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Original Article

Antibiotic use, antimicrobial resistance awareness, vaccine confidence, and trust in health information sources in health-related and non-health-related associate-degree students

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Abstract

Objective: To compare antibiotic/antimicrobial resistance (AMR) knowledge, antibiotic-use behavior, AMR perceptions, vaccine knowledge and confidence, and trust in health information sources between students enrolled in health-related and non-health-related associate-degree programs.

Methods: This single-center cross-sectional study included 128 students from the Vocational School of Health Services and the Vocational School of Technical Sciences at Bursa Uludağ University, Turkey: 65 enrolled in health-related programs and 63 in non-health-related programs. A structured online questionnaire assessed antibiotic/AMR knowledge, rational antibiotic-use behavior, AMR perceptions, vaccine knowledge, vaccine confidence, vaccine hesitancy, and trust in health information sources. Group comparisons, Spearman correlation analyses, and multivariable linear regression models adjusted for age and sex were performed.

Results: The median age was 21 years, and 78.9% of participants were female. Antibiotic use during the previous 12 months was similar between groups (50.8% vs 52.4%; p=0.491), whereas vaccination was more frequently reported by students in health-related programs (41.5% vs 11.1%; p<0.001). Students in health-related programs had higher scores for antibiotic/AMR knowledge (7 [IQR, 6–8] vs 4 [3–5.5]), vaccine knowledge (6 [5–7] vs 4 [2–5]), rational antibiotic-use behavior (45 [42–47] vs 41 [37–44]), AMR perception (34 [31–37] vs 28 [24–32]), and vaccine confidence (14 [13–16] vs 12 [8–14]) (all p<0.001). These associations remained significant after adjustment for age and sex (all p<0.001). Antibiotic/AMR knowledge was positively correlated with AMR perception (ρ=0.513) and rational antibiotic-use behavior (ρ=0.336), while vaccine knowledge was positively correlated with vaccine confidence (ρ=0.430) (all p<0.001). Physicians were the most trusted source of health information (87.5%). Trust in several individual professional and institutional sources was positively correlated with vaccine confidence but not with antibiotic/AMR knowledge.

Conclusion: Students in health-related programs had higher knowledge, more appropriate antibiotic-use behaviors, stronger AMR perceptions, and greater vaccine confidence than students in non-health-related programs. Nevertheless, important misconceptions, suboptimal treatment-adherence behaviors, and vaccine-related concerns persisted. Educational strategies may benefit from addressing both knowledge gaps and behavioral and confidence-related barriers.

Keywords: Antibacterial agents, drug resistance, trust, vaccination.

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INTRODUCTION

Antimicrobial resistance (AMR) is a major global public health threat and has also been described as a "silent pandemic" (1). Excessive and inappropriate antimicrobial use accelerates the selection and spread of resistant microorganisms, making infections more difficult to treat and contributing to treatment failure, increased healthcare costs, morbidity, and mortality (2-3). Alongside the development of new antimicrobials, preserving the effectiveness of existing antibiotics through appropriate use and reducing unnecessary antibiotic exposure remain central to efforts to control AMR. Nevertheless, inappropriate practices—including antibiotic use for viral infections, non-prescription or self-medication, reuse of leftover antibiotics, and prescribing influenced by patient expectations—remain common (4-5). Vaccination represents a complementary strategy for reducing antibiotic use and, consequently, the selective pressure that drives AMR. Preventing bacterial infections directly, as well as viral infections that may lead to secondary bacterial infections or unnecessary antibiotic use, can help reduce antibiotic exposure (6-7). However, vaccine knowledge, vaccine confidence, and vaccination behavior do not necessarily align: greater knowledge does not always translate into greater vaccine acceptance or uptake (8). These dimensions should therefore be considered related but distinct constructs. Knowledge gaps and inappropriate antibiotic-use behaviors among university students have been reported across different countries (4,9-10). Field of study may be associated with these differences, with students enrolled in health-related programs generally demonstrating greater knowledge of antibiotics and AMR than those in non-health-related programs (4,9). Better knowledge, however, is not always accompanied by more appropriate attitudes or behaviors. Vaccine knowledge, confidence, and hesitancy also vary among university students (11-12). In addition, because students obtain health information from professional, institutional, and digital sources, their level of trust in these sources is also relevant to understanding health-related knowledge and attitudes (13). Although studies in Turkey have examined antibiotic use, AMR, or vaccine-related knowledge and attitudes among university students (14-17), comparative studies integrating antibiotic/AMR knowledge and behavior, vaccine knowledge and confidence, and trust in health information sources within the same framework remain limited.

