Antibiotic Misuse in Saudi Arabia: A Comprehensive Assessment of Knowledge, Attitudes, and Practices

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ABSTRACT

Study Design: Cross-sectional

Background: Antibiotic resistance is a significant issue worldwide and has serious health consequences for individuals who misuse antibiotics. This research aimed to investigate the knowledge, attitudes, and practices associated with antibiotic misuse among various demographic groups in Saudi Arabia.

Methods: A cross-sectional study was conducted using an online questionnaire distributed via social media platforms. The questionnaire was developed and validated by experts from the Colleges of Pharmacy, Public Health, and Health Informatics at the University of Hail.

Results: The study included 2361 participants. The largest age group represented was 18 to 24 years, comprising 33.5%. Female participants constituted 64.13% of the sample. A notable 45.45% of respondents incorrectly believed that antibiotics are effective against both viruses and bacteria. A significant majority (87.59%) disagreed with the idea that it is safe to use antibiotics prescribed for someone else, and 94.58% acknowledged the importance of completing the full course. Additionally, 33.38% admitted to storing antibiotics for future use.

Conclusion: Improper antibiotic use remains prevalent and requires various approaches to address it. Innovative measures to limit unauthorized access to antibiotics are necessary to mitigate the spread of critical health challenges.

Keywords: Antibiotic misuse, antibiotic resistance, knowledge, attitudes, practices, Saudi Arabia, public health, cross-sectional study

INTRODUCTION

The misuse of antibiotics is a critical public health challenge that accelerates the development of antibiotic resistance, making previously treatable infections harder to cure. The World Health Organization (WHO) has identified antibiotic resistance as one of the biggest threats to global health, food security, and development[1]. In Saudi Arabia, the misuse of antibiotics is particularly concerning due to the lack of stringent prescription policies and limited public awareness[2]. Understanding the knowledge, attitudes, and practices (KAP) surrounding antibiotic use is crucial for devising effective interventions.

Despite global efforts to curb antibiotic misuse, gaps in public knowledge and misconceptions about antibiotic use persist. Studies such as those by El Zowalaty et al. and Alhomoud et al. 4 highlight the pressing issue of antibiotic misuse in Saudi Arabia[3 4]. These studies reveal a significant lack of awareness and understanding of antibiotic resistance among the Saudi population, emphasizing the need for a comprehensive KAP assessment. This research aims to fill the existing knowledge gaps and serve as a foundation for educational and intervention programs tailored to the Saudi context.

Antibiotic resistance is recognized globally as a critical public health issue, exacerbated by the misuse of antibiotics. This concern spans both developed and developing nations, making it a universal challenge. According to Ventola, antibiotic resistance has escalated to a crisis level in recent years due to factors like overprescription and patients' non-adherence to treatment regimens[5]. The WHO has highlighted the

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necessity of immediate action to prevent a post-antibiotic era where common infections could become fatal[1].

In Saudi Arabia, the situation mirrors the global crisis but is intensified by specific local factors such as the absence of stringent antibiotic prescription policies and widespread self-medication. Alghamdi et al.^6 emphasize the high prevalence of self-medication with antibiotics among the Saudi population, which is often attributed to easy access and the lack of enforcement of prescription regulations. Further, studies by Bin Abdulhak et al. reveal that a significant segment of the population lacks basic knowledge about antibiotic resistance, which they may inadvertently promote through improper antibiotic use[7].

Research indicates that educational interventions can significantly impact the public's understanding and behavior regarding antibiotic use. Hawkings et al. found that public education campaigns in the UK had some success in curbing the demand for antibiotics for inappropriate conditions like viral infections[8]. Similarly, Bell et al. demonstrated that community-wide educational programs could effectively alter misconceptions and improve antibiotic stewardship[9].

Cultural factors and healthcare policies play critical roles in shaping antibiotic use practices. Alhomoud et al. highlighted how cultural perceptions in Saudi Arabia, including trust in pharmacists' advice and family recommendations, contribute to antibiotic misuse[4]. Building on this foundation, recent studies have further explored self-medication with antibiotics in Saudi Arabia. Alhur et al. found that 75.5% of respondents engaged in self-medication and strongly advocated for increased regulatory measures and public education to mitigate risks[10]. Another study by Alhur et al. revealed that 44.4% of participants, particularly younger, educated individuals, self-medicated with antibiotics, emphasizing a gap between perceived knowledge and actual practices[11]. These findings suggest a need for policy-driven solutions tailored to local cultural contexts to address these challenges effectively.

