JHWCR JOURNAL OF HEALTH, WELLNESS AND COMMUNITY RESEARCH 3007-0570

Vol. 4 Issue 6, 2026
Open Access | DOI: 10.61919/y0ge8n80

Original Article

Self-Medication with Antibiotics and Its Association with Antimicrobial Resistance Among the Pakistani Public: A Cross-Sectional Study

Shakir Rahman[1], Muhammad Hamza[2], Sami Khan[2], Muhammad Toufeeq[2], Syed Hashim Hussain[2], Yahya Khan[2], Mubashir Naseer[2], Shayan Ahmad[2]

[1] Principal & Assistant Professor, Hamdan Institute of Nursing & Allied Health Sciences, Swabi, Pakistan
[2] Hamdan Institute of Nursing & Allied Health Sciences, Swabi, Pakistan.

✉ **Correspondence:** Shakir Rahman, shakirrahman12@gmail.com

Received: 16 February 2026	Revised: 03 March 2026	Accepted: 18 March 2026	Published: 30 March 2026

HOW TO CITE

Shakir Rahman et al. 2026. Self-Medication with Antibiotics and Its Association with Antimicrobial Resistance Among the Pakistani Public: A Cross-Sectional Study. Journal of Health, Wellness and Community Research. 4, 6 (Mar. 2026), 1–8. DOI:https://doi.org/10.61919/y0ge8n80

ARTICLE INFORMATION

Author Contributions	Concept: SR, MH; Design: SR, SK, MH; Data Collection: MT, SHH, YK, MN, SA; Analysis: SR, MH, SK; Drafting: SR, MH, SK, MT, SHH, YK, MN, SA.
Ethical Approval	The study was approved by research ethical board of Hamdan Institute of Nursing & Allied Health Sciences, Swabi, Pakistan
Informed Consent	Written informed consent was obtained from all participants
Conflict of Interest	The authors declare no conflict of interest.
Funding	No external funding.
Data Availability	Available from the corresponding author on reasonable request.
AI Declaration	No generative AI was used for conceptualization, analysis, or content generation. AI use was limited to language refinement, and the authors remain fully responsible for the accuracy, originality, validity, and integrity of the manuscript's content.

ABSTRACT

Background: Self-medication with antibiotics (SMA) contributes to inappropriate antimicrobial exposure and remains a public-health concern in Pakistan, but factors associated with willingness to repeat SMA are incompletely understood. Objective: To determine future SMA intention among Pakistani adults with a recent history of SMA and examine its relationships with antibiotic-related knowledge, attitudes, and educational qualification. Methods: A cross-sectional study was conducted in Pakistan from January 2026 using non-probability convenience sampling and an online questionnaire. A total of 364 participants completed the survey. Descriptive statistics, Spearman rank correlations, and chi-square tests with Cramér's V were applied using available-case analysis. Results: Among 343 participants with intention data, 45.5% intended to self-medicate again, 43.1% did not, and 11.4% were unsure. Moderate or good knowledge was observed in 78.4% of participants, while 47.5% demonstrated a positive attitude. Future SMA intention correlated weakly with knowledge (ρ=0.245, p<0.001) and attitude (ρ=−0.125, p=0.022). Educational qualification was associated with intention, $\chi^2(4, N=338)=26.93$, p<0.001, Cramér's V=0.200. Conclusion: Repeat SMA intention remained common despite generally moderate-to-good knowledge, suggesting that knowledge alone may not account for continued unsupervised antibiotic use. Keywords: antibiotic self-medication; antimicrobial resistance; knowledge; attitudes; Pakistan; cross-sectional study.

INTRODUCTION

Antimicrobial resistance (AMR) is a major public-health challenge, driven in part by inappropriate antimicrobial exposure and the persistence of resistant organisms and resistance determinants across human, animal, and environmental settings. Environmental water sources can act as reservoirs and transmission pathways for

© 2026 The Author(s). This is an open access article distributed under the terms of the Creative Commons Attribution (CC BY 4.0) License | jhwcr.com

antibiotic-resistance genes, highlighting the broader ecological dimensions of antimicrobial use (1). In Pakistan, the burden of resistance is particularly concerning. A recent systematic review and meta-analysis documented substantial resistance among Klebsiella pneumoniae isolates to commonly used antibiotics, including beta-lactams, cephalosporins, and fluoroquinolones (2). Similarly, surveillance from teaching hospitals has identified high resistance among commonly isolated bacterial pathogens to frequently prescribed antimicrobial agents (3). These findings emphasize the importance of reducing avoidable antibiotic exposure and promoting appropriate antimicrobial use at both healthcare and community levels.

