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

https://doi.org/10.61919/txzsca54

Original Article

AI Chatbots and Online Health Information Use in Self-Medication Among University Students in Lahore, Pakistan: A Cross-Sectional Study

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"Cite this Article" Received: 17 January 2026; **Accepted**: 19 April 2026; **Published**: 28 April 2026

Author Contributions: Concept: SM, WA; Design: ZA, AT; Data Collection: SM, ZA, AT, AM; Analysis: WA, AA; Drafting: SM, WA, AA. **Ethical Approval**: University of Central Punjab, Lahore, 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; **Acknowledgments**: N/A.

ABSTRACT

Background: Self-medication among university students is a growing public health concern, particularly in settings where prescription medicines are easily accessible and digital health information is widely used. The rapid adoption of AI chatbots and online platforms may further influence self-diagnosis and self-prescription practices. **Objective:** To determine the prevalence and pattern of self-medication among university students in Lahore, Pakistan, and assess its association with AI chatbot and internet-based health information use. **Methods:** A cross-sectional descriptive-analytical study was conducted among 451 medical and non-medical university students in Lahore. Data were collected using a structured self-administered questionnaire assessing sociodemographic characteristics, AI and internet use, self-medication practices, knowledge, attitudes, drug categories, adverse effects, and actions after adverse effects. Associations were analyzed using chi-square tests, odds ratios, 95% confidence intervals, and effect sizes where applicable. **Results:** Online symptom searching was reported by 363 students (80.5%), internet-based self-diagnosis by 319 (70.7%), and online self-prescription by 254 (56.3%). Medical students had higher odds of online symptom searching, internet-based self-diagnosis, online self-prescription, and antibiotic self-medication. Antibiotics were the most common self-medicated drug category (51.4%), and adverse effects were reported by 255 students (56.5%). **Conclusion:** AI and internet-based health information use is highly prevalent and associated with self-medication behaviors among university students in Lahore. Targeted AI health literacy, antimicrobial stewardship education, and stronger regulation of prescription-only medicines are needed. **Keywords:** Self-medication; artificial intelligence; ChatGPT; internet health information; university students; antibiotics; Pakistan.

INTRODUCTION

Self-medication, defined as the selection and use of medicines by individuals to treat self-recognized symptoms without consultation with a qualified health professional, remains a major public health concern because it can contribute to medication errors, inappropriate dosing, adverse drug reactions, delayed diagnosis, drug interactions, and antimicrobial resistance. Although responsible self-care may reduce unnecessary healthcare utilization for minor ailments, unsupervised self-medication becomes clinically unsafe when prescription-only medicines, particularly antibiotics, are used without diagnostic confirmation or professional guidance (1). The burden of self-medication is especially high in low- and middle-income countries, where non-prescription access to medicines, high out-of-pocket healthcare costs, limited consultation time, and socially normalized informal treatment practices often encourage students and young adults to manage symptoms independently (2, 3).

Pakistan provides an important setting for studying this problem because medicines are frequently accessible without strict prescription enforcement, and university students represent a population with high health information exposure, academic pressure, and increasing digital engagement. Previous studies from Pakistan and comparable regional settings have reported frequent self-medication among university students, with antibiotics, analgesics, antipyretics, and cough preparations commonly used without physician consultation (4–8). This pattern is particularly concerning among students in medical and allied health programs, where partial clinical knowledge may increase confidence in self-diagnosis and drug selection, while non-medical students may rely more heavily on informal sources, family advice, pharmacy access, or online information. Therefore, comparing medical and non-medical students is important because these groups may differ not only in knowledge level, but also in perceived competence, risk perception, and treatment-seeking behavior.

In parallel, health information-seeking behavior has changed substantially with the widespread availability of search engines, symptom-checking websites, drug-information platforms, and generative artificial intelligence tools. Students can now obtain immediate, conversational, and apparently authoritative health advice from platforms such as Google, ChatGPT, Gemini, DeepSeek, and other AI-supported systems. These tools may improve access to general health information; however, their use for self-diagnosis and self-prescription raises important safety concerns because AI-generated responses may be incomplete, inaccurate, context-insensitive, or falsely reassuring (9–15). The risk is greater when users interpret digital outputs as substitutes for clinical consultation, particularly for symptoms requiring physical examination, laboratory testing, or prescription-only treatment. Emerging studies have begun to document student reliance on AI and internet sources for health decision-making, but evidence remains limited in South Asian university populations, especially where antibiotic access and informal self-treatment practices are already common (16–21).

