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Original Article

PSYCHOLOGICAL AND BEHAVIORAL FACTORS ASSOCIATED WITH ANTIBIOTIC USE AND PERCEPTIONS OF ANTIMICROBIAL RESISTANCE AMONG UNIVERSITY STUDENTS IN SIALKOT, PAKISTAN

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ABSTRACT

Antimicrobial resistance (AMR) is influenced not only by microbial factors but also by human decisions regarding antibiotic use. Understanding the psychological and behavioral determinants of inappropriate antibiotic use is crucial for strengthening antimicrobial stewardship. This study assessed antibiotic-related attitudes, AMR risk perception, and antibiotic-use behaviors among university students in Sialkot, Pakistan, focusing on the knowledge-attitude-behavior gap. A cross-sectional online questionnaire was completed between 19 and 27 June 2026 by 506 respondents (293 females, 57.9%; 213 males, 42.1%). The questionnaire assessed demographics, antibiotic related knowledge, attitudes, AMR perceptions. Descriptive frequencies and percentages were calculated and chi-square test examined gender differences in behaviors. Participants showed favourable attitude towards responsible antibiotic use, with all respondents agreeing that doctors should prescribe antibiotics only when clinically necessary. However, inappropriate practices remained common. Non-prescription antibiotic use was reported by 55.3% of females and 75.1% of males ($\chi^2 = 20.89$, $p < 0.001$) while premature discontinuation after fever subsided was reported by 80.9% and 91.5% respectively. Concern about AMR affecting themselves or family members was reported by 64.6% females and 72.8% males. Healthcare professionals were the main source of AMR information (31.4% females;52.1% male), while university education was prominent among females (22.9% vs.12.7%). Overall, a clear knowledge-attitude behavior gap was evident as favorable attitudes and AMR concern did not consistently translate into appropriate antibiotic-use practices. These findings highlight the need for university-based behavioral interventions addressing risk perception, social influences, perceived behavioral control, and treatment adherence alongside conventional awareness-raising approaches to promote responsible antibiotic use.

I. INTRODUCTION

Antimicrobial resistance (AMR) is a major global health concern and it is becoming clear that human behavior plays a growing role in this issue. Decisions related to antibiotic purchasing, prescribing, self-medication, adherence, sharing, and discontinuation are common practices that can lead to inappropriate antibiotic use and, consequently, accelerate the development of resistance (WHO 2023; WHO, 2026; Gashaw et al., 2025). As a result,

AMR is not restricted to hospitals but it also occurs in homes, community healthcare, pharmacies, and other settings. The behavioral dimension of AMR is particularly important because knowledge about antibiotics does not necessarily result in appropriate antibiotic-use behavior (McCullough et al., 2016). Previous studies involving university and healthcare students have reported gaps between their knowledge, attitudes, and actual practices regarding antibiotic use (Lubwama et al., 2021; Marzan et al., 2021). Self-medication and premature discontinuation of antibiotic treatment remain important behavioral concerns, particularly in low- and middle-income countries (Ocan et al., 2015; Torres et al., 2019). Health psychology provides a useful framework for understanding these discrepancies. Health behavior is influenced by individual beliefs, perceived risk, social expectations, previous experiences, and perceived ability to control one's behavior (Rosenstock et al., 1988). Theory of Planned Behavior (TPB) suggests that perceived behavioral control, subjective norms, and attitudes are all factors that affect behavioral intentions, which in turn influences behavior (Ajzen, 1991). Therefore, the need for proper antibiotic use can be known while at the same time engaging in improper practices when social, practical and psychological factors promote such practices.

Moreover, the perception of risk is important for the decision-making process on antibiotic use. People can have the awareness that AMR is a serious public health issue, but not feel that they are at immediate risk due to their antibiotic use. This separation could help sustain self-medication and other inappropriate practices. Research on public perceptions of AMR has similarly demonstrated variation in awareness, perceived seriousness, and personal risk (Oniciuc et al., 2019). University students represent an important population for studying these behavioral processes because they increasingly make their own healthcare decisions and may consequently influence health-related practices within their families and communities. Previous research among university students has identified substantial gaps between knowledge and appropriate antibiotic practices (Limaye et al. 2019; Marzan et al., 2021). Previous studies have assessed students' knowledge and attitudes toward antibiotics; however, positive attitudes do not always result in appropriate antibiotic-use practices. Therefore, a need to examine antibiotic-related attitudes together with actual self-reported behaviors and perceived personal risk of AMR within the local context of Sialkot, Pakistan.

