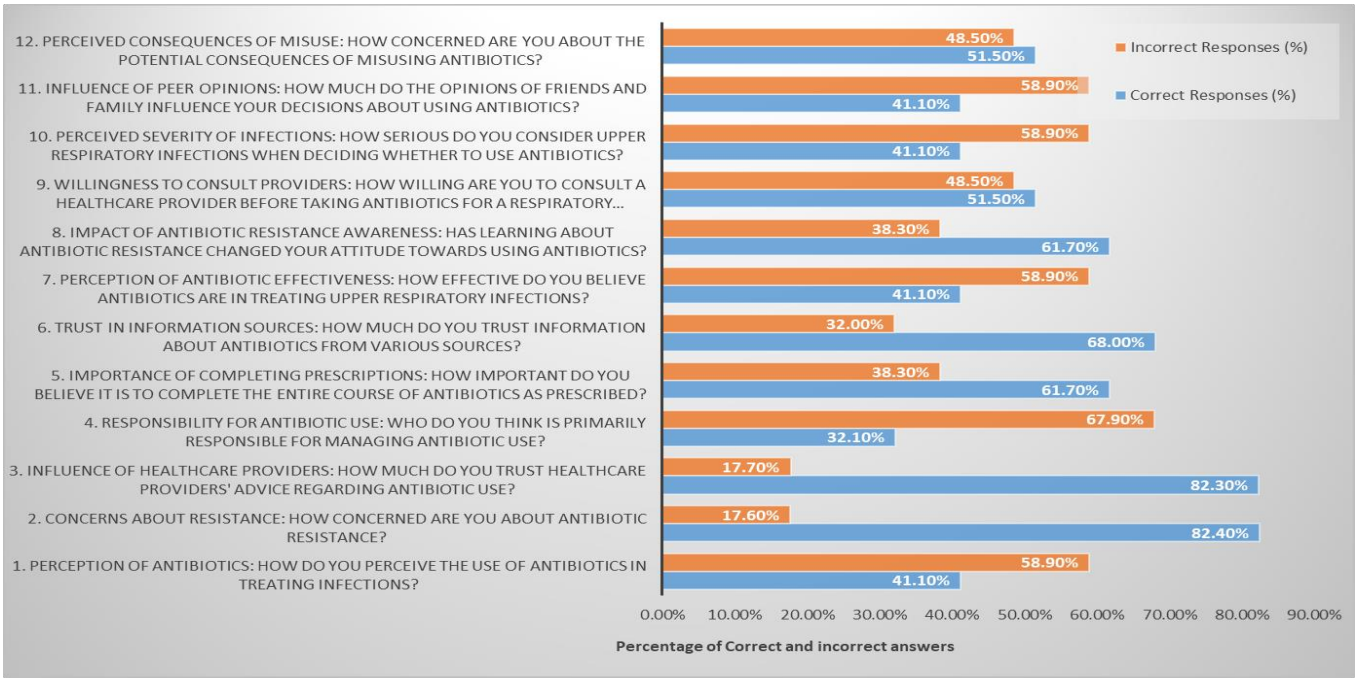

Figure 1. Attitude of Survey Respondents towards antibiotics use in URTi (n=486).

Table 3. Practice of Survey Respondents towards antibiotics use in URTi (n=486).

