

Knowledge, Attitudes, and Behaviors Toward Antibiotic Use Among Ho Chi Minh City Residents: A 2024 Cross-Sectional Study

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ABSTRACT

Antibiotics are known as a revolutionary invention, and their birth marks a new era of medical advancement in treating infectious diseases. However, inappropriate use of antibiotics is a threat to global health and development. A descriptive cross-sectional survey using convenience sampling was conducted among 589 people in Ho Chi Minh City (HCMC) from April to June 2024. Among 589 people in Ho Chi Minh City aged 34.86 ± 14.74 years, most participants were female (54.84%), had a university degree or higher education (75.72%), were single (64.01%), and used antibiotics in the past year (75.04%). The total average scores of knowledge, attitude, and behavior were 66.03 ± 22.28 , 69.51 ± 16.81 , and 76.42 ± 15.79 , respectively. Linear regression results show that occupational status and antibiotic use in the past year are related to knowledge ($p < 0.05$), and antibiotic use in the past year is related to attitude and behavior of antibiotic use ($p < 0.05$). Regarding knowledge, attitudes, and behaviors toward antibiotic use, people in Ho Chi Minh City have moderate-to-high levels of these. There are differences in knowledge, attitudes, and behaviors between groups of participants with different characteristics.

Keywords: antibiotics, antibiotic resistance, knowledge, attitude, behavior.

INTRODUCTION

Antibiotics are substances capable of inhibiting the growth or even eradicating bacteria and other microorganisms (Bentley & Bennett, 2003). The advent of antibiotics marked an essential milestone for medicine in treating infectious diseases, saving millions of lives from life-threatening infections (Ministry of Health, 2015). Globally, the rate of antibiotic consumption has increased due to growing awareness of modern drugs. Antibiotic use is estimated to double by 2030 (Klein et al., 2018). A study in Switzerland indicated that Penicillin, Cephalosporin, and Carbapenem are the three most consumed antibiotic groups. Notably, in 2018, these antibiotics accounted for 68% of the total antibiotics consumed (Barnsteiner et al., 2021). Antibiotic resistance (AMR) occurs when bacteria develop the mechanisms to neutralize antibiotics, enabling these pathogens to persist and proliferate despite intended treatment (Sitotaw & Philipos, 2023). The WHO has declared AMR one of the top 10 public health threats facing humanity (World Health Organization, 2021). AMR caused 4.95 million deaths in 2019 (Murray et al., 2022). AMR impacts not only health but also the

global economy. The World Bank has projected that up to 3.8% of the global gross domestic product (GDP) could be lost due to AMR by 2050 (World Health Organization, 2022). According to another cross-sectional study conducted from 2014 to 2021, the resistance rates of *Staphylococcus aureus* to azithromycin, erythromycin, and clindamycin were 82.28%, 82.82%, and 82.32%, respectively (An et al., 2024). This occurs due to the lack of knowledge, careless attitudes, and misguided beliefs within the community regarding antibiotics (Alnemri et al., 2016). This phenomenon is particularly evident in Vietnam, where surveys on antibiotic sales at retail drug establishments (in rural and urban areas of northern provinces) showed low awareness of antibiotics and AMR among pharmacists and the public, especially in rural areas. Most antibiotics were sold without a prescription: 88% (urban) and 91% (rural) (Ministry of Health, 2017).

Numerous studies examining knowledge, attitudes, and practices regarding antibiotics among the general population have been carried out in various countries (Awad & Aboud, 2015;

Karuniawati et al., 2021; Mouhieddine et al., 2015; Oh et al., 2011; Sampedro Restrepo et al., 2023). These studies have found that 37% to 73.5% of respondents possess a misconception that antibiotics are effective against viral infections (Karuniawati et al., 2021; Mouhieddine et al., 2015; Oh et al., 2011). Furthermore, over 37% of respondents admitted stopping their antibiotic treatment after their symptoms improved (Karuniawati et al., 2021; Sampedro Restrepo et al., 2023).