This study compared antibiotic/AMR knowledge, rational antibiotic-use behavior, AMR perceptions, vaccine knowledge and confidence, and trust in health information sources among students enrolled in the Vocational School of Health Services and the Vocational School of Technical Sciences at Bursa Uludağ University, Turkey. We also examined the associations between knowledge and attitude measures and trust in different sources of health information. We hypothesized that students enrolled in health-related programs would have higher antibiotic/AMR and vaccine knowledge, more rational antibiotic-use behaviors, stronger AMR perceptions, and greater vaccine confidence than students enrolled in non-health-related programs.

MATERIALS AND METHODS

Study design and population

This single-center, cross-sectional analytical survey was conducted among students at the Vocational School of Health Services and the Vocational School of Technical Sciences at Bursa Uludağ University, Turkey. Students from the Vocational School of Health Services were classified as the health-related group, whereas students from the Vocational School of Technical Sciences were classified as the non-health-related group.

Participants were recruited using non-probability convenience sampling through student communication groups and institutional communication channels of the two schools. Eligibility criteria were active enrollment in either school, age ≥18 years, provision of electronic informed consent, and completion of the questionnaire. No formal a priori sample size calculation was performed. Instead, the sample size was determined pragmatically by including all eligible students who provided consent and completed the questionnaire during the predefined data collection period. Accordingly, 128 students constituted the final study sample.

Data collection

Data were collected using a structured online questionnaire administered via Google Forms. The introductory page explained the purpose of the study, the voluntary nature of participation, and the use of the data for research purposes. Only participants who provided electronic informed consent were able to proceed to the questionnaire. No direct personal identifiers, such as name, national identification number, or telephone number, were collected. The single-response option in Google Forms was used to limit duplicate submissions.

Questionnaire development and domains

The questionnaire was developed specifically for this study after a review of national and international studies assessing antibiotic use, AMR, vaccination, and health information sources among university students. The items were selected to cover the main domains relevant to the study objectives. No formal pilot study or separate content-validity assessment was performed before data collection. The questionnaire consisted of seven sections: (1) demographic characteristics and self-reported antibiotic use and vaccination during the previous 12 months; (2) 10 true/false/don't know items assessing antibiotic/AMR knowledge; (3) 10 antibiotic-use behavior items rated on a five-point frequency scale; (4) eight items assessing AMR perceptions on a five-point Likert scale; (5) eight true/false/don't know items assessing vaccine knowledge; (6) eight five-point Likert items related to vaccine confidence and hesitancy; and (7) nine five-point Likert items assessing trust in health information sources.

Scoring and internal consistency

For the antibiotic/AMR and vaccine knowledge items, correct responses were scored as 1, whereas incorrect and "don't know" responses were scored as 0, yielding separate scores ranging from 0 to 10 and from 0 to 8, respectively. Risk-oriented antibiotic-use behavior items were reverse-coded as appropriate, and a total rational antibiotic-use behavior score ranging from 10 to 50 was calculated, with higher scores indicating more appropriate antibiotic use. AMR perception items were reverse-coded where necessary to obtain a total score ranging from 8 to 40. A vaccine confidence score ranging from 4 to 20 was calculated from four positively worded items. Because the four vaccine-hesitancy items showed insufficient internal consistency, no composite hesitancy score was calculated and the items were analyzed individually. A professional/institutional source trust score ranging from 1 to 5 was calculated as the mean of trust ratings for physicians, pharmacists, academics, the Turkish Ministry of Health, and the World Health Organization. Trust in older family members, friends, social media influencers, and artificial intelligence applications was analyzed separately. Internal consistency was assessed using the Kuder–Richardson 20 coefficient (KR-20) for dichotomously scored knowledge items and Cronbach's alpha for Likert-based composite scores.

Study outcomes

The main outcomes assessed were the antibiotic/AMR knowledge score and the vaccine knowledge score. The primary explanatory variable was field of education (health-related vs non-health-related). Other outcomes included rational antibiotic-use behavior, AMR perception, vaccine confidence, individual vaccine-hesitancy items, trust in health information sources, and self-reported antibiotic use and vaccination during the previous 12 months.