Despite growing international concern about AI-assisted self-diagnosis, there is limited evidence from Pakistan on how AI chatbots and online health information influence self-medication practices among university students. Existing local studies have largely focused on general self-medication prevalence and drug-use patterns, without adequately examining platform-specific digital health behaviors, image-based online diagnosis, online self-prescription, or differences between medical and non-medical students. Lahore is a particularly relevant setting because it is a major educational and urban center with high student density, broad smartphone use, and increasing exposure to generative AI tools. This creates a need to quantify not only how often students self-medicate, but also how frequently they use AI and internet platforms to identify symptoms, diagnose conditions, choose treatments, and manage adverse effects.

Therefore, this study aimed to determine the prevalence and pattern of self-medication among university students in Lahore, Pakistan, and to assess the association of AI chatbot use and internet-based health information-seeking with self-diagnosis, self-prescription, knowledge, attitudes, drug categories used and reported adverse effects. The study further compared these behaviors between medical and non-medical students to clarify whether academic discipline is associated with different levels of digital health engagement and self-medication risk. The primary research question was whether AI- and internet-based health information use is associated with self-medication behaviors among university students in Lahore, with differences by course type.

MATERIALS AND METHODS

This cross-sectional descriptive-analytical study was conducted among undergraduate and postgraduate students enrolled in public and private universities in Lahore, Punjab, Pakistan. The design was selected because the objective was to estimate the prevalence of self-medication practices and examine associations between course type, digital health information use, AI-assisted self-diagnosis, online self-prescription, knowledge, attitude, drug categories, and adverse effects at a single point in time. The study

population included students from medical and health-related programs, including MBBS, Pharm-D, Doctor of Physical Therapy, nursing, allied health sciences, and related disciplines, as well as students from non-medical programs, including computer science, engineering, business administration, social sciences, humanities, and other non-health academic fields.

Participants were eligible if they were currently enrolled as undergraduate or postgraduate students in a recognized university in Lahore, were available during the data-collection period, and provided written informed consent. Students who declined participation or returned incomplete or inadequately filled questionnaires were excluded from the final analysis. A purposive sampling approach was used because the study required representation of both medical and non-medical students to enable comparison of self-medication practices, AI and internet use, knowledge, and attitudes between academically distinct groups. This non-probability strategy was appropriate for an exploratory institutional survey; however, recruitment was conducted across different academic programs to improve heterogeneity of the sample and reduce overrepresentation of a single discipline.

Data were collected using a structured, self-administered, paper-based questionnaire adapted from a previously used instrument on artificial intelligence, internet use, and self-medication behavior (21). Minor contextual modifications were made to align the tool with the local academic and healthcare environment. The questionnaire included four components: informed consent; sociodemographic characteristics, including age, gender, academic discipline, and year of study; AI and internet-mediated self-medication items assessing online symptom searching, internet-based self-diagnosis, online self-prescription, perceived reliability and safety of internet-guided self-medication, perceived adverse drug reaction risk, frequency of online health information use, platform-specific use for diagnosis and treatment, and image-based online diagnosis; and knowledge, attitude, and practice items related to self-medication, including drug categories used, reasons for avoiding physician consultation, sources of medicines, symptoms prompting self-medication, duration of medicine use, symptom relief, adverse effects, and actions taken after adverse effects.

The main exposure variable was course type, categorized as medical and non-medical. Digital health variables included online symptom searching, internet-based self-diagnosis, online self-prescription, frequency of internet use for health information, use of specific platforms for diagnosis and treatment, and use of online images for diagnostic purposes. Outcome variables included self-medication practice patterns, knowledge level, attitude toward responsible self-medication, drug classes used for self-medication, reported symptom relief, and self-reported adverse effects. Knowledge was categorized as good, moderate, or poor according to questionnaire-based responses, while attitude was categorized as positive or negative toward responsible self-medication practices. Self-medication was operationalized as use of any medicine or treatment without direct professional medical consultation for the current episode.