Self-medication with antibiotics (SMA), defined as antibiotic use without appropriate prescription or consultation with a licensed healthcare professional, represents an important component of inappropriate community antibiotic use. Previous studies in Pakistan have demonstrated considerable variation in SMA across populations and settings. A cross-sectional study among the Pakistani public reported that approximately one-third of respondents practiced SMA, with antibiotics frequently used for symptoms such as cough, cold, influenza-like illness, sore throat, diarrhea, and fever (4). In rural Sindh, substantially higher levels of SMA were reported, with economic considerations, accessibility, and limited awareness of the consequences of inappropriate antibiotic use identified as important contributing factors (5). These differences suggest that antibiotic self-medication is shaped by socioeconomic circumstances, healthcare access, knowledge, perceived severity of illness, and individual beliefs regarding the safety and effectiveness of antibiotics.

The consequences of inappropriate antibiotic use extend beyond individual treatment decisions because resistant organisms and resistance determinants circulate across interconnected human, animal, and environmental systems. Studies from Pakistan have identified multidrug-resistant organisms in livestock-related sources, including raw milk in Khyber Pakhtunkhwa (6), while investigations of human, animal, and environmental isolates have further demonstrated the presence of clinically important resistance determinants across these reservoirs (7). Clinical studies have also identified multidrug-resistant, extensively drug-resistant, and carbapenem-resistant K. pneumoniae strains in healthcare settings in Khyber Pakhtunkhwa (8). Although such microbiological evidence does not establish that community SMA in any individual directly caused antimicrobial resistance, it demonstrates the wider resistance environment within which unnecessary or unsupervised antibiotic consumption occurs.

Reducing inappropriate antibiotic use therefore requires attention not only to antimicrobial availability but also to the behavioral factors that influence repeated self-medication. Antibiotic stewardship strategies have traditionally emphasized appropriate prescribing, review of antimicrobial therapy, and systematic interventions within healthcare settings (9). At the community level, however, education alone may be insufficient if individuals continue to self-treat because of previous experience, perceived knowledge of antibiotics, treatment costs, convenience, or confidence in recognizing familiar symptoms. Existing Pakistani studies have described the frequency and common patterns of SMA (4,5), but less is known about whether individuals who have already self-medicated intend to repeat this behavior and how that intention relates to their antibiotic-related knowledge, attitudes, and sociodemographic characteristics. This distinction is important because previous SMA and future intention represent different constructs: past behavior documents what has occurred, whereas intention may help identify individuals who remain willing to continue unsupervised antibiotic use.

Accordingly, the present cross-sectional study focused on Pakistani adults with a recent history of antibiotic self-medication. It aimed to determine the proportion who intended to self-medicate with antibiotics again if similar symptoms occurred, assess their levels of antibiotic-related knowledge and attitudes, and examine the relationships between future SMA intention, knowledge, attitude, and educational qualification. The study was designed to characterize behavioral factors associated with the intention to repeat SMA rather than to measure antimicrobial resistance directly or estimate the prevalence of SMA in the general Pakistani population.

MATERIAL AND METHODS

A quantitative cross-sectional study with descriptive and correlational components was conducted in Pakistan (January 2026). The study was designed to characterize antibiotic-related knowledge, attitudes, and intention to repeat self-medication among adults with a recent history of self-medication with antibiotics (SMA). Because eligible individuals were geographically dispersed, data were collected through an online questionnaire distributed across urban and rural settings through social media platforms, messaging groups, and personal and institutional networks. The study was reported with reference to the STROBE framework for observational research.