Statistical analysis

Statistical analyses were performed using IBM SPSS Statistics, version 26 (IBM Corp., Armonk, NY, USA). Normality was assessed using histograms, Q–Q plots, and the Shapiro–Wilk test. Continuous variables were summarized as mean ± standard deviation or median [interquartile range], and categorical variables as n (%). Between-group comparisons were performed using the independent-samples t test or Mann–Whitney U test for continuous variables and Pearson's chi-square test or Fisher's exact test for categorical variables, as appropriate. Individual five-point trust ratings were compared using the Mann–Whitney U test; high trust ("trust" or "strongly trust") was presented descriptively. Spearman rank correlations were used to assess associations between the study measures and trust ratings. Multivariable linear regression models adjusted for age and sex evaluated associations between field of education and the main study outcomes; adjusted B coefficients, 95% confidence intervals, and adjusted R^2 values are reported. Regression assumptions were checked. Two-sided p values <0.05 were considered statistically significant. Item-level and source-specific analyses were exploratory, and no adjustment for multiple comparisons was applied.

RESULTS

Participant characteristics

A total of 128 students were included; 65 (50.8%) were enrolled in health-related programs and 63 (49.2%) in non-health-related programs. Students in the health-related group were younger than those in the non-health-related group (20 [IQR, 19–21] vs 23 [22–24] years; p<0.001). Antibiotic use during the previous 12 months was similar between groups, whereas vaccination was more frequently reported by students in health-related programs (41.5% vs 11.1%; p<0.001) (Table 1).

Internal consistency of the study measures

The KR-20 coefficients were 0.696 for the antibiotic/AMR knowledge score and 0.781 for the vaccine knowledge score. Cronbach's alpha coefficients were 0.707 for rational antibiotic-use behavior, 0.794 for AMR perception, 0.843 for vaccine confidence, and 0.787 for professional/institutional source trust. Because the four vaccine-hesitancy items showed low internal consistency (α=0.552), no composite hesitancy score was calculated.

Main study outcomes

Students in health-related programs had higher antibiotic/AMR knowledge, vaccine knowledge, rational antibiotic-use behavior, AMR perception, and vaccine confidence scores than those in non-health-related programs (all p<0.001), whereas professional/institutional source trust did not differ between groups (p=0.359) (Table 2). These associations remained significant after adjustment for age and sex (all p<0.001) (Table 3).

Table 1. Demographic and descriptive characteristics of the study participants

Variable	Overall (n=128)	Health-related (n=65)	Non-health-related (n=63)	p
Age, median [IQR]	21 [20–23]	20 [19–21]	23 [22–24]	<0.001
Female, n (%)	101 (78.9)	55 (84.6)	46 (73.0)	0.164
Antibiotic use in the past 12 months				0.491
Yes	66 (51.6)	33 (50.8)	33 (52.4)	
No	53 (41.4)	29 (44.6)	24 (38.1)	
Cannot recall	9 (7.0)	3 (4.6)	6 (9.5)	
Vaccination in the past 12 months				**<0.001**
Yes	34 (26.6)	27 (41.5)	7 (11.1)	
No	92 (71.9)	37 (56.9)	55 (87.3)	
Cannot recall	2 (1.6)	1 (1.5)	1 (1.6)	

Abbreviations: IQR: interquartile range.
Data are presented as median [IQR] or n (%), as appropriate. Group comparisons were performed using the Mann–Whitney U test, Pearson's chi-square test, or Fisher's exact test, as appropriate.

Table 2. Internal consistency and group comparisons of the main study outcomes

Outcome	No. of items	Possible range	Internal consistency	Overall, median [IQR]	Health-related	Non-health-related	p
Antibiotic/AMR knowledge	10	0–10	KR-20=0.696	6[4–7]	7[6–8]	4 [3–5.5]	<0.001
Vaccine knowledge	8	0–8	KR-20=0.781	5[4–6]	6[5–7]	4 [2–5]	<0.001
Rational antibiotic-use behavior	10	10–50	α=0.707	43[40–46]	45[42–47]	41[37–44]	<0.001
AMR perception	8	8–40	α=0.794	32[26–35]	34[31–37]	28 [24–32]	<0.001
Vaccine confidence	4	4–20	α=0.843	13[11–15]	14[13–16]	12 [8–14]	<0.001
Professional/ institutional source trust	5	1–5[a]	α=0.787	3.80	3.80	4.00	0.359

Abbreviations: AMR: antimicrobial resistance; IQR: interquartile range; KR-20: Kuder–Richardson 20 coefficient; α: Cronbach's alpha.
[a]The source trust score was calculated as the mean of the relevant items and ranged from 1 to 5.
Data are presented as median [IQR]. Between-group comparisons were performed using the Mann–Whitney U test.