II. METHOD

Participants

A cross-sectional, questionnaire-based study was conducted among university students in Sialkot Pakistan. Data were collected through a self-administered online questionnaire via Google Forms from 19 June to 27 June 2026. Participants were recruited using a convenience sampling approach through online distribution of the questionnaire. The study includes 506 respondents, comprising 293 females (57.9%) and 213 males (42.1%). Participants from the target population in Sialkot were recruited through the online distribution of the questionnaire. Approximately 1000 individuals were invited for the questionnaire, of whom 506 completed it, yielding a response rate of 50.6%.

Measures

Data were collected using a structured online questionnaire administered through Google Forms. The questionnaire was adapted from previously validated instruments (WHO, 2015; Scaioli et al., 2015). The questionnaire included sections covering demographic characteristics, knowledge of antibiotic resistance, attitudes and beliefs regarding responsible antibiotic use, perceptions of AMR, self-reported antibiotic-use practices, and sources of information about AMR. Attitude items were primarily assessed using a three-point response format; strongly agree (SA), neither agree nor disagree (N) and strongly disagree (SD). Behavioral questions included non-prescription antibiotic use and the tendency to discontinue antibiotics when fever subsided.

Data Analysis

Data were analyzed using descriptive statistics. Frequencies and percentages were calculated to summarize participants' demographic characteristics, antibiotic-related attitudes, antimicrobial resistance (AMR) perceptions, antibiotic-use behaviors, and sources of AMR information. Chi-square tests were used to examine associations between gender and antibiotic-use behaviors (non-prescription use, discontinuation after fever subsided). A p-

value <0.05 was considered statistically significant. All analyses were conducted using Microsoft Excel and GraphPad Prism (Version 8.0).

Ethical Considerations

Participation in this study was voluntary. Before completing the questionnaire, participants were informed about the purpose of the study and the nature of their participation. Informed consent was obtained from participants prior to questionnaire completion. Participants were informed that they could choose not to participate and that their responses would be treated confidentially. No personally identifying information was required for participation, and the collected information was used solely for research purposes (World Medical Association 2013).

III. RESULTS

Demographic Characteristics

A total of 506 respondents were included in the summarized analysis. Females represented 57.9% (n = 293), while males represented 42.1% (n = 213). The largest age group was 19–24 years, representing 56.1% (n = 284) of respondents, followed by 25–34 years (24.1%, n = 122) and 16–18 years (12.5%, n = 63). Rural respondents represented 48.3% (n = 241), while 43.1% (n = 215) were from urban areas and 8.6% (n = 43) from suburban/outskirt areas. (37.9%, n = 191) (Table 1).

Table I: Demographic Characteristics of Study Participants

Variables	Categories	n	%
Gender	Female	293	57.9
	Male	213	42.1
Age	16–18	63	12.5
	19–24	284	56.1
	25–34	122	24.1
	≥35	37	7.3
Residence	Rural	241	48.3
	Urban	215	43.1
	Suburban/outskirts	43	8.6
	No response	7	1.4