The target population comprised adults residing in Pakistan who had used antibiotics without a prescription or consultation with a licensed healthcare professional during the preceding 12 months. Individuals were eligible if they were aged 21 years or older, resided in Pakistan, had self-medicated with antibiotics during the previous year, had access to the online questionnaire, were able to understand its content, and provided voluntary informed consent. Individuals who reported using antibiotics only following advice from a licensed healthcare professional, declined consent, were unable to understand the questionnaire, or provided responses that were unsuitable for analysis were excluded. Participants were recruited using non-probability convenience sampling through electronic dissemination of the study invitation. The required sample size was estimated using OpenEpi on the basis of an anticipated SMA proportion of approximately 33%, a 95% confidence level, and a 5% margin of error. The calculation produced a minimum required sample of 343 participants. To account for approximately 10% anticipated non-response or unusable questionnaires, the recruitment target was increased to 384 participants. A total of 364 completed questionnaires were obtained for the study. Because the number of valid responses differed across individual variables, analyses were conducted using the available observations for each analysis.

Data were collected using a structured, self-administered questionnaire adopted from the instrument used by Aslam et al. and modified for the study context (4). The questionnaire was reviewed for content relevance by experts from nursing and pharmacy disciplines. Before the main study, it was piloted among 34 individuals to assess clarity and feasibility; pilot participants were not included in the final study sample. Internal consistency was reported as Cronbach's $\alpha = 0.96$ for the knowledge scale and $\alpha = 0.92$ for the attitude scale. The electronic questionnaire was administered through Google Forms and required approximately 10–15 minutes to complete. Prospective participants first received information describing the study purpose, procedures, voluntary nature of participation, and confidentiality arrangements. Electronic informed consent was obtained before access to the questionnaire. Duplicate participation was minimized by restricting submissions to one response per account, and submitted responses were screened before analysis.

SMA was operationally defined as the use of antibiotics without a prescription or consultation with a licensed healthcare professional. The principal outcome was intention to self-medicate with antibiotics again if the same or similar symptoms occurred in the future, recorded as "yes," "no," or "not sure." This outcome represented intention to repeat SMA rather than the prevalence of past SMA, because a history of non-prescription antibiotic use during the preceding 12 months was part of the study eligibility criteria. Antibiotic resistance was not measured directly. Explanatory variables included total antibiotic-related knowledge and attitude scores, while background variables comprised gender, age, marital status, educational qualification, monthly income, occupation, and parental status.

Knowledge items were scored as 1 for a correct response and 0 for an incorrect or "don't know" response. Attitude items were assessed using a three-point Likert-type response format ranging from "always" to "not at all." Total knowledge and attitude scores were converted to percentage scores for categorical interpretation. Scores above 75% were classified as good knowledge or positive attitude, scores from 50% to 75% as moderate knowledge or attitude, and scores below 50% as poor knowledge or negative attitude. Participants were also asked about the approximate amount of money saved during an episode of SMA, categorized as less than PKR 500, PKR 600–1,000, PKR 1,000–1,500, more than PKR 1,500, or unable to estimate the amount.

Data were analyzed using IBM SPSS Statistics version 21. Categorical variables were summarized using frequencies and percentages, while numerical scale scores were summarized using means and standard deviations. Confidence intervals at the 95% level were calculated for the proportion of participants reporting each category of future SMA intention. Distributional characteristics of the knowledge and attitude scores were assessed using normality testing together with examination of skewness and kurtosis. Because the principal variables were ordinal or non-normally distributed, Spearman's rank-order correlation was used to examine associations between future SMA intention, total knowledge score, and total attitude score. Correlation coefficients were interpreted as negligible when <0.10, weak from 0.10 to 0.39, moderate from 0.40 to 0.69, and strong when ≥ 0.70.

Associations between categorical sociodemographic characteristics and future SMA intention were assessed using the chi-square test of independence, with Cramér's V used to quantify effect size. When sparse categories produced unacceptable expected cell counts, categories were combined where substantively appropriate to improve the validity of the contingency-table analysis. For educational qualification, primary, secondary, and certificate/diploma categories were combined into a single "below bachelor's" category before the final analysis.