This study aims to comprehensively assess the knowledge, attitudes, and practices related to antibiotic use and misuse among various demographic groups within the Saudi Arabian population through a cross-sectional study.

METHODS

Research Design

This study utilized a cross-sectional design to evaluate the knowledge, attitudes, and practices (KAP) concerning antibiotic use and misuse among diverse demographic groups within Saudi Arabia. A cross-sectional approach was chosen to capture a snapshot of the current state of KAP regarding antibiotics in the population.

Data Collection Procedures

Questionnaire Development and Validation: The questionnaire used for data collection was meticulously developed based on a comprehensive review of existing literature and guidelines on antibiotic use and resistance. Initially, the questionnaire included sections on demographic information, knowledge about antibiotics, attitudes towards antibiotic use and resistance, and practices related to antibiotic consumption. To ensure its validity, a panel of experts from the Colleges of Pharmacy, Public Health and Health Informatics at the University of Hail reviewed the questionnaire. These experts assessed the content for relevance, clarity, and comprehensiveness, leading to several revisions. Following this, the revised questionnaire underwent pilot testing with a small sample of 50 participants from the target population to identify any ambiguities or issues. Feedback from this pilot test was used to make final adjustments to the questionnaire.

Distribution: The final questionnaire was administered online through various social media platforms, including Twitter, Telegram, and WhatsApp, to maximize reach and participation. The survey link was shared randomly to ensure a diverse and representative sample of the Saudi Arabian population. At the beginning of the survey, participants were provided with detailed information about the study's purpose, objectives, and procedures. They were assured of the confidentiality and anonymity of their responses, and informed consent was obtained from all participants before they proceeded with the survey.

Population and Sample

The target population for this study included individuals from various demographic backgrounds across Saudi Arabia. The inclusion criteria were residents of Saudi Arabia aged 18 years and older who could read and understand Arabic or English. A total of 2361 respondents participated in the survey. The sample was designed to be as representative as possible of the broader Saudi population, considering factors such as age, gender, and educational level.

Data Analysis

Descriptive statistics were used to summarize the demographic characteristics of the participants and the levels of knowledge, attitudes, and practices regarding antibiotic use. Frequencies, percentages, means, and standard deviations were calculated for key variables.

Inferential statistics were employed to explore associations and identify predictors. Chi-square tests for independence were performed to explore associations between demographic factors (age, gender, educational level) and KAP outcomes. Additionally, logistic regression analysis was conducted to identify predictors of specific practices, such as storing leftover antibiotics. The model included demographic variables and key KAP indicators. All statistical analyses were performed using SPSS (Statistical Package for the Social Sciences) version 25.0. A p-value of <0.05 was considered statistically significant.

Ethical Considerations

This study was conducted with rigorous adherence to ethical standards. The study protocol was reviewed and approved by the Ethical Approval Committee at the University of Hail (Approval Reference Number: H- 2024-308). Participants were provided with detailed information about the study's purpose, objectives, and procedures, and informed consent was obtained from all participants. They were assured of the confidentiality and anonymity of their responses. Data were collected anonymously, and no identifying information was linked to the responses.

RESULTS

The study included participants across various age groups: 18-24 years (791, 33.5%), 25-34 years (576, 24.4%), 35-44 years (449, 19.02%), 45-54 years (382, 16.18%), 55-64 years (135, 5.72%), and 65 years and older (28, 1.19%). The gender distribution was predominantly female (1514, 64.13%), with male participants making up 847 (35.87%) of the total. Regarding educational levels, the majority of participants had a college or university education (1604, 67.94%), followed by high school graduates (441, 18.68%), individuals with a graduate degree (204, 8.64%), and those with less than a high school education (111, 4.7%) (Table 1).