Attitudes toward Responsible Antibiotic Use

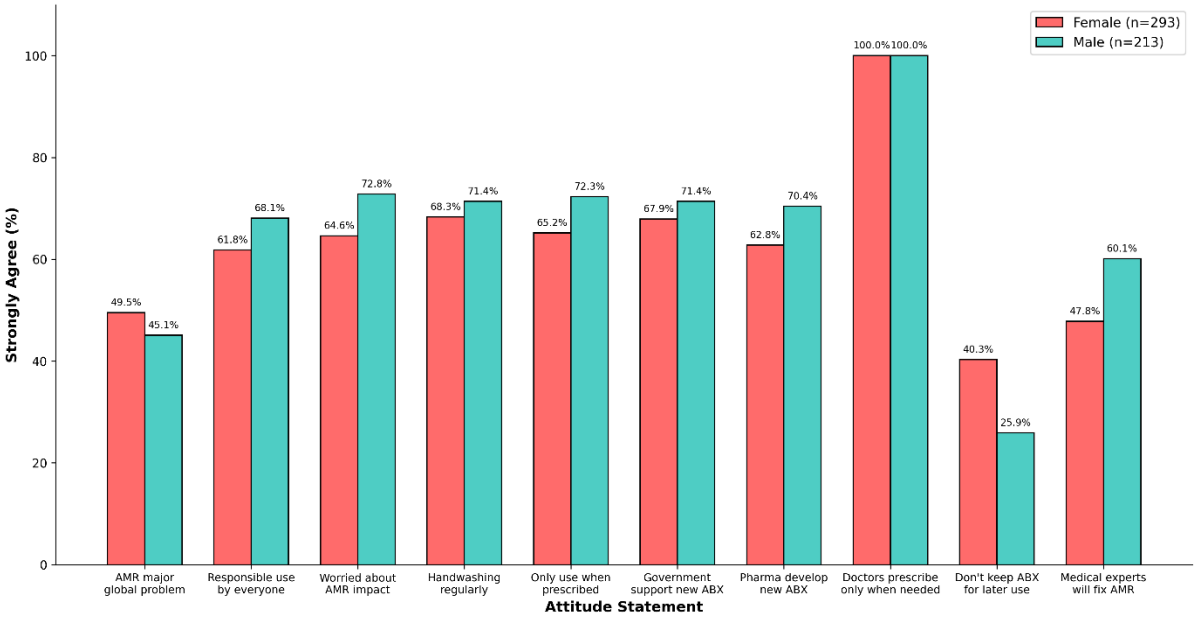
Participants demonstrated generally favorable attitudes toward responsible antibiotic use. All female and male respondents strongly agreed that doctors should prescribe antibiotics only when clinically necessary. Strong agreement that antibiotics should be used responsibly was reported by 61.8% of females and 68.1% of males (Figure 1). Similarly, 65.2% of females and 72.3% of males strongly agreed that antibiotics should only be used when prescribed. Strong agreement regarding the importance of regular handwashing was reported by 68.3% of females and 71.4% of males (Table 2). Concern about AMR affecting oneself or one's family was reported by 64.6% of females and 72.8% of males. Regarding the perception that antibiotic resistance represents one of the world's major problems, 49.5% of females and 45.1% of males strongly agreed. These results showed that attitude towards responsible antibiotic usage are generally positive and that AMR is acknowledged as a significant health risk.

Table II: Gender-Wise Distribution of Attitudes toward Responsible Antibiotic Use

Statements	Females (n=293)	Males (n=213)
Antibiotic resistance is one of the biggest problems in the world	SA 49.5% | N 41.8% | SD 5.1%	SA 45.1% | N 52.6% | SD 2.35%
Antibiotics need to be used responsibly by everyone	SA 61.8% | N 24.1% | SD 10.2%	SA 68.1% | N 21.6% | SD 10.8%
I am worried about the impact of AMR on myself/family	SA 64.6% | N 24.6% | SD 7.5%	SA 72.8% | N 21.6% | SD 6.1%
People should wash their hands regularly	SA 68.3% | N 22.5% | SD 6.5%	SA 71.4% | N 22.5% | SD 6.1%
People should only use antibiotics when prescribed	SA 65.2% | N 23.2% | SD 8.2%	SA 72.3% | N 22.1% | SD 5.6%
Governments should support development of new antibiotics	SA 67.9% | N 17.75% | SD 10.6%	SA 71.4% | N 26.3% | SD 2.35%
Pharmaceutical companies should develop new antibiotics	SA 62.8% | N 24.2% | SD 9.6%	SA 70.4% | N 15.5% | SD 5.6%
Doctors should only prescribe antibiotics when needed	SA 100% (293/293)	SA 100% (213/213)
People should not keep antibiotics for later use	SA 40.3% | N 42.0% | SD 15.0%	N 54.9% | SA 25.9% | SD 19.3%
Medical experts will fix AMR before it gets too bad	N 36.5% | SA 47.8% | SD 12.0%	N 30.1% | SA 60.1% | SD 8.1%

*Response options: SA = strongly agree, N = neither agree nor disagree, SD = strongly disagree

Figure I: Comparing attitude Toward Appropriate Antibiotic Usage by Gender (Strongly Agree Responses)



Perceived seriousness and personal risk of AMR

Participants showed a high level of concern about antimicrobial resistance (AMR). Strong agreement that AMR could affect respondents or their families was reported by 64.6% of females and 72.8% of males. Regarding the perception that antibiotic resistance represents one of the world's major problems, 49.5% of females and 45.1% of males strongly agreed. These results imply that respondents recognized AMR as an significant health risk and perceived potential consequences for themselves or their families. However, the presence of significant concern alongside inappropriate antibiotic-use behaviors suggests that awareness of the risks alone may not be enough to bring about positive behavioral changes.