The Fisher-Freeman-Halton exact procedure was specified as an alternative for contingency tables with substantial violations of expected-frequency assumptions. All statistical tests were two-tailed, and statistical significance was defined as $p < 0.05$. Missing observations were handled using pairwise deletion so that participants with available information could contribute to each applicable analysis. Consequently, denominators varied across descriptive variables and inferential analyses. Percentages were calculated using the valid denominator for the relevant variable. The analyses were primarily descriptive and bivariate; no multivariable-adjusted model was undertaken to control simultaneously for potential confounding among age, education, income, occupation, or other sociodemographic characteristics.

Ethical approval was obtained from the Institutional Review Board of Hamdan Institute of Nursing & Allied Health Sciences before commencement of data collection (HINAHS/Admin/026/05/4315-IRB). The study was conducted in accordance with the principles of the Declaration of Helsinki. Participation was voluntary, electronic informed consent was obtained before questionnaire completion, and study information emphasized confidentiality and the participant's right to decline participation.

RESULTS

A total of 364 questionnaires were included in the dataset. Because analyses were based on available responses, denominators varied across variables. Among participants with demographic information available, 52.9% were male, 79.6% were aged 21–25 years, 77.1% were single, and 80.8% held a bachelor's degree. Nearly half of respondents with income data available reported a monthly income below PKR 10,000 (47.0%), while 57.3% of those reporting occupation were professionals (Table 1).

Table 1. Sociodemographic Characteristics of Participants

Characteristic	n (%)
Gender (n = 344)	
Male	182 (52.9)
Female	162 (47.1)
Age group (n = 343)	
21–25 years	273 (79.6)
26–30 years	23 (6.7)
31–40 years	36 (10.5)
>40 years	11 (3.2)
Marital status (n = 345)	
Single	266 (77.1)
Married	79 (22.9)
Educational qualification (n = 343)	
Primary	3 (0.9)
Secondary	6 (1.7)
Certificate/Diploma	37 (10.8)
Bachelor's	277 (80.8)
Postgraduate	20 (5.8)
Monthly income (n = 302)	
<PKR 10,000	142 (47.0)
PKR 10,000–20,000	78 (25.8)
>PKR 20,000	82 (27.2)
Occupation (n = 335)	
Professional	192 (57.3)
Unemployed	78 (23.3)
Home duties	18 (5.4)
Self-employed	17 (5.1)
Administrative	12 (3.6)
Manual labor	7 (2.1)
Skilled labor	6 (1.8)
Pensioner	5 (1.5)
Has children (n = 346)	
Yes	69 (19.9)
No	277 (80.1)

Percentages are based on valid responses for each variable. Among the 343 participants who provided data on future SMA intention, 156 (45.5%; 95% CI 40.2%–51.0%) reported that they intended to self-medicate with antibiotics again if similar symptoms occurred, 148 (43.1%; 95% CI 37.9%–48.4%) reported that they did not intend to do so, and 39 (11.4%; 95% CI 8.0%–14.7%) were unsure (Table 2). Thus, affirmative intention to repeat SMA was reported by approximately two-fifths of respondents, while a further one-tenth remained uncertain.

Table 2. Intention to Self-Medicate With Antibiotics Again (n = 343)

Response	n (%)	95% CI (%)
Yes	156 (45.5)	40.2–51.0
No	148 (43.1)	37.9–48.4
Not sure	39 (11.4)	8.0–14.7

CI, confidence interval. Knowledge scores were available for 342 participants. Moderate knowledge was the most common category, reported by 183 (53.5%) participants, followed by good knowledge in 85 (24.9%) and poor knowledge in 74 (21.6%). The reported mean knowledge score was 9.93 ± 2.12. Attitude data were available for 339 participants; 161 (47.5%) had a positive attitude, 133 (39.2%) had a moderate attitude, and 45 (13.3%) had a negative attitude. The reported mean attitude score was 1.34 ± 0.70 (Table 3).