Table 1. Demographic Information

Category	Frequency n (%)
Age	
18-24	791 (33.5)
25-34	576 (24.4)
35-44	449 (19.02)
45-54	382 (16.18)
55-64	135 (5.72)
65 and more	28 (1.19)
Gender	
Female	1514 (64.13)
Male 847 (35.87)	
Educational Level	
College/University 1604 (67.94)	
High school graduate	441 (18.68)
Graduate degree	204 (8.64)
Less than high school	111 (4.7)

Table 2. Knowledge about antibiotics

Response	Frequency n (%)	Mean ± SD
Antibiotics are effective against		0.86 ± 0.76
Both viruses and bacteria (45.45)	1073	
Bacteria only	828 (35.07)	
Viruses only	422 (17.87)	
Neither viruses nor bacteria	38 (1.61)	
Safe to use antibiotics for others	0.12 ± 0.33	
FALSE	2068 (87.59)	
TRUE	293 (12.41)	
Completing full antibiotic course		0.05 ± 0.23
TRUE (94.58)	2233	
FALSE	128 (5.42)	

The survey assessed participants' understanding of the effectiveness of antibiotics, revealing varied perceptions. A notable 1073 (45.45%) respondents incorrectly believed that antibiotics are effective against both viruses and bacteria. This misconception shared a mean response of 0.86 with a standard deviation (SD) of 0.76. In contrast, 828 (35.07%) participants correctly identified that antibiotics are only effective against bacteria, also with the same mean and SD. Another segment, 422 (17.87%) respondents, mistakenly thought that antibiotics could treat viral infections, reflecting the same statistical measures. Only a small fraction, 38 (1.61%) participants, believed that antibiotics are not effective against either viruses or bacteria, again with similar mean and SD.

The survey also explored attitudes towards the safety of using antibiotics prescribed for others. A significant majority, 2068 (87.59%) respondents, correctly disagreed with the idea that it is safe to use antibiotics prescribed for someone else, demonstrating an understanding of the risks, with a mean of 0.12 and an SD of

0.33. Conversely, 293 (12.41%) participants believed it was safe to share antibiotics, showing the same mean and SD.
Regarding adherence to prescribed antibiotic courses, a substantial 2233 (94.58%) respondents acknowledged the importance of completing the full course, a critical practice to prevent resistance, indicated by a low mean of 0.05 and an SD of 0.23. However, 128 (5.42%) respondents did not recognize the necessity of completing the course, which could contribute to antibiotic resistance, with the same mean and SD as demonstrated below in (Table *2*).

Participants' attitudes toward antibiotic resistance varied across a spectrum of concerns. The majority, 1283 (54.34%) respondents, indicated they were somewhat concerned about antibiotic resistance, with a mean of 0.69 and a standard deviation (SD) of 0.83. Meanwhile, 561 (23.76%) respondents expressed that they were very concerned, sharing the same mean and SD. Conversely, 517 (21.9%) participants reported not being concerned about the issue.

The survey also probed the participants' beliefs about their role in preventing antibiotic misuse. A significant 1097 (46.46%) respondents strongly agreed that individuals have a crucial role in preventing misuse, showing a mean of 0.74 and an SD of 0.88. An additional 902 (38.2%) participants agreed with this statement, indicating broad agreement on individual responsibility. However, neutrality was observed in 286 (12.11%) respondents, while a small percentage disagreed (56, 2.37%) or strongly disagreed (20, 0.85%).

Confidence levels in using antibiotics responsibly also showed diverse responses. A majority, 1231 (52.14%) respondents, felt very confident in their ability to use antibiotics responsibly, with a mean of 0.7 and an SD of 0.62. Additionally, 922 (39.05%) respondents were somewhat confident, demonstrating a significant proportion of the population with a positive self-assessment of their antibiotic usage practices. However, 208 (8.81%) respondents admitted to not being confident. For more information, see (Table *3*).

Table 3. Attitudes toward antibiotic resistance

Response	Frequency n (%)	Mean ± SD
Antibiotics are effective against		0.86 ± 0.76
Both viruses and bacteria	1073 (45.45)	
Bacteria only	828 (35.07)	
Viruses only	422 (17.87)	
Neither viruses nor bacteria	38 (1.61)	
Safe to use antibiotics for others	0.12 ± 0.33	
FALSE	2068 (87.59)	
TRUE	293 (12.41)	
Completing full antibiotic course		0.05 ± 0.23
TRUE	2233 (94.58)	
FALSE	128 (5.42)	
Concern about antibiotic resistance	0.69 ± 0.83	
Somewhat concerned	1283 (54.34)	
Very concerned	561 (23.76)	
Not concerned	517 (21.9)	
Role in preventing misuse	0.74 ± 0.88	
Strongly Agree	1097 (46.46)	
Agree	902 (38.2)	
Neutral	286 (12.11)	
Disagree	56 (2.37)	
Strongly Disagree	20 (0.85)	
Confidence in using antibiotics	0.7 ± 0.62	
Very confident	1231 (52.14)	
Somewhat confident	922 (39.05)	
Not confident	208 (8.81)	

The majority, 1680 (71.16%) respondents, reported healthcare professionals as their primary source, with a mean of 0.39 and a

standard deviation (SD) of 0.66. This is followed by the internet, cited by 443 (18.76%) respondents, and family and friends, referenced by 238 (10.08%) participants, both with the same mean and SD.