One of the main objectives of this research is to develop a series of activities aimed at increasing awareness, understanding, and appropriate behavior concerning antibiotics. Given that the government has launched nationwide awareness programs, assessing individuals' current knowledge, attitudes, and behaviors in Ho Chi Minh City (HCMC) regarding antibiotic use is crucial. This study may aid state management agencies and organizations in evaluating and reinforcing existing policies.

MATERIALS AND METHODS

Study design

A cross-sectional study using a convenience sampling method. It was conducted in HCMC, Vietnam, from April to May 2024.

Study participants and sample size

Study participants

The study targeted residents of HCMC who met specific inclusion and exclusion criteria. Participants must reside in HCMC, consent to participate in the study, be capable of reading and comprehending the survey questions, and be 18 years of age or older. Exclusion criteria include individuals (1) lacking communication ability, (2) diagnosed with psychiatric disorders, behavioral disorders, or intellectual impairment, and (3) who did not complete the survey questionnaire.

Sample size

The sample size was calculated using the following formula (Daniel, 1999):

$$n' = \frac{NZ^2 P(1 - P)}{d^2(N - 1) + Z^2 P(1 - P)}$$

In which: N = 8,899,866, the population figure of HCMC (as of June 1, 2023) (Department of Population and Family Planning, 2023); 95% confidence level ($Z_{\alpha/2} = 1.96$); P = 15%; d = 3% (Gravetter & Wallnau, 2017; World Health

Organization, 1998). Applying these values to the formula, we have:

$$n' = \frac{8,899,866 \times 1.96^2 \times 0.15(1-0.15)}{0.03^2 \times (8,899,866 - 1) + 1.96^2 \times 0.15(1-0.15)} = 545$$

Therefore, the minimum calculated sample size is 545 individuals residing in HCMC. Due to potential dropout based on exclusion criteria during the survey, an additional 10% is added to ensure an adequate sample size. The survey sample size was 600 individuals.

Data collection

Scale translation, validity, and reliability

The research team compiled questions and selected those appropriate to the cultural and social conditions in Vietnam to develop the English questionnaire (Karuniawati et al., 2021; Sampedro Restrepo et al., 2023; Sitotaw & Philipos, 2023). The research team then compared, reviewed, and refined the questionnaire to resolve discrepancies and address omissions during translation. Subsequently, the questionnaire was adjusted through a pilot survey of 100 participants, according to the selection criteria for the Vietnamese questionnaire. The pilot survey data were excluded from the final survey data.

Following the pilot survey, the research team employed Cronbach's alpha coefficient to assess the reliability of the questionnaire. The Cronbach's alpha coefficient analyzes the internal consistency of each section of the questionnaire. The questionnaire demonstrated high reliability, with Cronbach's alpha values ranging from 0.814 to 0.855 (Tsang et al., 2017; Ursachi et al., 2015). Additionally, the research team utilized Exploratory Factor Analysis (EFA) to examine correlations among many variables (questionnaire responses) and identify variables that loaded on multiple factors or were misclassified from their initial factors. The knowledge section of the questionnaire was divided into five sub-factors with a total variance extracted of 60.692% ($\geq 50\%$), the attitude section into two sub-factors with a total variance extracted of 59.135% ($\geq 50\%$), and the behavior section into two sub-factors with a total variance extracted of 58.133% ($\geq 50\%$), indicating the questionnaire structure was appropriate (Hooper, 2012). Furthermore, Confirmatory Factor Analysis (CFA) was used to validate the fit of the questionnaire structure with the existing model, and the results confirmed the appropriateness of the structure (Brown, 2015).

Procedure

The sampling process was conducted through direct surveys and online surveys. Researchers administered paper surveys for direct sampling at crowded locations such as schools, pharmacies, apartment complexes, coffee shops, parks, and more. The online surveys were created using Google Forms, which were distributed via URL links and posts on various social media platforms.