Table 3. Knowledge and Attitude Measures

Measure	n (%) or mean ± SD
Knowledge (n = 342)	
Poor	74 (21.6)
Moderate	183 (53.5)
Good	85 (24.9)
Mean knowledge score	9.93 ± 2.12
Attitude (n = 339)	
Negative	45 (13.3)
Moderate	133 (39.2)
Positive	161 (47.5)
Mean attitude score	1.34 ± 0.70

SD, standard deviation. Spearman correlation analysis showed a weak positive correlation between future SMA intention and total knowledge score ($\rho = 0.245$, $p < 0.001$; $n = 340$). Future SMA intention was weakly negatively correlated with total attitude score ($\rho = -0.125$, $p = 0.022$; $n = 338$), while knowledge and attitude scores were also weakly negatively correlated ($\rho = -0.171$, $p = 0.002$; $n = 336$) (Table 4). The magnitudes of all three coefficients were small.

Table 4. Spearman Rank Correlations Among Future SMA Intention, Knowledge, and Attitude

Variable pair	n	Spearman ρ	p-value
Future SMA intention vs total knowledge	340	0.245	<0.001
Future SMA intention vs total attitude	338	−0.125	0.022
Total knowledge vs total attitude	336	−0.171	0.002

SMA, self-medication with antibiotics. All tests were two-tailed. Educational qualification was associated with future SMA intention after educational categories with small cell counts were combined. Among participants with below-bachelor's education, 34 of 46 (73.9%; 95% CI 59.7%–84.4%) reported intending to self-medicate again, compared with 109 of 272 bachelor's degree holders (40.1%; 95% CI 34.4%–46.0%) and 12 of 20 postgraduates (60.0%; 95% CI 38.7%–78.1%). The overall association was statistically significant, $\chi^2(4, N = 338) = 26.93$, $p < 0.001$, with Cramér's V = 0.200 (Table 5).

Table 5. Future SMA Intention According to Educational Qualification (n = 338)

Educational qualification	Yes, n (%)	Yes, 95% CI (%)	No, n (%)	Not sure, n (%)	Total, n	χ^2 (df)	p-value	Cramér's V
Below bachelor's	34 (73.9)	59.7–84.4	5 (10.9)	7 (15.2)	46	—	—	—
Bachelor's	109 (40.1)	34.4–46.0	133 (48.9)	30 (11.0)	272	—	—	—
Postgraduate	12 (60.0)	38.7–78.1	8 (40.0)	0 (0.0)	20	—	—	—
Total	155 (45.9)	—	146 (43.2)	37 (10.9)	338	26.93 (4)	<0.001	0.200

Percentages are row percentages. Below bachelor's combines primary, secondary, and certificate/diploma categories. CI, confidence interval; SMA, self-medication with antibiotics. The overall association was assessed using the chi-square test of independence.

Among participants who could estimate financial savings associated with an episode of SMA, 36.1% reported saving less than PKR 500, 32.9% reported PKR 600–1,000, 17.8% reported PKR 1,000–1,500, and 13.2% reported more than PKR 1,500. Overall, 69.0% of respondents were able to provide an estimate reported savings within the two lowest reported categories. In the full set of responses to this item, 36.0% were unable to estimate the amount saved.

DISCUSSION

The present study found that a substantial proportion of adults with a recent history of self-medication with antibiotics remained willing to repeat the practice if similar symptoms occurred, while a smaller proportion

remained uncertain. Most participants demonstrated moderate or good antibiotic-related knowledge, yet future self-medication intention persisted, indicating that knowledge alone may not be sufficient to discourage unsupervised antibiotic use. Future SMA intention was weakly associated with knowledge and attitude scores and was also associated with educational qualification, although the small magnitude of these relationships suggests that other behavioral, socioeconomic, and healthcare-access factors are likely to contribute.

The proportion of participants intending to self-medicate again was higher than the 32.5% prevalence of past SMA reported in an earlier Pakistani study, but substantially lower than the 81.25% prevalence reported among rural residents of Sindh (4,5). These figures should not be interpreted as directly equivalent because the earlier studies measured previous self-medication behavior, whereas the present study examined future intention among participants who had already used antibiotics without professional prescription. Nevertheless, the comparison illustrates the persistence of SMA-related behavior across different Pakistani settings. Differences between studies may reflect variation in participant characteristics, rural–urban context, educational profile, healthcare access, treatment cost, availability of antibiotics without prescription, and prior experience with self-treatment (4,5).