A total of 483 questionnaires were distributed. After screening, 32 questionnaires were excluded because they were incomplete or inadequately filled, leaving 451 responses for final analysis. Missing or unusable questionnaires were handled through complete-case analysis, and only questionnaires with sufficient information for the main variables were retained. To reduce information bias, participants completed the questionnaire anonymously without collecting personally identifiable information. The paper-based format minimized duplicate electronic submissions, and completed forms were reviewed before data entry to identify incomplete responses. Data were entered into IBM SPSS Statistics version 26.0, and categorical coding was checked before analysis to improve data integrity and reproducibility.

Categorical variables were summarized as frequencies and percentages, while continuous variables were summarized as mean and standard deviation. Chi-square tests of independence were used to assess associations between course type and categorical variables, including AI and internet use behaviors, knowledge categories, drug categories, and self-medication practice patterns. Comparisons between medical and non-medical students were interpreted at a statistical significance threshold of $p < 0.05$.

Where expected cell sizes were small, categories were interpreted cautiously to avoid overstatement. Because the study was cross-sectional, associations were interpreted as non-causal. The analysis emphasized prevalence estimates, group differences, and association patterns rather than causal inference.

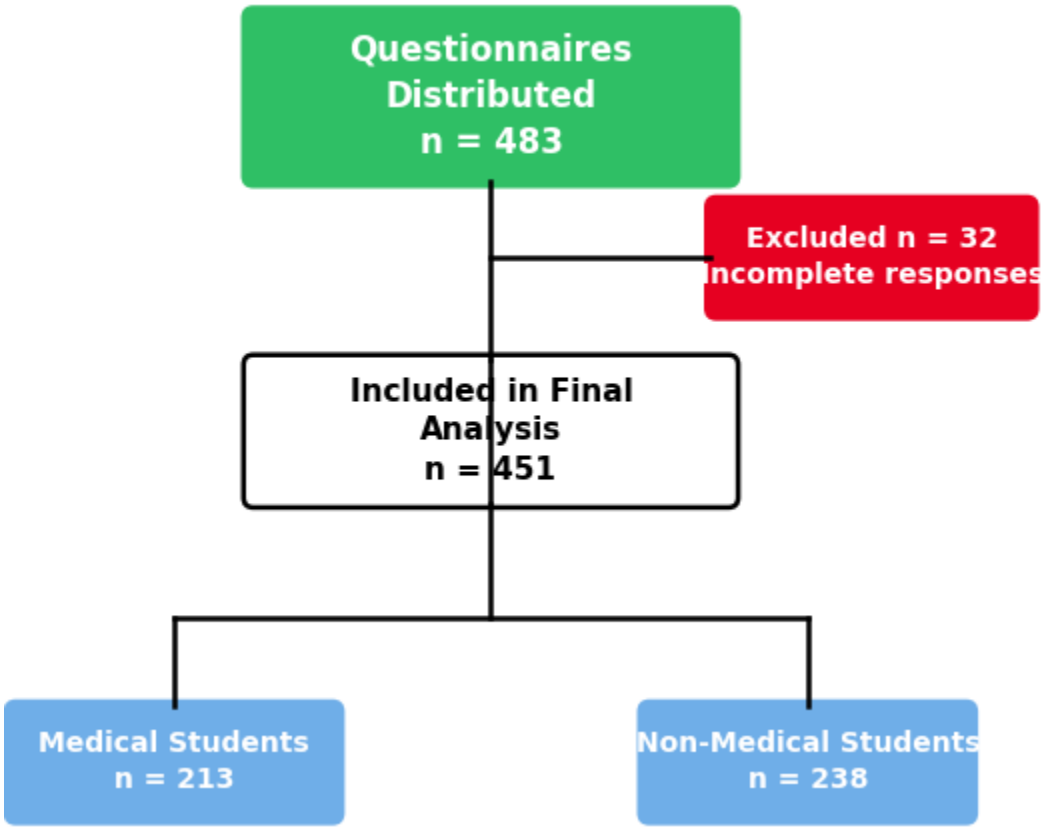

Figure 1 Sequential flow diagram of participant enrollment and inclusion. A total of 483 questionnaires were distributed to university students in Lahore. After exclusion of 32 incomplete responses, 451 questionnaires were included in the final analysis. The final sample comprised 213 medical students and 238 non-medical students.