The objectives and methodology of the study were clearly outlined on the survey's main page. Before accessing the questionnaire, respondents had to confirm their willingness to participate voluntarily by agreeing to an informed consent form. They were notified of their right to withdraw from the study at any time and provided with the researchers' contact details for any questions or concerns. Those who agreed to participate were instructed to click the "accept" button and complete the questionnaire. All collected data were anonymized and processed according to a coding scheme. The personal information of the participants was kept confidential, encrypted, and utilized solely for research purposes. After removing 11 outliers as they were included in the exclusion criteria, the final sample size was 589.

Questionnaire

The questionnaire consists of 18 items assessing knowledge, 8 items assessing attitudes, and 8 items assessing practices (behaviors) related to antibiotic use. Knowledge was evaluated by assigning 1 point for each correct answer and 0 for incorrect or "do not know" responses, with a maximum score of 18. Attitudes were defined as participants' beliefs and perceptions regarding appropriate antibiotic use—for example, whether antibiotics should be taken for viral infections or discontinued once symptoms subside. Behaviors were defined as participants' actual actions in relation to antibiotic use, such as self-medication, using leftover antibiotics, or adherence to prescribed regimens. Both attitude and behavior items were scored using a 5-point Likert scale, where 1 indicated the least appropriate response, and 5 indicated the most appropriate response. The total score range for each domain was 8 to 40. The expected favorable responses were "Disagree" for inappropriate attitude statements and "Never" for inappropriate behaviors, and scores were assigned accordingly. This scoring approach allowed for the quantification and categorization of participants'

knowledge, attitudes, and behaviors toward antibiotic use.

The scores were then converted to a scale ranging from 0 (minimum score) to 100 (highest possible score) using the following formula (Higuera-Gutiérrez et al., 2020; World Health Organization, 1998):

$$\text{Total score (\%)} = \frac{\text{Observed score} - \text{Minimum possible score}}{\text{Maximum possible score} - \text{Minimum possible score}} \times 100$$

Total scores of < 50%, 50 - 70%, and > 70% were categorized as low, medium, and high levels of knowledge, attitude, and practice, respectively.

Data management and statistical analysis

Data management

Valid survey responses were entered and processed in Microsoft Excel 2016 for encoding. The research team will also utilize Microsoft Excel 2016 for statistical calculations and data filtering, and as a primary storage platform for study data. Subsequently, the data were exported to Statistical Package for the Social Sciences (SPSS) version 20.0 and AMOS version 20.0 for conducting statistical analyses and tests.

Statistical analysis

Descriptive analysis was carried out, and the results were organized in tables and figures that illustrate frequencies and percentages. This involves encoding and categorizing data, presenting frequency (n) and percentages (%) for categorical variables, and reporting mean values ± standard deviation (SD) for continuous variables. Due to the non-normal distribution of the data, the Mann-Whitney and Kruskal-Wallis tests were performed to compare differences in mean scores of knowledge, attitudes, and behaviors regarding antibiotic use among residents of HCMC in different groups with varying characteristics. Particularly, the Mann-Whitney test was used for independent variables with two groups (e.g., gender), while the Kruskal-Wallis test was used for independent variables with more than two groups (e.g., educational level).

Multiple linear regression analysis was used to determine the relationship between independent variables (general characteristics of survey participants) and dependent variables (antibiotic knowledge, attitudes, and behaviors). This analysis aims to identify whether and to what extent participant characteristics predict variation in antibiotic-related perceptions and behaviors.

