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Research Article

Antibiotic Resistance Awareness and Self-Reported Antibiotic Use among Undergraduates in Anuradhapura District, Sri Lanka: A Cross-Sectional Survey

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Abstract

Introduction: Evidence on how antibiotic resistance (ABR) awareness relates to antibiotic use among university undergraduates in rural Sri Lanka is limited.

Methods: A stratified recruitment approach was used across faculties, combining paper-based administration with voluntary online participation in a cross-sectional survey of undergraduates aged 18–29 years in Anuradhapura District in April 2025. 274 responses were analysed against a planned 374. A pilot-tested, expert-reviewed questionnaire was used. The campus research ethics review process cleared the study. Analyses were exploratory and unadjusted (six chi-square tests; Cramér's V; Holm-adjusted p-values; 95% confidence intervals).

Results: Overall, 75.5% (95% CI 70.1–80.3) had heard of ABR, but 25.9% (21.1–31.4) rated their understanding as "very well"; 26.3% (21.4–31.8) believed antibiotics speed recovery from colds. 38.3% (32.8–44.2) had taken antibiotics without consulting a doctor, 31.4% (26.2–37.1) stopped courses early, and 57.3% (51.4–63.0) always completed prescribed courses. Awareness was not associated with stopping early ($p = 0.128$). Believing that antibiotics speed cold recovery was associated with a hypothetical intention (not behaviour) to ask doctors for unnecessary antibiotics ($p = 0.011$), but not after Holm adjustment ($p = 0.067$). All participants were undergraduates, so education level was not analysed as a comparison variable.

Conclusions: Misconceptions and risky self-reported antibiotic use were common despite high awareness. The one nominal association did not survive multiple-comparison adjustment; findings are preliminary and warrant larger multivariable studies.

Keywords: Antibiotic resistance, awareness, antibiotic-use behaviour, undergraduates, Sri Lanka

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Introduction

Antibiotic resistance (ABR) is a global health emergency. Bacterial ABR was directly associated with an estimated 1.27 million deaths worldwide in 2019 and contributed to a further 4.95 million deaths [1]. Inappropriate antibiotic use, including unnecessary prescriptions, self-medication and incomplete courses, accelerates resistance [2].

University students are an influential group whose knowledge and attitudes shape future public health outcomes. Knowledge-attitude-practice studies among undergraduates in Sri Lanka, Nepal and elsewhere in South Asia generally report a gap between awareness of

ABR and safe antibiotic use [3–6,10]. Sri Lankan work has focused mainly on pharmacy and medical students [3,4], whose curricula already cover antibiotics. Evidence from undergraduates in other faculties, and from Anuradhapura District, a predominantly rural setting, is limited.

This study aimed to describe ABR awareness, attitudes, misconceptions and self-reported antibiotic use among university undergraduates in Anuradhapura District, and to explore whether awareness, misconceptions and information source were associated with taking antibiotics without consultation, stopping a course early and intention to request antibiotics.

Methods

Design, setting and participants

This cross-sectional survey was conducted from 1 to 28 April 2025, mainly at Rajarata University of Sri Lanka, with undergraduates from other university-level institutions in Anuradhapura District (the Open University of Sri Lanka Anuradhapura Regional Centre, the Bhiksu University of Sri Lanka and smaller institutions such as ICBT and ESOFT); the district undergraduate population was estimated at 13,500 [7]. All registered undergraduates aged 18–29 years who consented and completed the questionnaire were eligible; all participants were registered undergraduates (diploma students were counted as undergraduates). Incomplete or inconsistent responses (for example, identical answers throughout) were excluded; their number was not recorded.

Sample size and recruitment

Cochran's formula ($Z = 1.96$, $p = 0.5$, $e = 0.05$) gave 384, and the finite population correction for 13,500 undergraduates gave a target of 374 [7,11]. Limited institutional access, connectivity problems and examination schedules produced 274 complete responses. A stratified recruitment approach was used across faculties (Health Sciences, Applied Sciences, Management Studies, and Humanities and Social Sciences), combining paper-based administration in lecture halls and libraries with voluntary online participation (Google Forms shared through university mailing lists, course groups and student forums). This was not a probability-based stratified random sample: online participation was voluntary, the number of undergraduates approached was not recorded, so the response rate is unknown, and faculty, institution and administration mode were not retained in the dataset. The sample is therefore treated as a non-probability sample.