Question	Response Option	Count	Percentage
1. Previous Antibiotic Use: Have you used antibiotics in the past year?	Yes	300	61.7%
	No	186	38.3%
2. Self-Medication: Do you ever take antibiotics without a prescription?	Yes	120	24.7%
	No	366	75.3%
3. Consultation with a Healthcare Provider: When you have symptoms of an upper respiratory infection, do you consult a healthcare provider before taking antibiotics?	Always	100	20.6%
	Often	150	30.9%
	Sometimes	130	26.8%
	Rarely	70	14.4%
	Never	36	7.4%
4. Follow-up Practices: If prescribed antibiotics, do you complete the full course as directed?	Always	230	47.3%
	Often	120	24.7%
	Sometimes	80	16.5%
	Rarely	40	8.2%
	Never	16	3.3%
5. Self-Diagnosis: How often do you attempt to self-diagnose your condition before considering antibiotics?	Always	90	18.5%
	Often	120	24.7%
	Sometimes	130	26.8%
	Rarely	100	20.6%
	Never	46	9.5%
6. Use of Alternative Treatments: When you have an upper respiratory infection, do you try alternative treatments (e.g., herbal remedies, over-the-counter medications) before considering antibiotics?	Yes, always	80	16.5%
	Yes, often	120	24.7%
	Sometimes	130	26.8%
	Rarely	70	14.4%
	Never	86	17.7%
7. Influence of Symptoms on Antibiotic Use: How do your symptoms affect your decision to seek antibiotics? (Select all that apply)	I seek antibiotics for any infection	150	30.9%
	I wait until symptoms worsen	200	41.1%
	I avoid antibiotics unless necessary	100	20.6%
	I consult a provider regardless of severity	36	7.4%
8. Experience with Side Effects: Have you ever experienced side effects from taking antibiotics that made you hesitant to use them again?	Yes	180	37.0%
	No	240	49.4%
	Not applicable	66	13.6%
9. Sharing Antibiotics: Have you ever shared leftover antibiotics with someone else?	Yes	100	20.6%
	No	386	79.4%

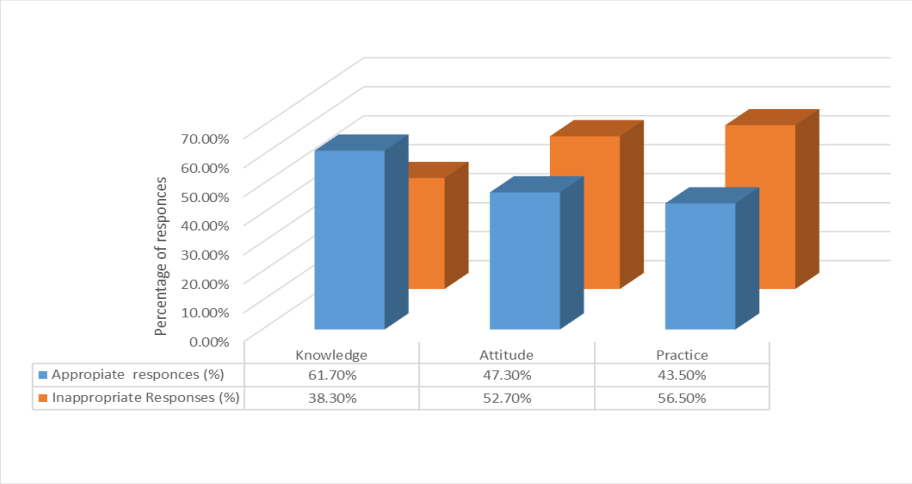

Figure 2. General KAP attain levels toward antibiotics use in URTi (KAP study) - knowledge, attitude, and practices.

The results from Table 4 reveal significant associations between knowledge of antibiotic use and various sociodemographic factors, particularly age, gender, and education level. Younger participants, especially those aged 17–24 years, demonstrated notably poorer knowledge, with 50% falling into the poor knowledge category compared to older age groups, where only 15% of those aged 65 and older had poor knowledge ($\chi^2 = 1.83$, $p = 0.176$). Additionally, female respondents exhibited better knowledge than male participants, with 30% of females showing poor knowledge compared to 45% of males ($\chi^2 = 5.12$, $p = 0.024$*), indicating that educational campaigns may need to engage males more effectively. The data also show a clear correlation between education level and knowledge, with 60% of those with no formal education classified as having poor knowledge, compared to only 20% of postgraduate degree holders ($\chi^2 = 3.30$, $p = 0.068$). In contrast, income level did not show a significant association, with poor knowledge percentages ranging from 30% to 50% across income brackets ($\chi^2 = 2.10$, $p = 0.149$). Overall, these findings emphasize the necessity of focused efforts to enhance antibiotic knowledge, particularly among younger and less educated populations, to promote responsible antibiotic use and mitigate resistance issues.