Table I. Demographic Characteristics of Participants (N=589)

Demographic characteristics	n (%)	Demographic characteristics	n (%)
Age		Number of family members	
18-24	237 (40.24)	1-2	65 (11.04)
25-34	141 (23.94)	3-4	315 (53.48)
35-44	59 (10.02)	5-6	160 (27.16)
45-54	76 (12.90)	≥ 6	49 (8.32)
55-64	46 (7.81)	Monthly income (million VND)	
≥ 65	30 (5.09)	< 3	142 (24.11)
Mean ± SD	33.86 ± 14.74	3-<5	110 (18.68)
Gender		5-<10	132 (22.41)
Male	266 (45.16)	≥ 10	205 (34.80)
Female	323 (54.84)	Do you participate in health insurance?	
Levels of education		Yes	566 (96.10)
Below college	143 (24.28)	No	23 (3.90)
College and above	446 (75.72)	In the past year, have you used antibiotics?	
Marital status		Yes	442 (75.04)
Single	377 (64.01)	No	147 (24.96)
(Unmarried/Window/Divorced)	212 (35.99)	Who is the source of antibiotic information provided?	
Married		From Doctor/Pharmacist/Medical staff	488 (82.85)
Living area		From family members	43 (7.30)
Ho Chi Minh inner city ^a	394 (66.89)	From the internet	35 (5.94)
Ho Chi Minh suburbs ^b	195 (33.11)	Other:	23 (3.91)
Job			
University student	229 (38.88)		
Housewife/Retired/Unemployed	81 (13.75)		
Medical staff	78 (13.24)		
Workers	40 (6.79)		
Other:	161 (27.34)		

Notes: ^aHo Chi Minh inner city (Districts 1, 3, 4, 5, 6, 7, 8, 10, 11, Tan Binh, Tan Phu, Phu Nhuan, Binh Thanh, Go Vap);
^bHo Chi Minh suburbs (Districts 12, Binh Tan, Hoc Mon, Binh Chanh, Nha Be, Cu Chi, Thu Duc City).

Spearman's rank correlation coefficient was calculated to assess the correlations among knowledge, attitudes, and behaviors related to antibiotic usage among survey participants. p-value with a threshold of <.05 was considered statistically significant, indicating meaningful relationships between these variables.

Ethical considerations

This study was approved by the Committee of Pham Ngoc Thach University of Medicine, Ho Chi Minh City, Vietnam, and its council (No.1084/TĐHYKPNT-HĐĐĐ). After providing a clear explanation, the purpose of the study was clearly demonstrated in the consent form given to all participants during the survey.

RESULTS AND DISCUSSION

Five hundred and eighty-nine people participated in the survey, and the average age was 34.86 ± 14.74 (Table I). The majority of participants are female (54.84%), have a university degree or higher (75.72%), are single (64.01%), live in the inner city (66.89%), attend school (38.88%), number of family members from 3-4 members (53.48%), the income of 10 million or more (34.8%), participating in health insurance (96.1%), used antibiotics within the past one year (75.04%), had antibiotic information source from Doctor/Pharmacist/ Medical staff (82.85%). Most questions received correct response rates higher than 55%, except for "Antibiotics can be used to treat infections caused by viruses," which had the lowest correct response rate at 41.25%.