Questionnaire and outcome measures

The self-administered, 29-item questionnaire was adapted from a World Health Organisation survey framework [8] and previous South Asian instruments. It covered demographics, antibiotic use, ABR awareness, self-rated understanding, beliefs, intentions, information sources and support for education. Table 1 gives the exact wording, response options, time frame and coding of every variable used. The two primary behavioural outcomes were taking antibiotics without consulting a doctor ("ever", any antibiotic use; reported as occasionally or frequently versus never) and completing a prescribed course (prescribed antibiotics only, no stated time frame; reported as "always" versus "not always", that is, sometimes, rarely or never). Stopping a course early (yes/no) and hypothetical intention to ask a doctor for antibiotics were analysed separately, and intention is not treated as behaviour. All items were answered by all participants, including 29 (10.6%) who reported no antibiotic use in the previous five years.

Questionnaire validity

The questionnaire was developed in English and translated into Sinhala and Tamil with back-translation to check conceptual accuracy; respondents completed the version they preferred (Sinhala or English). A medical practitioner, Dr M.S.W.D.S. Wijebandara, assessed content validity for relevance, clarity and cultural appropriateness. It was piloted with 30 undergraduates outside the study sample, who were excluded from the final analysis, and ambiguous items were revised. A pilot of 30 can reveal comprehension problems but is not sufficient for formal psychometric evaluation. The instrument consists of categorical items (yes/no/not sure and frequency options) rather than a multi-item Likert scale, so internal-consistency statistics are not appropriate evidence of its validity; a Cronbach's alpha of 0.83 recorded during development for scale-type items cannot be linked to a specified item set and is not relied upon [12].

Ethics and consent

The protocol was submitted to the campus research ethics review process on 9 February 2025 and cleared on 16 March 2025; review was at campus level only. Participants received an information sheet describing the purpose, voluntary nature, confidentiality and right to withdraw, and gave consent through a mandatory checkbox (online) or a signed form (paper). No incentives were offered, and no personal identifiers or IP addresses were recorded.

Statistical analysis

Data were analysed in IBM SPSS Statistics version 29.0. Proportions are given with 95% Wilson confidence intervals. Every percentage uses n = 274 as the denominator; there were no missing responses for any variable because incomplete questionnaires were excluded. Associations were tested with Pearson chi-square tests, with Cramér's V (approximate 95% confidence intervals from the non-central chi-square distribution) as effect size. Tests concerning the behavioural outcomes were primary and the others exploratory. Six chi-square tests were performed, and Holm-adjusted p-values are reported across all six. No adjustment was made for confounders such as age, faculty or prior health coursework; all analyses are exploratory and unadjusted.

Table 1: Wording, response options, time frame and coding of key variables

Variable (item)	Exact item wording	Response options	Time frame	Coding
Heard of ABR (Q13)	Have you heard of antibiotic resistance?	Yes / no / not sure	Ever	3 categories
Self-rated understanding (Q14)	How well do you understand antibiotic resistance?	Very well (I know what it is and its consequences) / somewhat (I have heard about it but don't know details) / not at all (I do not understand it)	Current	3 categories
Antibiotic use in last five years (Q6)	Have you used antibiotics in the last five years?	Yes, prescribed by a doctor / yes, self-medicated without a prescription / no, I have not used antibiotics	Last five years	Descriptive only
Took antibiotics without consulting a doctor, primary outcome 1 (Q12)	Have you ever taken antibiotics without consulting a doctor?	Yes, frequently / yes, occasionally / no, never	Ever	Ever (occasionally/frequently) vs never; 3 categories in tests. Any antibiotic use
Completes full course, primary outcome 2 (Q9)	How often do you complete the full course of prescribed antibiotics?	Always / sometimes / rarely / never	Not stated (usual practice)	Always vs not always. Prescribed antibiotics only
Stops once feeling better (Q10)	Do you stop taking antibiotics once you feel better, even if the course isn't completed?	Yes / no	Not stated	2 categories
Takes antibiotics from friend/family (Q22)	Would you take antibiotics recommended by a friend or family member without consulting a doctor?	Yes, frequently / yes, occasionally / no, never	Hypothetical	Occasionally/frequently vs never
Intention to ask doctor (Q21)	Would you ask a doctor for antibiotics even	Yes, always / Sometimes / no	Hypothetical	3 categories; yes/sometimes in prevalence