Non-prescription antibiotic use

A considerable proportion of participants reported using antibiotics without a prescription. Among females, 55.3% (n = 162) reported taking antibiotics without a prescription, compared with 75.1% (n = 160) of males. (Table 3). This gender difference was statistically significant ($\chi^2 = 20.89$, $p < 0.001$) (Figure 2). The greater proportion among male respondents indicates an important pattern in antibiotic-use behavior.The higher proportion observed among male respondents represents an important behavioral pattern. Self-medication with antibiotics has been widely identified as a contributor to inappropriate antibiotic use, particularly in developing-country settings (Ocan et al., 2015; Torres et al., 2019).

Figure II: A Gender-Wise Comparison of Non-Prescription Antibiotic Use among University Students. A Statistically Significant Gender Difference was Observed ($\chi^2 = 20.89$, $p < 0.001$)

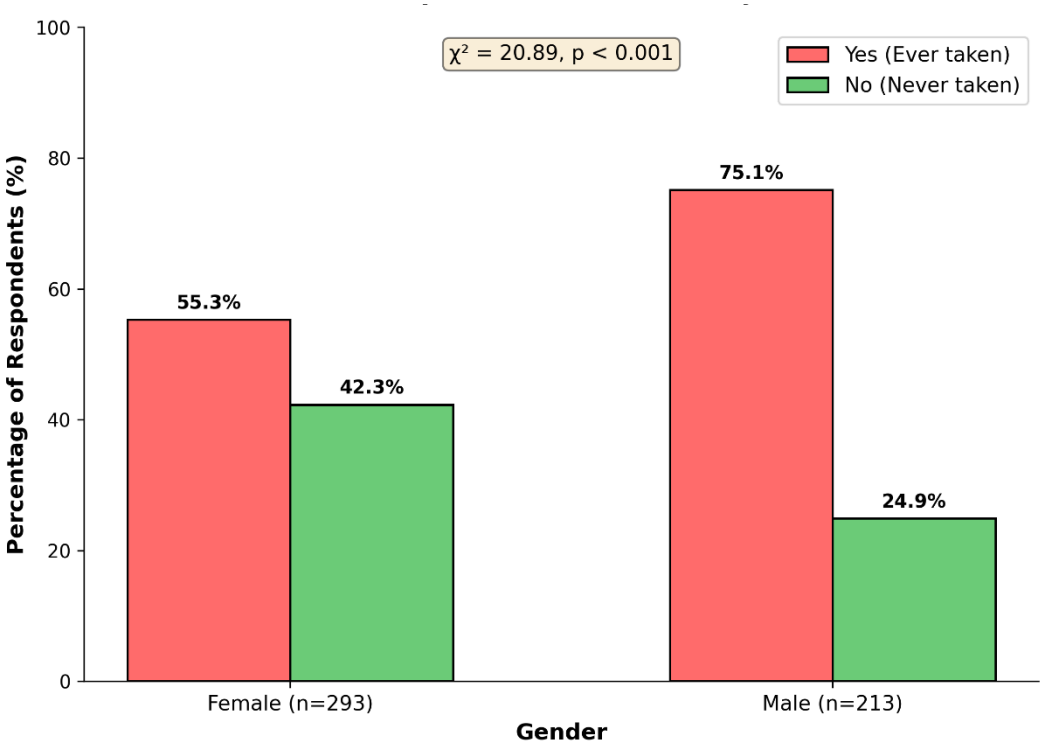


Table III: Self-reported Antibiotic-Use Behavior

Behavior	Females (n=293)	Males (n=213)	χ^2	p-value
Stop antibiotic once fever subsides			9.35	0.009*
Always	87 (29.7%)	55 (25.9%)		
Sometimes	150 (51.2%)	140 (65.8%)		
Never	49 (16.8%)	18 (8.5%)		
No response	7 (2.4%)			
Ever taken antibiotics without a prescription			20.89	<0.001*
Yes	162 (55.3%)	160 (75.1%)		
No	124 (42.3%)	53 (24.9%)		