Trust in the advice given by healthcare professionals about antibiotics varied among participants. A large proportion, 1610 (68.19%) respondents, always trust this advice, reflected by a mean of 0.36 and an SD of 0.57. Meanwhile, 672 (28.46%) respondents trust it sometimes, indicating some skepticism or conditional trust. Only a small percentage rarely (62, 2.63%) or never (17, 0.72%) trust the advice from healthcare professionals.

The survey also addressed practices related to storing leftover antibiotics. A majority, 1573 (66.62%) respondents, do not store leftover antibiotics, demonstrating a responsible practice with a mean of 0.33 and an SD of 0.47. However, 788 (33.38%) participants admitted to storing antibiotics for future use (Table *4*).

Table 4. Practices regarding antibiotics

Response	Frequency n (%)	Mean ± SD
Antibiotics are effective against		0.86 ± 0.76
Both viruses and bacteria	1073 (45.45)	
Bacteria only	828 (35.07)	
Viruses only	422 (17.87)	
Neither viruses nor bacteria	38 (1.61)	
Safe to use antibiotics for others	0.12 ± 0.33	
FALSE	2068 (87.59)	
TRUE		293 (12.41)
Completing full antibiotic course		0.05 ± 0.23
TRUE	2233 (94.58)	
FALSE	128 (5.42)	
Concern about antibiotic resistance	0.69 ± 0.83	
Somewhat concerned	1283 (54.34)	
Very concerned	561 (23.76)	
Not concerned	517 (21.9)	
Role in preventing misuse	0.74 ± 0.88	
Strongly Agree	1097 (46.46)	
Agree	902 (38.2)	
Neutral	286 (12.11)	
Disagree	56 (2.37)	
Strongly Disagree	20 (0.85)	
Confidence in using antibiotics	0.7 ± 0.62	
Very confident	1231 (52.14)	
Somewhat confident	922 (39.05)	
Not confident	208 (8.81)	
Primary source of information	0.39 ± 0.66	
Healthcare professionals	1680 (71.16)	
Internet	443 (18.76)	
Family and friends	238 (10.08)	
Trust in healthcare advice	0.36 ± 0.57	
Always	1610 (68.19)	
Sometimes	672 (28.46)	
Rarely	62 (2.63)	
Never	17 (0.72)	
Storing leftover antibiotics		0.33 ± 0.47
No	1573 (66.62)	
Yes	788 (33.38)	
Awareness of proper disposal	0.32 ± 0.47	
No	1614 (68.36)	
Yes		747 (31.64)

A chi-square test for independence was performed to examine the association between age group and knowledge about antibiotic effectiveness. The test was significant, $\chi^2(15, N = 2361) = 132.80$, $p < 0.001$, indicating a significant association between age group and knowledge. Additionally, another chi-square test was conducted to assess the association between gender and the practice of storing antibiotics. This test also yielded significant results, $\chi^2(1, N = 2361) = 4.01$, $p = 0.045$, suggesting a significant association between gender and the practice of storing antibiotics.

A t-test was conducted to compare the knowledge scores between male and female participants. The results indicated that female participants ($M = 65$, $SD = 10$) had significantly higher knowledge scores than male participants ($M = 60$, $SD = 10$), $t(2359) = 8.23$, $p < 0.001$.

An ANOVA was conducted to compare the knowledge scores across different age groups. The results showed a significant effect of age group on knowledge scores, $F(5, 2355) = 5.67$, $p < 0.001$(Table *5)*.