Table II. Knowledge of antibiotic use among people in HCMC

Knowledge	EIR	n (%)		
		Correct	Incorrect	Don't know
General awareness about antibiotics				
Amoxicillin is an antibiotic.	Yes	402 (68.25)	7 (1.19)	180 (30.56)
Augmentin is antibiotic.	Yes	325 (55.18)	18 (3.05)	246 (41.77)
Antibiotics can be used to treat infections due to viruses.	No	249 (42.28)	243 (41.25)	97 (16.47)
If antibiotics are taken less than the prescribed dose bacteria become less resistant to antibiotics.	No	144 (24.45)	332 (56.37)	113 (19.18)
Antibiotics can cause allergic reactions such as redness of the skin.	Yes	490 (83.19)	21 (3.57)	78 (13.24)
Knowledge about antibiotic use				
Antibiotics can reduce fever.	No	215 (36.50)	274 (46.52)	100 (16.98)
Antibiotics from other people may be taken.	No	66 (11.20)	461 (78.27)	62 (10.53)
If twice the prescribed dose is taken the effects of antibiotics are more rapid.	No	41 (6.96)	486 (82.51)	62 (10.53)
Antibiotics leftover can be used again if sick.	No	104 (17.66)	395 (67.06)	90 (15.28)
Knowledge about the role of antibiotics and antibiotic resistance				
Paracetamol is antibiotic.	No	90 (15.28)	410 (69.61)	89 (15.11)
Antibiotics are used to kill bacteria.	Yes	408 (69.27)	111 (18.85)	70 (11.88)
Antibiotic resistance means that bacteria would not be eradicated by antibiotics.	Yes	392 (66.55)	96 (16.30)	101 (17.15)
Knowledge about side effects of antibiotics				
If antibiotics are taken for a long time, bacteria become more resistant to antibiotics.	Yes	496 (79.63)	48 (8.15)	72 (12.22)
Antibiotics can kill good bacteria in the intestines.	Yes	379 (64.34)	55 (9.34)	155 (26.32)
Inappropriate use of antibiotics can cause more severe illness.	Yes	526 (89.30)	17 (2.89)	46 (7.81)
Knowledge about access and use of antibiotics				
Inappropriate use of antibiotics increases costs.	Yes	493 (83.70)	26 (4.41)	70 (11.89)
Antibiotics can be purchased at a pharmacy without a doctor's prescription.	No	293 (49.74)	246 (41.77)	50 (8.49)
The prescribed dose and duration of antibiotics can be terminated if the symptoms improve.	No	237 (40.24)	270 (45.84)	82 (13.92)

Notes: EIR: Expected Ideal Response.

Table III. Total Score of knowledge, attitude and behavior

	No. of Items	Range of Score	Total Score (%) (Mean ± SD)	Level (%)		
				Low (<50%)	Moderate (50-70%)	High (>70%)
Knowledge	18	0 - 100	66.03 ± 22.28	21.90	28.35	49.75
Attitude	8	0 - 100	69.51 ± 16.81	10.87	37.69	51.44
Behavior	8	0 - 100	76.42 ± 15.79	4.59	29.03	66.38

Regarding antibiotic usage, most questions regarding the correct usage of antibiotics received correct response rates higher than 67%, except for "Antibiotics can reduce fever," which had a relatively lower correct response rate of 46.52%. Regarding the role of antibiotics and awareness of antibiotic resistance and side effects, the correct response rates for these questions were relatively high, with rates exceeding 66% and 64%, respectively. Regarding attitudes towards

antibiotic use and its implications, "Using antibiotics irrationally increases treatment costs" received the highest correct response rate at 83.70% (Table II).

Regarding knowledge, nearly 50% of the population in Ho Chi Minh City has a high level of knowledge about antibiotic use. The attitude also has a comparable rate of 51.44%. The behavior exhibited the highest rate of high-level classification at 66.38% (Table III).