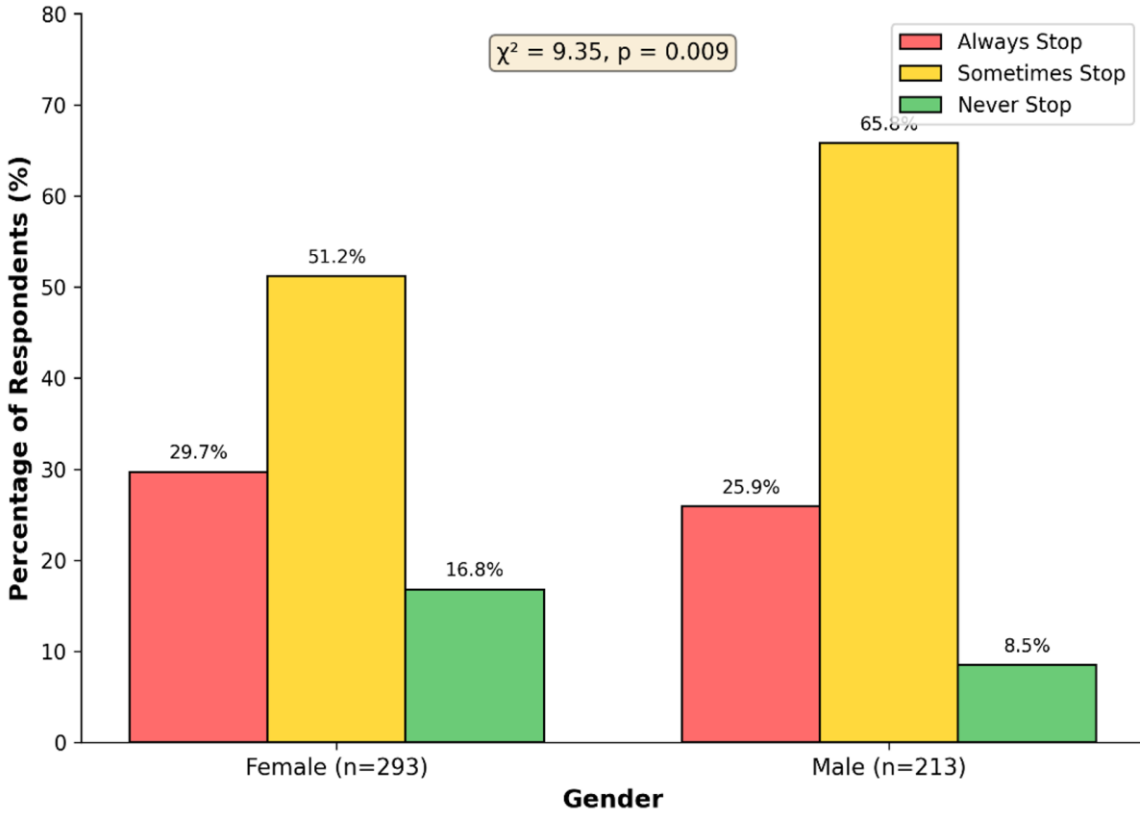
*$p < 0.05$

Antibiotic Discontinuation After Fever Subsided

Premature discontinuation of antibiotic treatment was also commonly reported. Only 16.8% of females (n = 49) and 8.5% of males (n = 18) reported that they never stopped taking antibiotics when their fever subsided. Approximately 29.7% of females and 25.9% of males reported always stopping antibiotics when fever subsided, while 51.2% of females and 65.8% of males reported doing so sometimes (Table 3). The gender difference in discontinuation behavior was statistically significant ($\chi^2 = 9.35$, $p = 0.009$) (Figure 3). This finding is particularly significant from a behavioral perspective, as improvement in symptoms may serve as an immediate signal to

change health-related behavior. Individuals may interpret relief from symptoms as an indication that continuing the treatment is no longer necessary.

Figure III: Gender-wise comparison of antibiotic discontinuation after fever subsides. Categories include "Always Stop," "Sometimes Stop," and "Never Stop." The gender difference was statistically significant ($\chi^2 = 9.35$, $p = 0.009$)



Knowledge–Attitude–Behavior Gap

A notable discrepancy was observed between favorable attitudes and reported antibiotic-use practices. Participants overwhelmingly supported appropriate antibiotic prescribing and responsible antibiotic use (Table 2). Nevertheless, more than half of female respondents and approximately three-quarters of male respondents reported non-prescription antibiotic use. Similarly, premature discontinuation remained common (80.9% of females and 91.5% of males) despite favorable attitudes toward responsible antibiotic use (Figure 5).