The study was approved by the Institutional Review Board of the University of Central Punjab, Lahore. All participants received information regarding the study purpose, voluntary nature of participation, confidentiality of responses, and right to withdraw without penalty. Written informed consent was obtained before questionnaire administration. Participation was voluntary, no incentives were offered, and anonymity was maintained by excluding personal identifiers from the questionnaire. Data were accessible only to the research team and were used exclusively for academic analysis and reporting.

RESULTS

A total of 451 valid responses were analyzed after exclusion of 32 incomplete questionnaires from 483 distributed forms. The final sample included 213 medical students (47.2%) and 238 non-medical students (52.8%). The mean age was 22.3 ± 3.1 years. Gender distribution was comparable between groups, with 109 males (51.2%) and 104 females (48.8%) among medical students, and 131 males (55.0%) and 107 females (45.0%) among non-medical students. The distribution of study year differed significantly by course type (p = 0.002), reflecting the higher representation of senior years in medical programs.

Table 1. Sociodemographic Characteristics of Study Participants by Course Type (n = 451)

Variable	Category	Overall n (%)	Medical n (%)	Non-Medical n (%)	p-value
Gender	Male	240 (53.2)	109 (51.2)	131 (55.0)	0.653
	Female	211 (46.8)	104 (48.8)	107 (45.0)	
Age	Mean ± SD	22.3 ± 3.1	22.3 ± 3.1	22.1 ± 3.2	0.218
Age group	18–22 years	253 (56.1)	115 (54.0)	138 (58.0)	0.112

Variable	Category	Overall n (%)	Medical n (%)	Non-Medical n (%)	p-value
	23–27 years	194 (43.0)	98 (46.0)	96 (40.3)	
	≥28 years	4 (0.9)	0 (0.0)	4 (1.7)	
Study year	1st year	126 (27.9)	47 (22.1)	79 (33.2)	0.002
	2nd year	110 (24.4)	48 (22.5)	62 (26.1)	
	3rd year	107 (23.7)	55 (25.8)	52 (21.8)	
	4th year	80 (17.7)	48 (22.5)	32 (13.4)	
	5th year	20 (4.4)	15 (7.0)	5 (2.1)	
	Postgraduate	8 (1.8)	0 (0.0)	8 (3.4)	

AI- and internet-mediated health-seeking behaviors were highly prevalent. Overall, 363 students (80.5%) had searched online for symptoms, 319 (70.7%) had self-diagnosed using internet information, and 254 (56.3%) had self-prescribed medication or treatment based on online information. Medical students had significantly higher odds of online symptom searching than non-medical students (88.7% vs. 73.1%; OR = 2.90, 95% CI: 1.74–4.83; $p < 0.001$), internet-based self-diagnosis (80.3% vs. 62.2%; OR = 2.48, 95% CI: 1.61–3.80; $p < 0.001$), and online self-prescription (62.4% vs. 50.8%; OR = 1.61, 95% CI: 1.10–2.34; $p = 0.013$). Perceived reliability and safety of internet-guided self-medication did not differ significantly between groups (45.5% vs. 43.3%; OR = 1.10, 95% CI: 0.76–1.59; $p = 0.629$).

Table 2. AI and Internet Use in Self-Medication by Course Type

Variable	Overall n (%)	Medical n (%)	Non-Medical n (%)	OR (95% CI)	p-value	Effect Size
Online symptom searching	363 (80.5)	189 (88.7)	174 (73.1)	2.90 (1.74–4.83)	<0.001	0.197
Internet-based self-diagnosis	319 (70.7)	171 (80.3)	148 (62.2)	2.48 (1.61–3.80)	<0.001	0.199
Online self-prescription	254 (56.3)	133 (62.4)	121 (50.8)	1.61 (1.10–2.34)	0.013	0.117
Believed internet self-medication was dependable/secure	200 (44.3)	97 (45.5)	103 (43.3)	1.10 (0.76–1.59)	0.629	0.023

Knowledge level showed a significant association with attitude toward self-medication ($p < 0.001$; Cramer's V = 0.232). Among students with good knowledge, 73 of 108 (67.6%) had a positive attitude toward responsible self-medication, compared with 111 of 223 (49.8%) among those with moderate knowledge and 42 of 120 (35.0%) among those with poor knowledge. Good knowledge was more common in medical students than non-medical students (37.6% vs. 11.8%), while poor knowledge was more frequent among non-medical students (38.2% vs. 13.6%).