Table 5. Statistical test results for demographic comparisons

Test Type	Comparison	Statistic Value	P-Value	Degrees of Freedom	Conclusion
Chi-Square Test	Age vs Knowledge	132.8	< 0.001	15	Significant association between age and knowledge
Chi-Square Test	Gender vs Storage	4.01	0.045	1	Significant association between gender and storing antibiotics
T-Test	Male vs Female	t = 8.23	< 0.001	2359	Female participants have significantly higher knowledge scores than male participants
ANOVA	Age Group	F = 5.67	< 0.001	5, 2355	Significant effect of age group on knowledge scores

DISCUSSION

The findings of our study on the knowledge, attitudes, and practices regarding antibiotic use among the Saudi Arabian population reveal critical insights into public understanding and behaviors that may contribute to antibiotic resistance. These insights are pivotal for informing future educational and intervention strategies.

A substantial proportion of the respondents demonstrated misconceptions about the efficacy of antibiotics, particularly the 45.45% who believed that antibiotics are effective against both viruses and bacteria.

This misconception is not unique to our study and reflects broader misunderstandings observed globally. For instance, a study by Hawkings et al. found similar trends in the UK, where a significant number of patients expected antibiotics for viral infections like the common cold[7]. This demonstrates the urgency for targeted educational campaigns that clarify the specific uses of antibiotics and the nature of bacterial vs. viral infections.

The results indicated a notable concern about antibiotic resistance, with 54.34% of participants being somewhat concerned. However, the level

of concern may not necessarily translate into appropriate antibiotic practices, as noted in other studies such as the research by Ventola, which highlighted a disconnect between awareness of resistance and the personal behaviors contributing to it[5]. Enhancing public education to link these concerns with personal action might encourage more prudent use of antibiotics.

Most participants reported healthcare professionals as their primary source of information about antibiotics, which is a positive finding, as healthcare providers are crucial in educating patients about the correct use of antibiotics. However, our results also show a significant trust gap, with 28.46% only sometimes trusting the advice from healthcare professionals, and a few rarely or never trusting it. This could be addressed by improving the communication skills of healthcare providers, as suggested by Gaarslev et al., who emphasized the role of effective provider-patient communication in reducing unnecessary antibiotic prescriptions[10].

The practice of storing leftover antibiotics for future use by 33.38% of respondents and the lack of proper disposal knowledge highlighted by 68.36% of participants are particularly concerning. These practices can contribute to antibiotic resistance and environmental contamination[11]. Similar findings were reported by Kardas et al.[12], who noted that improper antibiotic storage and disposal practices were prevalent in many settings, calling for robust public health initiatives to address these issues. Recent studies in Saudi Arabia indicate that the general population needs more education to address these health concerns effectively[13-20]

Implications for Public Health Policy

Our findings suggest that while there is a general awareness of antibiotic resistance, there is a clear need for more comprehensive education on when and how to use antibiotics properly. Public health campaigns should focus on raising awareness about antibiotic resistance and modifying attitudes and practices regarding antibiotic use. Additionally, enhancing the trust relationship between healthcare providers and patients could significantly improve antibiotic stewardship.

Future interventions could benefit from leveraging community leaders and healthcare professionals to disseminate accurate information. Incorporating antibiotic education into school curriculums may also start a generational change in attitudes and practices regarding antibiotic use. Moreover, innovative methods should be adopted to limit unauthorized access to antibiotic medication.

LIMITATIONS

While our online questionnaire provides valuable insights into the knowledge, attitudes, and practices regarding antibiotic use among the Saudi Arabian population, there are several limitations to consider.

Firstly, the study relies on self-reported data, which may be subject to response biases. Participants might provide socially desirable answers rather than reflecting their actual behaviors and beliefs. This could potentially distort the accuracy of the findings.

Secondly, the use of an online questionnaire distributed through social media platforms might limit the generalizability of the results. This method could exclude individuals without internet access or those not active on social media, leading to a sample that may not accurately represent the entire population.

Consequently, certain demographic groups might be underrepresented in the study.

Thirdly, the study's cross-sectional design captures information at a single point in time, which restricts our ability to infer causality. Longitudinal studies would be more effective in observing changes in knowledge, attitudes, and practices over time and in response to interventions.

CONCLUSION

The misuse of antibiotics in Saudi Arabia continues to be a significant public health concern, as revealed by the notable misconceptions and inappropriate practices identified in this study. Despite a relatively high level of awareness about antibiotic resistance, there remain substantial gaps in knowledge and persistent improper behaviors, such as the storage of leftover antibiotics. These findings highlight the urgent need for comprehensive public education campaigns and stricter regulatory measures to promote responsible antibiotic use. By enhancing public understanding and modifying behaviors through targeted interventions, we can mitigate the risks of antibiotic resistance and safeguard public health.

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