	if they say they are not necessary?			
Cold/flu belief (Q20)	Do you think taking antibiotics when you have a cold or flu helps you recover faster?	Yes / no / not sure	Current	3 categories; misconception = yes
All-infections belief (Q19)	Do you believe antibiotics are effective against all infections?	Yes / no / not sure	Current	3 categories; misconception = yes
Seriousness (Q16, Q29)	Q16: Do you think antibiotic resistance is a serious health problem? Q29: Do you believe antibiotic resistance could become a serious issue in Sri Lanka?	Q16: Yes, very serious / somewhat serious / not serious / I don't know. Q29: Yes / Not sure / No (as recorded in the dataset)	Current	Q16 very/somewhat and Q29 yes reported separately
Information source (Q18)	Which sources have provided you information about antibiotic resistance? (select all that apply)	Doctors or healthcare professionals / TV/radio / social media / newspapers/magazines / friends/family / I have not received any information	Ever	One six-category variable (one category per respondent in the dataset)

Results

Participants

Table 2 shows the participants' characteristics: 58.0% were female, 56.9% lived in rural areas, 66.1% were Sinhala, and all were undergraduates (including 33 diploma students; Table 2). In the previous five years, 62.4% (171) had used antibiotics prescribed by a doctor, 27.0% (74) had self-medicated, and 10.6% (29) had used none.

Awareness, understanding and misconceptions

Of 274 respondents, 75.5% (207; 95% CI 70.1–80.3) had heard of ABR, but only 25.9% (71; 21.1–31.4) rated their understanding as "very well" and 19.7% (15.4–24.8) as "not at all". Misconceptions were common: 26.3% (21.4–31.8) believed antibiotics help recovery from a cold or flu, and 16.4% (12.5–21.3) believed they work against all infections. Overall, 73.0% (67.4–77.9) believed ABR could become a serious issue in Sri Lanka, whereas 51.5% (45.6–57.3) called it a very or somewhat serious health problem (Table 4, Figure 1). Having heard of ABR ($\chi^2 = 3.635$, df = 4, p = 0.458, V = 0.08) and gender (p = 0.396, V = 0.08) were not significantly associated with self-rated understanding.

Behaviours and intentions

Overall, 38.3% (32.8–44.2) had taken antibiotics without consulting a doctor (27.4% occasionally, 10.9% frequently), and 35.4% (30.0–41.2) would take antibiotics recommended by a friend or family member. A total of 31.4% (26.2–37.1) stopped courses once feeling better, and 57.3% (51.4–63.0) always completed prescribed courses. Intention to ask a doctor for antibiotics even if told they were unnecessary was reported by 32.5% (27.2–38.2; 9.5% yes, 23.0% sometimes). Having heard of ABR was not significantly associated with stopping early (p = 0.128), and believing antibiotics treat all infections was not associated with taking antibiotics without consultation (p = 0.809; Table 3).

Believing that antibiotics speed recovery from a cold was associated with the hypothetical intention to ask a doctor for antibiotics anyway ($\chi^2 = 13.040$, df = 4, p = 0.011, V = 0.15, 95% CI 0.04–0.22). Still, the

association did not remain significant after Holm adjustment (adjusted p = 0.067).

Table 2: Characteristics of participants (n = 274)

Characteristic	n	%
Age group (years)		
20–21	60	21.9
22–23	65	23.7
24–25	64	23.4
26–27	38	13.9
28–29	47	17.2
Gender		
Female	159	58.0
Male	115	42.0
Ethnicity		
Sinhala	181	66.1
Muslim	63	23.0
Tamil	12	4.4
Burgher	7	2.6
Other	11	4.0
Residence		
Rural	156	56.9
Suburban	64	23.4
Urban	54	19.7
Education level		
Undergraduate (including 33 diploma students)	274	100.0

Percentages may not sum to 100% because of rounding (age groups and ethnicity sum to 100.1%).

Information sources

Information source was analysed as one six-category variable (doctors or healthcare professionals, friends/family, newspapers/magazines, social media, TV/radio, none; df = 10), with each respondent in one category and n = 274 as the denominator. The item was worded "select all that apply", but the dataset records one category per respondent, and how multiple selections were handled was not documented. TV/radio (20.8%; 95% CI 16.4–26.0), newspapers/magazines (18.2%; 14.1–23.2) and doctors (16.8%; 12.8–21.7) were most often recorded, followed by friends/family (16.1%), no information received (14.6%) and social media (13.5%; Table 4). Source was not significantly associated with self-rated understanding ($\chi^2 = 12.793$, $p = 0.235$, V = 0.15). This does not show that all sources are equally effective: the test had limited power, and source reflects self-reported exposure, not information quality.