Most participants in the present study had moderate or good knowledge, yet many continued to express an intention to repeat SMA. This pattern is consistent with earlier Pakistani evidence showing that greater awareness does not necessarily eliminate inappropriate antibiotic use (4,5). Knowledge may improve recognition of antibiotic indications and risks without necessarily changing behavior when competing influences such as convenience, treatment cost, previous successful self-treatment, perceived familiarity with symptoms, or easy access to antibiotics remain present. The weak correlation between knowledge and intention observed in this study supports the interpretation that antibiotic-related decision-making is likely influenced by factors beyond factual knowledge alone. The observed direction of this relationship should, however, be interpreted cautiously because intention was assessed as an ordinal categorical variable and the study was not designed to establish causal pathways.

Attitude toward antibiotic use was also only weakly related to future SMA intention. This suggests that favorable antibiotic-related attitudes may not reliably translate into appropriate treatment-seeking behavior. Previous studies in Pakistan have similarly described a disconnect between awareness and actual self-medication practices (4,5). One plausible explanation is that individuals may understand that inappropriate antibiotic use carries risks while still judging self-treatment to be acceptable when symptoms appear familiar or when professional consultation is perceived as inconvenient or costly. Because confidence in self-diagnosis, perceived severity, access to healthcare, and perceived effectiveness of previous SMA episodes were not directly examined as explanatory variables in the present study, these mechanisms remain hypotheses for future investigation rather than demonstrated explanations.

Educational qualification showed a statistically significant association with future SMA intention. Participants with below-bachelor's education had the highest proportion reporting an intention to self-medicate again, whereas bachelor's degree holders had the lowest proportion. This finding is broadly compatible with previous evidence suggesting that lower health literacy and limited awareness may contribute to inappropriate antibiotic use (5). However, the relationship was not monotonic, as a comparatively high proportion of postgraduate participants also reported future SMA intention. The postgraduate subgroup was small, producing considerable uncertainty around that estimate, and the absence of a simple educational gradient suggests that formal education alone is unlikely to determine antibiotic-use behavior. Education may interact with health literacy, professional background, previous antibiotic experience, confidence in self-treatment, and access to healthcare.

Economic considerations may also influence the persistence of SMA. Among participants who were able to estimate financial savings from self-medication, most reported savings within the lower monetary categories, while almost half of respondents with income data available reported a monthly income below PKR 10,000. Previous rural Pakistani research identified economic considerations as an important reason for antibiotic self-medication (5). Even relatively modest savings may therefore be meaningful for some individuals. However, the present study did not directly test the association between income, reported savings, and future SMA intention, so financial explanations should be regarded as plausible contextual factors rather than demonstrated determinants in this dataset.

The public-health relevance of these findings lies in the persistence of unsupervised antibiotic use within a broader setting where antimicrobial resistance is already well documented. Pakistani studies have reported substantial resistance among clinically important bacterial pathogens and multidrug-resistant Klebsiella pneumoniae isolates (2,3,8), while resistant organisms and resistance determinants have also been identified in animal and environmental sources (6,7). The present study did not measure antimicrobial resistance and therefore cannot establish that SMA among these participants caused resistant infections. Nevertheless, repeated unsupervised antibiotic exposure represents a behavior that is relevant to antimicrobial stewardship because inappropriate selection, dosing, duration, or indication can increase unnecessary antimicrobial exposure. Stewardship approaches that are effective within healthcare settings emphasize appropriate antibiotic selection, review, and accountability (9); at the community level, similar principles may need to be accompanied by improved access to affordable care, responsible dispensing practices, and interventions that address convenience, beliefs, and previous self-treatment experience.

The study has several strengths. It included more participants than the minimum calculated sample size, assessed knowledge, attitude, future SMA intention, and educational characteristics within the same survey, reported confidence intervals for the principal intention estimates, and used effect-size reporting alongside chi-square analysis. The online approach also permitted recruitment from geographically dispersed participants. At the same time, several limitations are important when interpreting the findings. Convenience sampling and online recruitment limit representativeness, and the sample was dominated by younger, bachelor-educated, and single participants. Individuals without internet access, older adults, people with lower educational attainment, and populations from underserved settings may therefore be underrepresented. Because eligibility required a history of antibiotic self-medication during the previous 12 months, the study cannot estimate the prevalence of SMA in the general Pakistani population; it describes future intention and related characteristics among previous self-medicators.