Table 3. Adjusted associations between field of education and the main study outcomes

Outcome	Health-related education, adjusted B[a]	95% CI	p	Adjusted R^2
Antibiotic/AMR knowledge score	2.51	1.76–3.26	<0.001	0.254
Vaccine knowledge score	2.29	1.53–3.04	<0.001	0.241
Rational antibiotic-use behavior score	3.63	1.84–5.41	<0.001	0.266
AMR perception score	5.04	2.90–7.17	<0.001	0.132
Vaccine confidence score	2.38	1.07–3.69	<0.001	0.102

Abbreviations: AMR: antimicrobial resistance, B: regression coefficient; CI: confidence interval.
[a]Reference category: non-health-related education. Adjusted B values were obtained from multivariable linear regression models adjusted for age and sex.

Responses to individual knowledge items

The most prominent gaps in antibiotic/AMR knowledge concerned viral infections and the concept of antimicrobial resistance. Only 23.4% of participants correctly identified that antibiotics do not treat viral infections; the proportion was 33.8% among students in health-related programs and 12.7% among those in non-health-related programs (p=0.005). Similarly, only 20.3% correctly recognized that antibiotic resistance does not mean that the human body becomes accustomed to antibiotics, with no difference between groups (p=0.726). In contrast, correct responses regarding the contribution of unnecessary antibiotic use to resistance and the effects of antibiotics on the gut microbiota were more frequent among students in health-related programs (both p<0.001). For the vaccine knowledge items, 79.7% of participants correctly recognized that vaccines can prevent some bacterial infections, and 76.6% recognized that preventing viral infections may help reduce unnecessary antibiotic use. Knowledge was lower regarding the role of pneumococcal vaccination (40.6%) and the fact that vaccines are not therapeutic substitutes for antibiotics (33.6%). For both concepts, correct responses were more frequent among health-related students (60.0% vs 20.6%, $p<0.001$; and 46.2% vs 20.6%, $p=0.002$, respectively). Recognition that vaccination can also protect vulnerable members of the community was also higher in the health-related group (89.2% vs 47.6%; $p<0.001$).

Antibiotic-use behaviors

Overall, 55.5% of participants reported that they stopped taking antibiotics early at least sometimes when they felt better. This behavior was more frequent among students in non-health-related programs than among those in health-related programs (69.8% vs 41.5%; p=0.001). The proportion who reported at least sometimes believing that antibiotics were needed for a sore throat was 30.2% in the non-health-related group and 10.8% in the health-related group (p=0.006). Conversely, adherence to antibiotic dosing schedules "often" or "always" was reported by 58.7% and 80.0%, respectively (p=0.009).

AMR perceptions

Overall, 48.4% of participants considered AMR an important health threat for people in their age group, whereas 82.0% recognized that AMR is not a concern limited to healthcare professionals. Both responses were more frequent among students in health-related programs (60.0% vs 36.5% and 95.4% vs 68.3%, respectively). Antibiotic/AMR knowledge showed a moderate positive correlation with AMR perception (ρ=0.513; p<0.001) and a weaker positive correlation with rational antibiotic-use behavior (ρ=0.336; p<0.001).

Vaccine confidence and hesitancy

Confidence in vaccine effectiveness was reported by 72.3% of students in health-related programs and 30.2% of those in non-health-related programs, whereas 49.2% and 22.2%, respectively, agreed that vaccines are safe (p<0.001 and p=0.001, respectively). In contrast, 57.0% of participants expressed concern about serious vaccine adverse effects and 64.1% reported difficulty trusting newly developed vaccines; neither item differed significantly between groups. Vaccine knowledge was moderately and positively correlated with vaccine confidence (ρ=0.430; p<0.001). Health-related students were also more likely to report willingness to receive vaccines recommended by healthcare professionals (60.0% vs 34.9%; p=0.005) and to reject the view that vaccination is solely a personal decision unrelated to public health (80.0% vs 54.0%; p=0.002).