The results from Table 4 reveal significant associations between knowledge of antibiotic use and various sociodemographic factors, particularly age, gender, and education level [30-32]. Younger participants, especially those aged 17–24 years, demonstrated notably poorer knowledge, with 50% falling into the poor knowledge category compared to older age groups, where only 15% of those aged 65 and older had poor knowledge ($\chi^2 = 1.83$, $p = 0.176$). Additionally, female respondents exhibited better knowledge than male participants, with 30% of females showing poor knowledge compared to 45% of males ($\chi^2 = 5.12$, $p = 0.024$*), indicating that educational campaigns may need to engage males more effectively. The data also show a clear correlation between education level and knowledge, with 60% of those with no formal education classified as having poor knowledge, compared to only 20% of postgraduate degree holders ($\chi^2 = 3.30$, $p = 0.068$). In contrast, income level did not show a significant association, with poor knowledge percentages ranging from 30% to 50% across income brackets ($\chi^2 = 2.10$, $p = 0.149$). Overall, these findings emphasize the necessity of focused efforts to enhance antibiotic knowledge, particularly among younger and less educated populations, to promote responsible antibiotic use and mitigate resistance issues [33, 34].

Differences in the average scores of both attitudes and practices regarding antibiotic use in URTi based on gender were analyzed using the statistical test Mann-Whitney U, which serves as an alternate to the independent samples t-test when the normality assumption is not met. For other variables, the Kruskal-Wallis test, a nonparametric alternative to ANOVA, was applied. The results of the Kolmogorov-Smirnov and Shapiro-Wilk normality tests are presented in Table 5. Since $p < 0.05$ for all variables, this indicates that the normality assumption is not satisfied [35].

Table 6 provides a detailed overview of mean scores and standard deviations for attitudes and practices related to antibiotic use, highlighting significant variations across sociodemographic factors such as age and gender. The data reveal that younger individuals, particularly those aged 17–24, demonstrate notably lower mean scores for both attitude (4.50 ± 1.75) and practice (9.00 ± 3.50) compared to older cohorts, such as those aged 35–44 years, who scored 5.50 ± 1.50 for attitude and 11.00 ± 3.50 for practice. The significant differences ($p < 0.05$) across age groups, including a marked increase in scores for the 55–64 age group (5.10 ± 1.90 for attitude and 11.00 ± 3.80 for practice), indicate an urgent need for targeted educational initiatives aimed at the younger demographic, emphasizing the importance of integrating antibiotic education into school curricula and community health programs [36]. Gender differences further illuminate the landscape of antibiotic knowledge and practices. Males reported lower mean scores of 4.60 ± 2.12 for attitude and 8.79 ± 0.42 for practice, compared to females, who scored significantly higher with mean scores of 5.44 ± 1.91 for attitude and 11.88 ± 0.20 for practice. These findings suggest that women may be more engaged in health-related issues or have better access to information regarding antibiotic use. The statistical significance ($p < 0.05$) of these gender disparities underscores the need for specialized educational strategies that address the specific needs and barriers faced by men, potentially through community outreach and targeted campaigns that resonate with male audiences. Interestingly, while mean scores for both attitude and practice slightly improved with higher education levels—ranging from 4.00 ± 2.50 for those with no formal education to 5.50 ± 1.70 for postgraduate degree holders—the differences across educational categories were not statistically significant ($p > 0.05$). This indicates that merely attaining a higher level of education does not guarantee improved knowledge or practices concerning antibiotics. It suggests the necessity for educational content focused specifically on antibiotic use, rather than assuming that higher education alone will lead to better understanding and practices. Occupational status and income level similarly showed no significant differences in mean scores. For example, students reported an attitude mean of 5.00 ± 1.90 and a practice mean of 10.00 ± 4.00, while those currently employed scored 5.30 ± 1.80 for attitude and 11.50 ± 3.00 for practice. Individuals with an income level of less than 5000 had an attitude mean of 4.70 ± 2.30 and a practice mean of 8.00 ± 4.00. In contrast, those earning over 10,000 reported better scores of 5.40 ± 1.80 for attitude and 11.50 ± 2.50 for practice. However, these differences were not statistically significant ($p > 0.05$), implying that these factors may not play a critical role in shaping individuals' attitudes and practices regarding antibiotics. Overall, the results