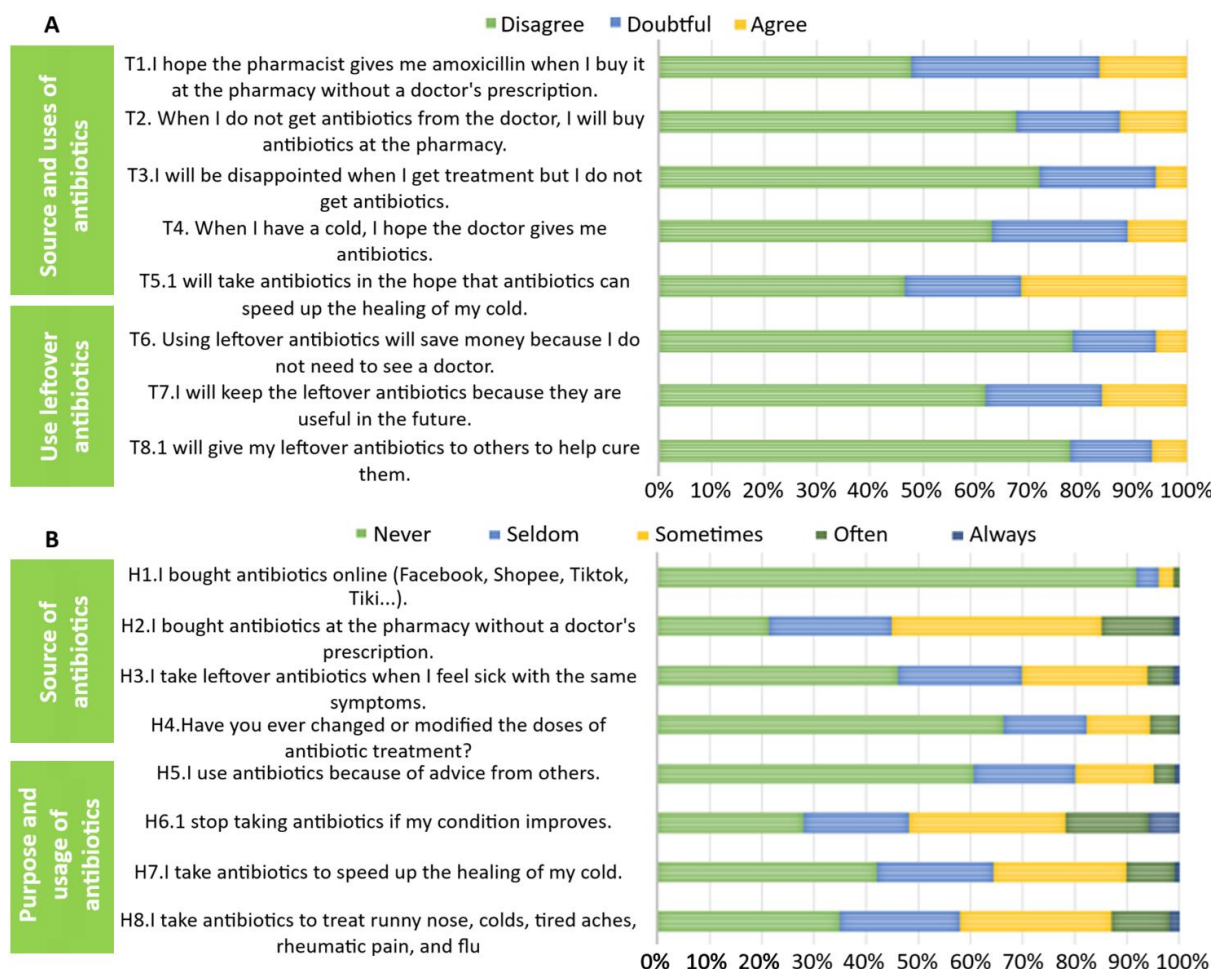


Figure I. The responses patterns of (A) attitude and (B) behaviour towards antibiotics

The disagreement rates were relatively high, exceeding 63% in most cases, except for T1 (hoping that the pharmacist will give amoxicillin when buying without a doctor's prescription) and T5 (taking antibiotics in the hope that it will speed up the healing of a cold), which had lower disagreement rates of 47.88% and 46.52%, respectively. Regarding leftover antibiotic usage, the disagreement rates were generally high, exceeding 61%. The "never" selection rate is relatively high, exceeding 46% in most cases, except for H2 (buying antibiotics without a doctor's prescription), which had a lower rate of 21.39%. Regarding antibiotic purpose and usage, the "never" selection rate is also relatively high, exceeding 41% in most cases, except for H6 (stop taking antibiotics if condition improves) and H8 (taking antibiotics to treat runny nose, colds, tired aches, rheumatic pain, and flu), which had

lower rates of 28.02% and 34.97%, respectively (Figure 1).