Education level

All participants were undergraduates, so education level was not analysed as a comparison variable. The education × course-completion test in the original submission (p = 0.026), which violated chi-square assumptions (66.7% of cells with expected counts below 5), is withdrawn and is not interpreted.

Table 3: Pearson chi-square tests (unadjusted for confounders)

Variables tested	n	χ^2 (df)	*p*	Holm-adj. *p*	Cramér's V (95% CI)	Interpretation
Primary analyses (behavioural outcomes)						
Heard of ABR × stops antibiotics early	274	4.119 (2)	0.128	0.638	0.12 (0.00–0.23)	Not significant
Believes antibiotics treat all infections × takes antibiotics without consultation	274	1.601 (4)	0.809	1.000	0.05 (0.00–0.10)	Not significant
Exploratory analyses						
Belief antibiotics speed cold recovery × intention to ask doctor anyway	274	13.040 (4)	0.011	0.067	0.15 (0.04–0.22)	Nominal only; not significant after adjustment
Heard of ABR × self-rated understanding	274	3.635 (4)	0.458	1.000	0.08 (0.00–0.14)	Not significant
Information source × self-rated understanding	274	12.793 (10)	0.235	0.942	0.15 (0.00–0.19)	Not significant
Gender × self-rated understanding	274	1.852 (2)	0.396	1.000	0.08 (0.00–0.19)	Not significant

Holm-adjusted p-values cover the six tests shown and are capped at 1.000. Cramér's V = $\sqrt{[\chi^2/(n(k-1))]}$; confidence intervals are approximate. Primary and exploratory analyses are marked as shown.

Table 4: Prevalence of key outcomes (denominator n = 274)

Variable	n	%	95% CI

Had heard of ABR	207	75.5	70.1-80.3
Understands ABR "very well"	71	25.9	21.1-31.4
Understands ABR "not at all"	54	19.7	15.4-24.8
Believes ABR could become a serious issue in Sri Lanka	200	73.0	67.4-77.9
Considers ABR a very/somewhat serious health problem	141	51.5	45.6-57.3
Believes antibiotics help recovery from cold or flu	72	26.3	21.4-31.8
Believes antibiotics work against all infections	45	16.4	12.5-21.3
Has taken antibiotics without consulting a doctor	105	38.3	32.8-44.2
Would take antibiotics from friend/family without consulting a doctor	97	35.4	30.0-41.2
Stops antibiotics once feeling better	86	31.4	26.2-37.1
Always completes prescribed course	157	57.3	51.4-63.0
Would ask doctor for antibiotics even if unnecessary (yes/sometimes)	89	32.5	27.2-8.2
Supports awareness campaigns	229	83.6	78.7-87.5
Willing to learn more about ABR	247	90.1	86.0-93.1
Information source: TV/radio	57	20.8	16.4-26.0
Information source: newspapers/magazines	50	18.2	14.1-23.2
Information source: doctors/healthcare professionals	46	16.8	12.8-21.7
Information source: friends/family	44	16.1	12.2–20.9
Information source: none received	40	14.6	10.9–19.3
Information source: social media	37	13.5	10.0–18.1

Information-source categories are mutually exclusive and sum to 274 (100%). Support for campaigns and willingness to learn are shown in Figure 1.

Discussion

Three-quarters of undergraduates had heard of ABR, but only about a quarter rated their understanding as strong, and misconceptions about colds and general infections were common. This awareness–understanding gap matches studies among pharmacy and medical students in Sri Lanka [3,4] and among undergraduates in Nepal [5,9] and elsewhere [6]. Our findings extend this evidence to undergraduates beyond health-science programmes in a predominantly rural district.

Having heard of ABR was not associated with stopping antibiotics early, the only awareness–behaviour association tested. Specific, actionable misconceptions were associated with risky intentions in this sample, whereas the broad awareness measure was not associated with stopping antibiotics early. This association was small, did not survive multiple-comparison adjustment ($p = 0.067$), and the cross-sectional, unadjusted design supports association only, not prediction or causation. It concerns hypothetical intention, which does not necessarily translate into behaviour.

TV/radio, newspapers/magazines and doctors were the most frequently recorded information sources, and 14.6% reported receiving none, but source was not associated with self-rated understanding. Because source reflects self-reported exposure rather than information quality, and the test had limited power, these data cannot show which channel would be most

effective. Campaigns could nonetheless combine mass-media messages with clinician advice, and should address specific misconceptions, such as the belief that antibiotics treat colds, alongside general awareness-raising.