Table 3. Association Between Knowledge Level and Attitude Toward Self-Medication

Knowledge Category	Positive Attitude n (%)	Negative Attitude n (%)	Overall n (%)	Medical n (%)	Non-Medical n (%)	p-value	Cramer's V
Good	73 (67.6)	35 (32.4)	108 (24.0)	80 (37.6)	28 (11.8)	<0.001	0.232
Moderate	111 (49.8)	112 (50.2)	223 (49.4)	104 (48.8)	119 (50.0)		
Poor	42 (35.0)	78 (65.0)	120 (26.6)	29 (13.6)	91 (38.2)		

Antibiotics were the most commonly self-medicated drug category, reported by 232 students (51.4%). Antibiotic self-medication was significantly higher among medical students than non-medical students (62.0% vs. 42.0%; OR = 2.25, 95% CI: 1.54–3.28; $p < 0.001$; effect size = 0.199). Other commonly used categories included cough syrups (33.5%), multivitamins (19.1%), analgesics (18.6%), and antipyretics (17.3%), with no statistically significant course-type differences for these categories.

Table 4. Self-Medicated Drug Categories by Course Type

Drug Category	Overall n (%)	Medical n (%)	Non-Medical n (%)	OR (95% CI)	p-value
Antibiotics	232 (51.4)	132 (62.0)	100 (42.0)	2.25 (1.54–3.28)	<0.001
Cough syrups	151 (33.5)	78 (36.6)	73 (30.7)		0.182
Multivitamins	86 (19.1)	41 (19.2)	45 (18.9)		0.945
Analgesics	84 (18.6)	39 (18.3)	45 (18.9)		0.874
Antipyretics	78 (17.3)	35 (16.4)	43 (18.1)		0.652
Antacids	40 (8.9)	19 (8.9)	21 (8.8)		0.987
Antiemetics	24 (5.3)	13 (6.1)	11 (4.6)		0.514

Drug Category	Overall n (%)	Medical n (%)	Non-Medical n (%)	OR (95% CI)	p-value
Antidiarrheals	17 (3.8)	9 (4.2)	8 (3.4)		0.678

Self-medication was recent in a substantial proportion of respondents: 133 students (29.5%) reported self-medication within the past month and 150 (33.3%) within the previous 2–3 months. The timing of the last self-medication episode did not differ significantly between medical and non-medical students (p = 0.759). The most common reasons for avoiding physician consultation were busy schedule (39.5%), mild symptoms (29.0%), and academic or personal knowledge (19.7%). Medication sources were most commonly relatives or friends (39.5%), previous prescription or experience (30.6%), own academic knowledge (24.4%), and pharmacies (19.1%). Fever (47.7%), cough (38.8%), and headache (37.3%) were the leading symptoms prompting self-medication. Symptom relief was reported by 342 students (75.8%), while adverse effects were reported by 255 students (56.5%), without a significant difference between medical and non-medical students (53.5% vs. 59.2%; p = 0.259).

Table 5. Self-Medication Practice Patterns and Outcomes

Variable	Category	Overall n (%)	Medical n (%)	Non-Medical n (%)	p-value
Last self-medication episode	Within 1 month	133 (29.5)	64 (30.0)	69 (29.0)	0.759
	2–3 months ago	150 (33.3)	74 (34.7)	76 (31.9)	
	6 months ago	92 (20.4)	39 (18.3)	53 (22.3)	
	≥1 year ago	76 (16.9)	36 (16.9)	40 (16.8)	
Duration of self-medication	2–3 days	210 (46.6)	98 (46.0)	112 (47.1)	0.853
	Until symptom relief	192 (42.6)	90 (42.3)	102 (42.9)	
	1 week	49 (10.9)	25 (11.7)	24 (10.1)	
Symptom relief	Yes	342 (75.8)	164 (77.0)	178 (74.8)	0.599
	No	108 (23.9)	48 (22.5)	60 (25.2)	
Experienced adverse effects	Yes	255 (56.5)	114 (53.5)	141 (59.2)	0.259
	No	196 (43.5)	99 (46.5)	97 (40.8)	

Medical students showed consistently higher odds of key digital health and self-medication behaviors compared with non-medical students. The strongest association was observed for online symptom searching (OR = 2.90, 95% CI: 1.74–4.83), followed by internet-based self-diagnosis (OR = 2.48, 95% CI: 1.61–3.80) and antibiotic self-medication (OR = 2.25, 95% CI: 1.54–3.28).