Trust in health information sources

Physicians were the most highly trusted source of health information (87.5%), followed by the Turkish Ministry of Health (69.5%), the World Health Organization (WHO) (67.2%), pharmacists (63.3%), and academics (61.7%). Trust was lower for older family members (29.7%), artificial intelligence applications (19.5%), friends (11.7%), and social media influencers (2.3%). The professional/institutional source trust score did not differ by field of education (p=0.359). Trust ratings for the Ministry of Health were higher among students in the non-health-related group than among those in the health-related group (p=0.003); high trust was reported by 77.8% and 61.5% of students, respectively. Vaccine confidence was positively correlated with trust in physicians, the WHO, the Ministry of Health, pharmacists, and academics (ρ=0.203–0.416), with the strongest correlation observed for trust in physicians (ρ=0.416; p<0.001). In contrast, antibiotic/AMR knowledge was not significantly correlated with trust in any of the nine health information sources. Detailed results are presented in Table 4.

Table 4. Trust in health information sources and associations with the main study outcomes

Health information source	Overall high trust[a], n (%)	Health-related high trust, n (%)	Non-health-related high trust, n (%)	Group comparison p	Antibiotic/ AMR knowledge, ρ (p)	Vaccine confidence, ρ (p)
Physicians	112 (87.5)	56 (86.2)	56 (88.9)	0.810	0.043 (0.632)	0.416 (<0.001)
Turkish Ministry of Health	89 (69.5)	40 (61.5)	49 (77.8)	0.003	−0.126 (0.155)	0.270 (0.002)
World Health Organization	86 (67.2)	41 (63.1)	45 (71.4)	0.201	−0.041 (0.648)	0.308 (<0.001)
Pharmacists	81 (63.3)	37 (56.9)	44 (69.8)	0.250	−0.083 (0.353)	0.205 (0.021)
Academics	79 (61.7)	42 (64.6)	37 (58.7)	0.533	0.114 (0.199)	0.203 (0.022)
Older family members	38 (29.7)	14 (21.5)	24 (38.1)	0.141	−0.074 (0.408)	−0.035 (0.692)
Artificial intelligence applications	25 (19.5)	14 (21.5)	11 (17.5)	0.177	0.000 (0.998)	0.002 (0.985)
Friends	15 (11.7)	4 (6.2)	11 (17.5)	0.233	−0.098 (0.270)	−0.036 (0.685)
Social media influencers	3 (2.3)	1 (1.5)	2 (3.2)	0.946	−0.005 (0.953)	−0.106 (0.235)

Abbreviations: AMR: antimicrobial resistance; ρ: Spearman's rank correlation coefficient.
[a]High trust was defined as responses of "trust" or "strongly trust."
Group p values were obtained using the Mann–Whitney U test based on the original five-point trust ratings. Correlations were assessed using Spearman's rank correlation analysis; p values in parentheses refer to the significance of the corresponding correlation coefficients. Source-specific analyses were exploratory and were not adjusted for multiple comparisons.

DISCUSSION

The findings indicate that differences between health-related and non-health-related students extend beyond factual knowledge to antibiotic-use behavior, AMR perception, and vaccine confidence. However, important knowledge gaps and behavioral and vaccine-related concerns persisted even among health-related students. The stronger association of antibiotic/AMR knowledge with AMR perception than with rational antibiotic-use behavior suggests that greater knowledge may not translate into appropriate behavior to the same extent. Although antibiotic use during the previous 12 months was similar between groups, vaccination was more frequently reported by students in health-related programs. In Turkey, students in health vocational programs may receive several vaccines because of occupational exposure risks (18); therefore, this difference may reflect clinical training, occupational risk, and institutional vaccination practices in addition to knowledge and attitudes. Higher vaccination coverage among health-related university students has also been reported in France (19). However, the type of vaccine and reason for vaccination were not assessed in our study, limiting interpretation of this difference. Higher antibiotic/AMR and vaccine knowledge among health-related students is consistent with previous studies comparing students from different fields of education (4,9). However, the cross-sectional design does not allow these associations to be interpreted as direct effects of health-related education, and self-selection into different fields may also have contributed to the observed differences. Item-level findings revealed important conceptual gaps despite differences in overall knowledge scores. Misconceptions regarding antibiotic indications, including the distinction between bacterial and viral infections, and key concepts related to antimicrobial resistance persisted in both groups, consistent with previous studies among university students (4,16,20). In contrast, health-related students performed better on more specific topics, including the contribution of unnecessary antibiotic use to resistance and the effects of antibiotics on the gut microbiota. Vaccine-related knowledge showed a similar pattern. Although general concepts were relatively well recognized, important gaps remained regarding pneumococcal vaccination, the distinction between vaccines and therapeutic agents, and the indirect protection provided by vaccination. Health-related students generally performed better on these more specific concepts, suggesting that general vaccine knowledge and understanding of more detailed vaccine-related mechanisms may not develop to the same degree. Although health-related students had more rational antibiotic-use behavior overall, inappropriate practices such as early treatment discontinuation persisted. Similar findings have been reported among medical and university students, indicating that greater knowledge does not necessarily translate into equally large improvements in antibiotic-use behavior (10,14-15). The relatively weak correlation between antibiotic/AMR knowledge and rational antibiotic-use behavior in our study further supports this interpretation. Despite higher overall AMR perception among health-related students, the findings suggest a distinction between general awareness and personal risk perception. Previous studies have similarly reported differences in AMR awareness according to field of study (9,21). The moderate correlation between antibiotic/AMR knowledge and AMR perception supports an association between greater knowledge and stronger awareness, while also indicating that recognizing AMR as a societal problem may not necessarily translate into perceiving it as personally relevant. Greater vaccine confidence among health-related students did not eliminate concerns related to vaccine hesitancy. Concerns about adverse effects and newly developed vaccines remained common, consistent with findings from a recent systematic review