Additional limitations arise from the cross-sectional and self-reported nature of the data. The temporal relationship between knowledge, attitudes, education, and future intention cannot be established, and causal inference is not possible. Responses may also have been affected by recall or social-desirability bias. Antimicrobial resistance was not measured microbiologically, and no linkage between individual self-medication behavior and resistant infection could be examined. Item-level missing data reduced the available denominator for several analyses. Furthermore, the inferential analyses were primarily bivariate, so potential confounding by age, income, occupation, marital status, or other characteristics was not controlled through multivariable modelling. Future studies using probability-based sampling, direct measures of past antibiotic use, multivariable analysis, and qualitative assessment of motivations for repeat SMA would provide a more complete understanding of the behavioral pathways underlying unsupervised antibiotic use.

CONCLUSION

Among Pakistani adults with a recent history of antibiotic self-medication, a substantial proportion intended to self-medicate again if similar symptoms occurred, despite generally moderate or good antibiotic-related knowledge. Future SMA intention showed only weak relationships with knowledge and attitude and was associated with educational qualification, indicating that repeated self-medication is unlikely to be explained by knowledge alone. These findings highlight the importance of understanding the broader behavioral and sociodemographic factors associated with continued unsupervised antibiotic use while recognizing that the study does not estimate SMA prevalence in the general population or directly measure antimicrobial resistance.

REFERENCES

1. Amarasiri M, Takezawa T, Malla B, Furukawa T, Sherchand JB, Haramoto E, et al. Prevalence of antibiotic resistance genes in drinking and environmental water sources of the Kathmandu Valley, Nepal. Front Microbiol. 2022;13:894014. doi:10.3389/fmicb.2022.894014.

2. Mehmood MS, Saddique MN, Ullah H, Iqbal MU, Waqas S, Sirait BCN, et al. Prevalence and antimicrobial resistance of Klebsiella pneumoniae in Pakistan, 2015–2025: a systematic review and meta-analysis. Curr Clin Microbiol Rep. 2026;13(1):17.

3. Bashir N, Dablool AS, Khan MI, Almalki MG, Ahmed A, Mir MA, et al. Antibiotics resistance as a major public health concern: a pharmaco-epidemiological study to evaluate prevalence and antibiotics susceptibility-resistance pattern of bacterial isolates from multiple teaching hospitals. J Infect Public Health. 2023;16 Suppl 1:61-68. doi:10.1016/j.jiph.2023.09.019.

4. Aslam A, Zin CS, Jamshed S, Ab Rahman NS, Ahmed SI, Pallós P, et al. Self-medication with antibiotics: prevalence, practices and related factors among the Pakistani public. Antibiotics (Basel). 2022;11(6):795. doi:10.3390/antibiotics11060795.

5. Bilal M, Haseeb A, Khan MH, Arshad MH, Ladak AA, Niazi SK, et al. Self-medication with antibiotics among people dwelling in rural areas of Sindh. J Clin Diagn Res. 2016;10(5). doi:10.7860/JCDR/2016/18294.7730.

6. Khan R, Khan S, Pari B. Raw milk as a reservoir of multidrug resistant bacteria in Khyber Pakhtunkhwa. BMC Microbiol. 2026;26(1):617. doi:10.1186/s12866-026-05083-8.

7. Habib S. Prevalence of antibiotic resistance in Klebsiella spp. and Escherichia coli isolates from human, animal, and environment sources in Pakistan [doctoral thesis]. Bath: University of Bath; 2023.

8. Azra, Khan TA, Ul Haq I, Hinthong W, Campino S, Gohar A, et al. Antibiotic susceptibility patterns and virulence profiles of classical and hypervirulent Klebsiella pneumoniae strains isolated from clinical samples in Khyber Pakhtunkhwa, Pakistan. Pathogens. 2025;14(1):79. doi:10.3390/pathogens14010079.

9. Pickens CI, Wunderink RG. Principles and practice of antibiotic stewardship in the ICU. Chest. 2019;156(1):163-171. doi:10.1016/j.chest.2019.01.013.