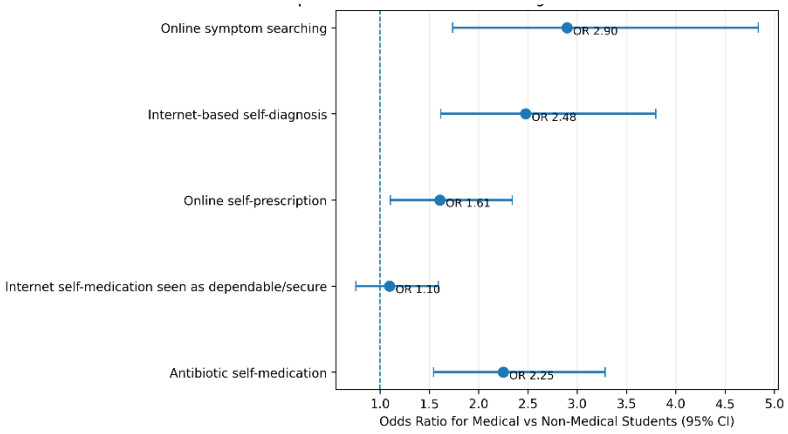

Figure 2 Discipline-Based Risk Gradient for Digital Health and Self-Medication Behaviors

Online self-prescription showed a smaller but statistically meaningful association (OR = 1.61, 95% CI: 1.10–2.34), whereas perceiving internet-guided self-medication as dependable or secure showed no significant group difference (OR = 1.10, 95% CI: 0.76–1.59), indicating that behavioral engagement with digital health tools differed more clearly by discipline than perceived safety beliefs.

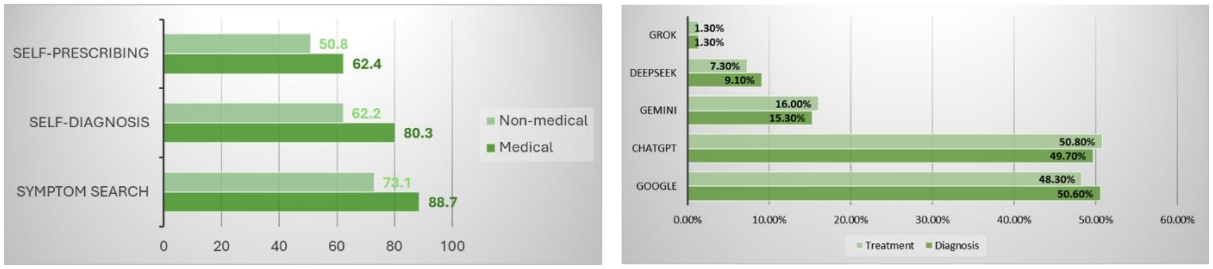

Figure 3 AI- and internet-related self-medication behaviours and digital platform use among university students. Panel A compares online symptom searching, internet-based self-diagnosis, and online self-prescription between medical and non-medical students. Medical students reported higher use across all three behaviours: symptom searching (88.7% vs. 73.1%), self-diagnosis (80.3% vs. 62.2%), and self-prescribing (62.4% vs. 50.8%). Panel B shows platforms used for diagnosis and treatment decisions. Google and ChatGPT were the most frequently used platforms for both diagnosis and treatment, while Gemini, DeepSeek, and Grok were used by smaller proportions of participants.