Strong support for campaigns (83.6%) and willingness to learn (90.1%) suggest a receptive audience for education that addresses specific misconceptions.

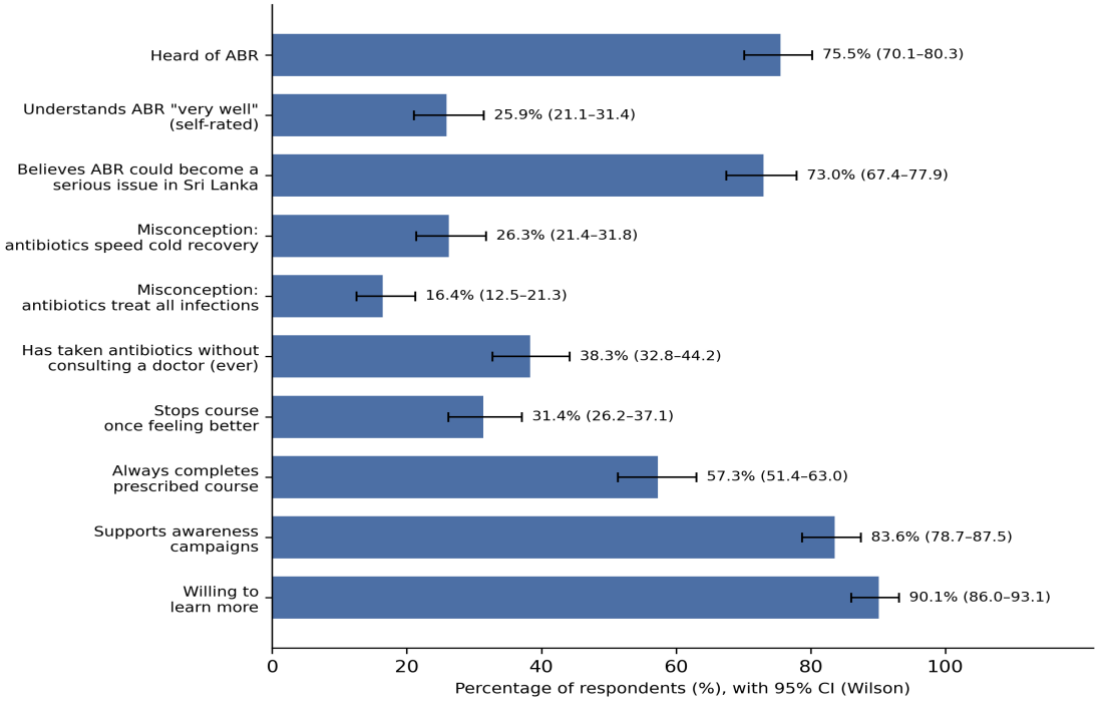


Figure 1: Key findings with 95% confidence intervals (n = 274).

Strengths and limitations

Strengths include inclusion of undergraduates beyond health-science programmes, a pilot-tested and expert-reviewed instrument, separation of intention from behaviour, and transparent reporting. Limitations are as follows. The sample (274) fell short of the target (374), reducing precision. Recruitment combined paper-based and voluntary online participation; the number approached was not recorded, and the response rate is unknown, so self-selection and non-response bias are likely, and representativeness cannot be assumed. Institutional and faculty distribution and administration mode were not retained, so mode effects could not be assessed. The design was cross-sectional, so temporal and causal relationships cannot be established. Self-reported behaviour may also be affected by recall and social-desirability bias, particularly for antibiotic-course completion; behavioural items had no stated time frame and were answered by all participants, including 29 with no recent antibiotic use. The information-source item was worded "select all that apply" but recorded as one category. Analyses were univariable and unadjusted for confounders; six tests were performed, the one nominal association did not survive Holm correction, and an education analysis with sparse cells was withdrawn. A single medical practitioner reviewed content validity, and the instrument has no multi-item scale, so factor analysis, internal consistency and test–retest reliability were not assessed. Ethics review was at campus level only, with no external committee review. Future studies should use a documented sampling frame, record response rates, and apply multivariable analysis in larger multi-institutional samples.

Conclusions

Among responding undergraduates in Anuradhapura District, most had heard of ABR, yet self-rated understanding was low, and misconceptions and risky self-reported antibiotic use were common. Having heard of ABR was not associated with stopping antibiotics early. A specific misconception was nominally associated with risky intention, but not after multiple-comparison adjustment. Given the non-probability sample and exploratory, unadjusted analyses, the findings are preliminary and support further study.

Conflict of interest: The authors declare no conflict of interest.

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