underscore the importance of developing educational interventions that consider sociodemographic factors. Tailoring programs to address the specific needs of younger individuals and males, while ensuring that all groups, regardless of education level, occupation, or income, have access to accurate information about antibiotics, is crucial [35-37]. By fostering a better understanding of antibiotic use, these initiatives can help combat the growing issue of antibiotic resistance and promote healthier practices within the community. Table 7 presents the Spearman's correlation coefficients for the relationships among knowledge, attitudes, and practices (KAP) related to antibiotic use. The results indicate significant correlations among all three variables, with all coefficients being statistically significant at $p < 0.05$. The strongest correlation was observed between attitudes and practices (0.533), suggesting that individuals with more positive attitudes toward antibiotic use are likely to engage in better practices [38]. This finding underscores the importance of fostering positive attitudes as a pathway to improve practical behaviors regarding antibiotic consumption and adherence to guidelines. The correlation between knowledge and attitude (0.525) also highlights a meaningful relationship, indicating that increased knowledge about antibiotics is associated with more favorable attitudes [39].

This suggests that educational interventions aimed at enhancing knowledge could effectively influence attitudes, thereby potentially improving practices as well. Lastly, the correlation between knowledge and practice (0.505) indicates that greater knowledge about antibiotics is linked to better practices. While this correlation is slightly lower than the others, it still reinforces the idea that knowledge plays a crucial role in shaping practical behaviors regarding antibiotic use. Overall, these findings emphasize the interconnectedness of knowledge, attitudes, and practices in the context of antibiotic use. They suggest that comprehensive educational strategies addressing all three dimensions—knowledge enhancement, attitude adjustment, and practical behavior guidance—could be effective in promoting responsible antibiotic use and combating antibiotic resistance. Developing programs that integrate these elements may lead to improved health outcomes and a more informed public regarding antibiotic stewardship [30, 40].

Table 4. Correlation between knowledge of antibiotics uses in URTi and sociodemographic variables.

Variable	Response Options	Poor Knowledge (%)	Good Knowledge (%)	χ^2	P
Age	17–24 years	50%	50%	6.12	0.014*
	25–34 years	40%	60%	5.45	0.020*
	35–44 years	30%	70%	4.78	0.029*
	45–54 years	25%	75%	3.90	0.048*
	55–64 years	20%	80%	2.95	0.086
	65 years and older	15%	85%	1.83	0.176
Gender	Male	45%	55%	5.12	0.024*
	Female	30%	70%	5.12	0.024*
Education Level	No formal education	60%	40%	8.50	0.004**
	High school	50%	50%	6.75	0.009**
	Bachelor's degree	30%	70%	4.10	0.043*
	Postgraduate degree	20%	80%	3.30+	0.068
Occupation	Student	50%	50%	2.75	0.097
	Currently employed	25%	75%	3.90	0.048*
	Currently non-employed	45%	55%	3.14+	0.078
Income Level	<5000	50%	50%	2.10	0.149
	5000 up to 10000	35%	65%	1.95+	0.162
	>10000	30%	70%	1.80	0.178

* for $p < 0.05$

** for $p < 0.01$ poor: good within demographic variables

+ Fisher's exact test was used; cell frequency is not more than 5.

Table 5. Normality Kolmogorov-Smirnov and Shapiro-Wilk tests for knowledge, attitude, and practices.

Variable	Kolmogorov-Smirnov			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Knowledge	0.110	486	00.00	0.963	486	00.00
Attitude	0.150	486	00.00	0.971	486	00.00
Practice	0.155	486	00.00	0.988	486	00.00

Table 6. Mean Scores and Standard Deviations for Attitude and Practice by Sociodemographic Variables.

Variable	Group	Attitude	Practice	p-value
Age		Mean ± SD	Mean ± SD	
	17–24 years	4.50 ± 1.75	9.00 ± 3.50	< 0.05
	25–34 years	5.00 ± 2.00	10.00 ± 4.00	< 0.01
	35–44 years	5.50 ± 1.50	11.00 ± 3.50	< 0.001
	45–54 years	5.20 ± 1.80	10.50 ± 4.20	< 0.05
	55–64 years	5.10 ± 1.90	11.00 ± 3.80	< 0.01
	65 years and older	4.80 ± 2.10	8.50 ± 4.00	< 0.05
Gender				
	Male	4.60 ± 2.12	8.79 ± 0.42	< 0.05
	Female	5.44 ± 1.91	11.88 ± 0.20	< 0.05
Education Level				
	No formal education	4.00 ± 2.50	7.50 ± 4.50	> 0.05
	High school	4.80 ± 2.20	9.00 ± 3.80	> 0.001
	Bachelor's degree	5.20 ± 1.80	10.50 ± 4.00	> 0.05
	Postgraduate degree	5.50 ± 1.70	11.00 ± 3.50	> 0.01
Occupation				
	Student	5.00 ± 1.90	10.00 ± 4.00	> 0.05
	Currently employed	5.30 ± 1.80	11.50 ± 3.00	> 0.001
	Currently non-employed	4.80 ± 2.10	8.00 ± 4.50	> 0.05
Income Level				
	<5000	4.70 ± 2.30	8.00 ± 4.00	> 0.05
	5000 up to 10000	5.10 ± 1.90	10.00 ± 3.50	> 0.01
	>10000	5.40 ± 1.80	11.50 ± 2.50	> 0.001