Sources of AMR Information

Doctors and nurses were an important source of AMR information, particularly among male respondents, where 52.11% identified healthcare professionals. Among females, doctors and nurses accounted for 31.4%, while university or school education represented 22.9% compared with 12.7% among males (Figure 4). Family, friends, and social media accounted for 14.7% of female and 15.0% of male responses. The findings indicate an important role for healthcare professionals and educational institutions in communicating information about antibiotic resistance.

Figure IV: Primary sources of awareness about antimicrobial resistance (AMR) by gender (side-by-side comparison). Healthcare professionals (doctors/nurses) were the most frequently cited source, particularly among males

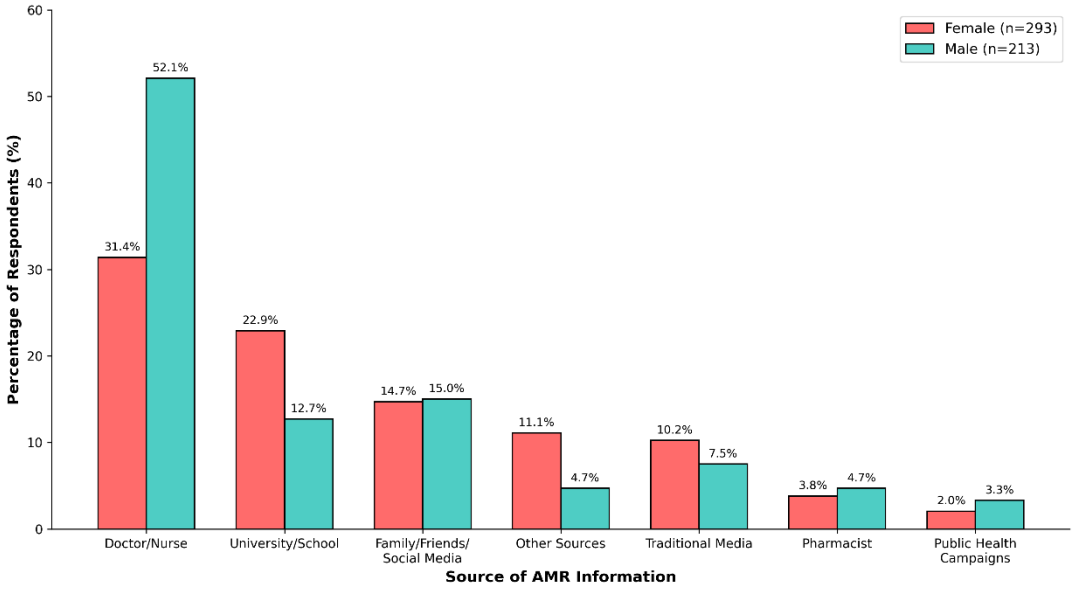
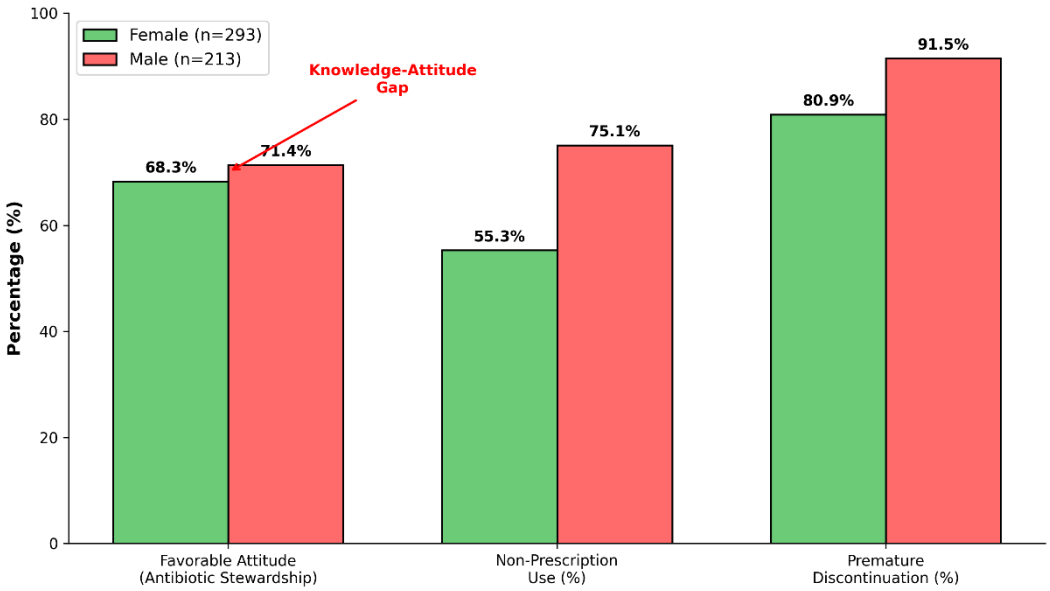