DISCUSSION

This study found a high prevalence of self-medication and extensive use of internet- and AI-based health information among university students in Lahore. More than four-fifths of participants had searched online for symptoms, nearly seven in ten had used internet information for self-diagnosis, and more than half had self-prescribed medication or treatment using online information. These findings suggest that self-medication among university students is no longer driven only by convenience, prior prescriptions, or advice from family and friends, but is increasingly shaped by digital health-seeking behavior. This pattern is clinically important because online information and AI-generated responses may influence students' decisions before any professional assessment occurs, especially when symptoms appear mild or consultation is perceived as inconvenient. (4,22)

Medical students demonstrated significantly higher odds of online symptom searching, internet-based self-diagnosis, online self-prescription, and antibiotic self-medication compared with non-medical students. This may reflect greater exposure to health-related terminology and greater confidence in interpreting symptoms, but the finding also raises concern that partial professional knowledge may encourage unsupervised treatment decisions. (5) The lack of significant difference in perceived safety of internet-guided self-medication indicates that medical students were not necessarily more likely to consider online self-medication safe, yet they were more likely to engage in it. This distinction is important because behavior appears to be influenced not only by safety beliefs, but also by perceived competence, accessibility of information, and convenience. (10,24)

Antibiotics were the most frequently self-medicated drug category and were used significantly more often by medical students than non-medical students. This is one of the most important public health findings of the study, given the established relationship between inappropriate antibiotic use and antimicrobial resistance. The finding suggests that university-level health education alone may not be sufficient to prevent irrational antimicrobial use unless it is paired with explicit training on antimicrobial stewardship, prescription ethics, and the limitations of self-diagnosis. In settings where prescription-only medicines remain easily accessible, student education must be supported by stronger pharmacy regulation and institutional awareness campaigns. (3)

Knowledge level was significantly associated with attitude toward responsible self-medication. Students with good knowledge were more likely to show a positive attitude, whereas poor knowledge was associated with negative attitude. However, the nearly equal distribution of positive and negative attitudes in the overall sample suggests that knowledge remains moderate and inconsistent. (2) This supports the need for targeted digital health literacy programs that address not only general medication safety, but also AI-specific risks such as hallucinated information, incomplete clinical context, false reassurance, and inappropriate treatment suggestions. (27)

The high rate of reported adverse effects is clinically concerning. More than half of the participants reported adverse effects after self-medication, yet many managed these effects independently by discontinuing, switching medicines, or seeking advice from non-physician sources. This pattern creates a second layer of risk: students first self-medicate without professional input and then manage complications without adequate clinical assessment. The finding emphasizes the need for university-based health counseling, accessible student clinics, and clear referral pathways for medication-related adverse events.

The study has several strengths. It addresses a timely and underexplored topic by linking AI chatbot use, online health information, and self-medication behavior in a Pakistani university population. It includes both medical and non-medical students, allowing meaningful comparison by academic discipline. It also evaluates multiple dimensions of digital health behavior, including symptom searching, self-diagnosis, online self-prescription, platform-specific use, image-based diagnosis, and treatment decisions. These features provide a broader understanding of AI-mediated self-medication than earlier studies focused only on general self-medication prevalence.

The findings should be interpreted within the limitations of the study design. The cross-sectional design prevents causal inference; therefore, AI and internet use should be interpreted as associated with self-medication behaviors rather than as direct causes. The purposive sampling strategy may limit generalizability to all university students in Lahore or Pakistan. Self-reported responses may be affected by recall bias, social desirability bias, or inaccurate reporting of drug categories and adverse effects. The study also did not independently verify the quality of AI-generated or online information used by participants, nor did it assess whether students critically evaluated the information before acting on it. Future studies should use longitudinal designs, probability-based sampling where feasible, and multivariable models to identify independent predictors of unsafe self-medication. Experimental or audit-based studies evaluating the accuracy of AI chatbot responses to common student health queries would also be valuable.

CONCLUSION

This study demonstrates that self-medication is highly prevalent among university students in Lahore and is closely associated with widespread use of internet- and AI-based health information for symptom searching, self-diagnosis, and self-prescription. Medical students showed stronger engagement with digital health tools and higher antibiotic self-medication than non-medical students, highlighting the need to address overconfidence, partial clinical knowledge, and antimicrobial stewardship within health-professional education. The high frequency of adverse effects further indicates that unsupervised medication use creates clinically meaningful risks. Universities should integrate AI health literacy, responsible self-medication education, and medication safety counseling into student health programs, while regulatory authorities should strengthen enforcement against non-prescription dispensing of antibiotics and other prescription-only medicines.

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