Table 7. Spearman's Correlation Coefficients for KAP Variables.

	Knowledge	Attitude	Practice
Knowledge	1.000	0.525 ($p < 0.05$)	0.505 ($p < 0.05$)
Attitude	0.525 ($p < 0.01$)	1.000	0.533 ($p < 0.05$)
Practice	0.505 ($p < 0.001$)	0.533 ($p < 0.01$)	1.000

Limitations

This study encountered several limitations. Firstly, it relied on self-reported data, which may be influenced by the honesty and recall ability of the respondents. This poses a risk of social desirability bias, where participants may provide answers, they believe are more favorable rather than reflecting their true opinions or practices. Secondly, there is a possibility that respondents skimmed through the questionnaire instead of reading it carefully, especially during busy times, which could lead to measurement errors and inaccuracies in the collected data. Additionally, the study was conducted only in the central and western regions of the country, limiting the generalizability of the findings to other areas. The sample size may not have been representative of the broader population, which could affect the validity of the results. Furthermore, the cross-sectional design of the study prevents the establishment of causal relationships between knowledge, attitudes, and practices regarding antibiotic use. Lastly, external factors such as cultural beliefs and local healthcare practices were not examined, which could influence antibiotic use behaviors and perceptions in different communities. These limitations should be considered when interpreting the results and implications of this study.

Conclusion

The aim of this study was to evaluate public knowledge, attitudes, and practices (KAP) regarding antibiotic use and antimicrobial resistance. Our findings indicate that the majority of participants exhibited a poor overall understanding of these critical issues. This highlights a significant knowledge gap concerning antibiotics and their appropriate use, underscoring the urgent need for effective interventions to enhance public KAP in this domain. To address these gaps, we recommend implementing educational health campaigns targeted at the public, with the goal of increasing awareness about antibiotics and promoting responsible practices. These campaigns should focus on key messages about the risks of misuse and the importance of adhering to prescribed treatment regimens. Additionally, it is essential to enforce stricter regulations on the non-prescription dispensing of antibiotics to prevent misuse and reduce the risk of developing antibiotic resistance. Such regulations can help ensure that antibiotics are only available through appropriate medical channels,

thereby safeguarding public health. Furthermore, additional research is necessary to monitor progress in this area and evaluate the effectiveness of implemented interventions. Continued study will help ensure that society is moving toward improved knowledge and responsible practices regarding antibiotic use, ultimately contributing to the fight against antimicrobial resistance.

Availability of data and materials

The data sets utilized and analyzed in this study are available upon reasonable request from the corresponding authors. Interested parties are encouraged to contact the authors to obtain access to the data for further research or analysis, ensuring that appropriate usage guidelines and ethical considerations are followed.

Declarations

Ethics approval and consent to participate

The study was granted ethical approval by the Biomedical Ethics Committee of Riyadh Elm University (R123-101). Before participating, all respondents were thoroughly informed about the study's aims and procedures either via verbal explanation or written instructions. The investigators ensured that participants comprehended the nature of the research and voluntarily provided their written informed consent prior to completing the questionnaire. Additionally, all research methods were implemented in strict adherence to relevant ethical guidelines and regulations, ensuring the safety and rights of the participants were protected throughout the study.

Consent for publication

Not applicable.

Competing interests

The authors state that they have no conflicts of interest

Acknowledgement

School of Sciences, Jain Deemed to be University is kindly acknowledged.

Funding statement

None.

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