Figure V: Knowledge-attitude-behavior (KAB) gap in antibiotic use among university students. A notable discrepancy exists between favorable attitudes toward antibiotic stewardship (e.g., regular handwashing, responsible use) and actual self-reported behaviors (non-prescription use and premature discontinuation). This gap was more pronounced among male respondents



IV.DISCUSSION

The main finding of this study is the discrepancy between favorable attitudes toward appropriate antibiotic use and inappropriate self-reported antibiotic-use behaviors. Participants expressed strong support for appropriate antibiotic prescribing and responsible antibiotic use; however, non-prescription antibiotic use and premature discontinuation remained common. This pattern is consistent with previous studies demonstrating that antibiotic knowledge and positive attitudes do not necessarily translate into appropriate practices (Ferreira Leal et al., 2022; Lubwama et al., 2021; Marzan et al., 2021). Evidence from Pakistan similarly supports this knowledge–attitude–behavior discrepancy. Gillani et al. (2017), in a study of 727 non-medical university students from three universities in Southern Punjab, reported that 45% had used antibiotics without consulting a physician. Despite awareness of antibiotic-related adverse effects, knowledge regarding antibiotic resistance and the consequences of

inappropriate antibiotic use remained limited. This suggests that favorable attitudes alone may be insufficient to promote responsible antibiotic-use behavior (Gillani et al., 2017). In the present study, non-prescription antibiotic use was reported by 55.3% of women and 75.1% of men, with a statistically significant gender difference. These proportions are considerably higher than those reported in some comparable student populations. Marzan et al. (2021) reported antibiotic self-medication among 10.2% of Bangladeshi university students, whereas Scaioli et al. (2015) found that 16.0% of Italian medical students reported purchasing antibiotics without a medical prescription. In contrast, Pakistani studies have generally reported higher levels of antibiotic self-medication. Gillani et al. (2017) found that 45% of university students in Southern Punjab had used antibiotics without medical consultation, while a Sialkot-based study among students of Sialkot Medical College reported antibiotic use for self-medication in 36.6% of respondents. These differences should be interpreted cautiously because definitions, recall periods, populations, and measurement of non-prescription antibiotic use varied across studies. The observed differences may also reflect contextual factors such as antibiotic availability, healthcare accessibility, healthcare costs, and regulatory enforcement; however, these factors were not directly assessed in the present study (Ocan et al., 2015; Torres et al., 2019).

The discrepancy between attitudes and behavior can be further understood from a health-psychological perspective. According to the Theory of Planned Behavior, attitudes represent only one determinant of behavioral intentions; subjective norms and perceived behavioral control also influence whether intentions translate into actual behavior (Ajzen, 1991). The present findings suggest that favorable attitudes toward antibiotic stewardship may coexist with social, contextual, and behavioral factors that facilitate inappropriate antibiotic use. Consequently, interventions focused solely on increasing knowledge or strengthening positive attitudes may have limited effects when barriers to appropriate behavior remain unaddressed (Ghisi et al., 2014). A considerable proportion of respondents expressed concern that AMR could affect themselves or their families. Nevertheless, this concern did not appear to prevent inappropriate antibiotic use. This may indicate that individuals distinguish between AMR as a general public-health threat and the perceived consequences of their own antibiotic-use decisions. Previous research has similarly demonstrated variation in public understanding and personal risk perception regarding AMR (Oniciuc et al., 2019). This interpretation is consistent with findings from Pakistani university students. Gillani et al. (2017) reported substantial awareness of antibiotic adverse effects despite continued antibiotic self-medication, indicating that awareness of potential harms does not necessarily result in appropriate antibiotic-use decisions. AMR communication should therefore make the link between individual antibiotic-use decisions and their potential personal, familial, and community-level consequences more explicit.