of university students (11). The positive association between vaccine knowledge and confidence suggests that these constructs are related but not interchangeable. Professional and institutional sources were generally trusted more than informal or digital sources, with physicians emerging as the most trusted source. Similar findings have been reported among university students in Türkiye, where physicians were considered the most reliable health information source, despite the internet being the most frequently used source during the COVID-19 pandemic (13). In our study, trust in individual professional and institutional sources was not associated with antibiotic/AMR knowledge but was positively associated with vaccine confidence, suggesting that trust may relate more strongly to attitudinal than factual dimensions of health-related decision-making. The isolated difference in trust in the Ministry of Health should be interpreted cautiously because source-specific analyses were exploratory and were not adjusted for multiple comparisons. The findings suggest that interventions for university students may be more useful when they address the specific gaps identified in knowledge, behavior, and confidence rather than relying on uniform information delivery. Recent studies have similarly shown that gaps between knowledge and appropriate antibiotic-use behavior may persist among university students, including those enrolled in health-related programs (22,23). Among students in non-health-related programs, strengthening basic knowledge of antibiotics, AMR, and vaccination may be particularly relevant. Among students in health-related programs, persistent conceptual misconceptions, treatment-adherence behaviors, and concerns about vaccine safety may require additional attention. The relatively high level of trust in professional and institutional sources also suggests that physicians and other healthcare professionals may provide appropriate channels for educational and health communication initiatives.

Limitations

Several limitations should be considered. The single-center design and convenience sampling limit the generalizability of the findings. No formal a priori sample size calculation was performed; therefore, estimates for small effects and subgroup differences may be imprecise. The cross-sectional design precludes causal inference, and self-selection into different fields of study may have contributed to the observed differences. Self-reported behaviors and attitudes may have been affected by social desirability and recall bias. In addition, the questionnaire was developed specifically for this study and was not subjected to a separate formal pilot or validation study before administration, which may limit the generalizability of its measurement properties. Information on year of study, vaccine type, and reason for vaccination was not collected, limiting more detailed interpretation. The low internal consistency of the vaccine-hesitancy items also precluded calculation of a composite score. Finally, item-level and source-specific analyses were exploratory and were not adjusted for multiple comparisons; these findings should therefore be interpreted cautiously. Despite these limitations, a strength of this study is the simultaneous assessment of antibiotic/AMR knowledge, antibiotic-use behavior, AMR perception, vaccine knowledge and confidence, and trust in health information sources within the same analytical framework. Comparing health-related and non-health-related students within the same university also provided a shared institutional context for examining differences by field of education.

CONCLUSION

Students in health-related programs had higher antibiotic/AMR and vaccine knowledge, more rational antibiotic-use behaviors, stronger AMR perceptions, and greater vaccine confidence than those in non-health-related programs. However, important misconceptions, suboptimal treatment-adherence behaviors, and vaccine-related concerns persisted even among health-related students. The composite professional/institutional source trust score did not differ by field of education, whereas trust in individual professional and institutional sources was positively associated with vaccine confidence. Educational strategies should address knowledge, behavior, and confidence-related barriers, while larger longitudinal studies are needed to further clarify these relationships and evaluate targeted interventions.

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