The high prevalence of non-prescription antibiotic use represents an important behavioral concern. Self-medication is influenced by multiple interacting factors, including previous successful treatment experiences, easy access to medicines, healthcare costs, accessibility of healthcare professionals, and recommendations from family or acquaintances (Ocan et al., 2015; Torres et al., 2019). Local evidence from Sialkot also demonstrates a substantial burden of self-medication among students. Sajjad et al. (2023), in a study of 349 students of Sialkot Medical College, reported that 83.8% had practiced self-medication during the previous year, with antibiotics representing one of the commonly used medication categories (36.6%). Accordingly, interventions should address not only knowledge deficits but also the practical, social, and perceptual factors that influence decisions to obtain and use antibiotics without professional advice. The high frequency of discontinuing antibiotics following resolution of fever represents another significant behavioral concern. Symptom improvement provides an immediate and personally observable outcome, whereas AMR is a delayed and less visible consequence. This difference in psychological salience may influence treatment decisions (Borek et al., 2024; Moharab et al., 2021). Health-communication interventions should therefore explain antibiotic treatment in ways that connect immediate treatment decisions with longer-term individual and community-level consequences. The persistence of inappropriate antibiotic practices despite awareness among Pakistani students further supports the need to complement educational approaches with behavioral interventions targeting treatment adherence and decision-making (Gillani et al., 2017; Shah et al., 2014).

Higher levels of non-prescription antibiotic use and premature discontinuation were observed among male respondents than female respondents. Interestingly, male participants also demonstrated favorable attitudes toward several responsible-use statements. This finding further reinforces that favorable attitudes do not necessarily predict appropriate behavior. The observed gender differences may reflect differences in perceived

behavioral control, healthcare-seeking patterns, social norms, or access to antibiotics. Gender-related differences in antibiotic self-medication have also been reported among Pakistani university students, supporting the possibility that antibiotic-use behaviors may differ according to gender within the local sociocultural context. Future research should investigate the mechanisms underlying these differences, particularly the roles of perceived behavioral control, social norms, healthcare-seeking preferences, and access to medicines (Hussain et al., 2017; Ali et al., 2016). Healthcare professionals constituted an important source of AMR information, while universities and schools were also prominent sources. This represents an opportunity for health-psychological interventions to use trusted information channels rather than relying exclusively on general awareness campaigns. However, evidence from Sialkot suggests that informal interpersonal networks may also substantially influence antibiotic-related decisions, with family and friends identified as important sources of information among medical students (Shah et al., 2014; Gillani et al., 2017). University-based interventions could therefore combine formal educational approaches with behavioral components addressing antibiotic self-medication, treatment adherence, AMR risk perception, social influence, misconceptions about antibiotics, appropriate healthcare-seeking, and perceived autonomy in antibiotic-use decisions (WHO, 2022; WHO Regional Office for Europe, 2024).

Overall, the findings demonstrate a clear knowledge–attitude–behavior gap: participants generally endorsed responsible antibiotic use and recognized AMR as a potential threat, yet inappropriate practices remained prevalent. This pattern is broadly consistent with evidence from Pakistan, including university-based studies in Southern Punjab and Karachi and the Sialkot-specific evidence from medical students, which collectively demonstrate that antibiotic self-medication can remain prevalent despite awareness of antibiotic-related risks. The present study extends this evidence by examining not only antibiotic-use practices but also AMR risk perception, information sources, attitudes, and gender differences within the university-student population. These findings suggest that effective antimicrobial stewardship among university students requires a shift from knowledge-focused awareness toward interventions that address perceived behavioral control, social influences, risk perception, treatment adherence, and healthcare-seeking behavior. Such approaches may be more effective in translating favorable attitudes and AMR awareness into sustained responsible antibiotic-use practices.

V. CONCLUSION

This study demonstrates a gap between university students' knowledge, attitude and actual behavior about the usage of antibiotic in Sialkot, Pakistan. Many students continued to purchase antibiotics without a prescription or stopped taking them early, despite the fact that the majority of students stated that they had attitudes towards using antibiotic ethically and expressed real concern about AMR. The finding implies that improving knowledge and attitude about antibiotics alone may not be sufficient to promote acceptable behaviors. Psychological and behavioral aspects like how persons perception of danger, peer pressure, decision making process and sense of control over their choices also play a big role. Because of this, behavioral factors should be taken into account in programs meant to lesson antibiotic abuse. A health-psychological approach may provide a foundation for developing treatments aimed to lower inappropriate antibiotic use and improve AMR prevention in Sialkot, Pakistan.

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