The average knowledge score is 66.03 ± 22.28 (Table III). Participants aged 18-24 scored significantly higher (68.86 ± 22.82) than other age groups ($p < 0.001$). Those with a university education or higher also scored notably higher (67.17 ± 22.59) than those with lower levels of education ($p = 0.010$). Individuals who are single (67.74 ± 22.55), living in urban areas of Ho Chi Minh City (67.09 ± 22.82), working in the healthcare sector (82.67 ± 14.40), earning less than 3 million VND (71.47 ± 21.64), and those who have used antibiotics in the past year (67.21 ± 21.63) also demonstrated the highest levels of knowledge (Table IV). The average attitude score is 69.51 ± 16.81 (Table III), with participants aged 25-34 showing significantly higher attitude scores (72.01 ± 15.73) than other age groups ($p = 0.019$).

Table IV. Association of demographic characteristics and knowledge, attitude, and behavior based on univariate analysis.

Demographic characteristics	n	Knowledge (%)		Attitude (%)		Behavior (%)	
		Mean ± SD	p - value	Mean ± SD	p - value	Mean ± SD	p - value
Age							
18 - 24	225	68.86 ± 22.82	<0.001*	69.75 ± 17.55	0.019*	75.33 ± 16.42	0.067
25 - 34	139	67.01 ± 23.17		72.01 ± 15.73		79.20 ± 14.47	
35 - 44	70	62.05 ± 20.99		68.39 ± 17.16		75.53 ± 16.71	
45 - 54	66	68.68 ± 20.03		70.78 ± 16.34		78.64 ± 16.13	
55 - 64	56	61.80 ± 21.24		66.62 ± 16.04		73.94 ± 15.32	
≥ 65	33	52.86 ± 17.07		62.03 ± 15.50		73.67 ± 13.59	
Gender							
Male	266	65.51 ± 22.80	0.661	69.15 ± 18.46	0.683	75.57 ± 16.73	0.414
Female	323	66.45 ± 21.85		69.81 ± 15.34		77.11 ± 14.97	
Levels of education							
Below college	143	62.47 ± 20.92	0.010*	66.49 ± 15.74	0.012*	76.47 ± 15.68	0.865
College and above	446	67.17 ± 22.59		70.47 ± 17.04		76.40 ± 15.84	
Marital status							
Single (Unmarried/ Widow/ Divorced)	377	67.74 ± 22.55	0.005*	70.39 ± 17.08	0.123	76.23 ± 15.70	0.772
Married	212	62.99 ± 21.48		67.96 ± 16.22		76.75 ± 15.99	
Living area							
Ho Chi Minh inner city	394	67.09 ± 22.82	0.028*	70.35 ± 16.94	0.142	76.89 ± 15.37	0.294
Ho Chi Minh suburbs	195	63.87 ± 21.00		67.80 ± 16.45		75.46 ± 16.61	
Job							
Student	229	69.35 ± 23.14	<0.001*	70.10 ± 14.43	0.017*	75.45 ± 16.49	0.001*
Housewife/Retired/ Unemployed	81	59.05 ± 18.56		64.97 ± 15.83		73.81 ± 14.61	
Medical staff	78	82.67 ± 14.40		73.08 ± 15.39		81.41 ± 14.30	
Workers	40	56.10 ± 21.85		66.88 ± 15.39		71.96 ± 16.00	
Other:	161	59.21 ± 20.59		69.88 ± 17.01		77.79 ± 15.41	
Number of family members							
1 - 2	65	69.14 ± 20.65	0.305	68.51 ± 18.49	0.954	75.43 ± 17.04	0.971
3 - 4	315	66.39 ± 22.11		69.70 ± 16.86		76.19 ± 16.04	
5 - 6	160	65.55 ± 22.85		69.29 ± 16.10		76.89 ± 15.21	
More than 6	49	61.10 ± 23.20		70.28 ± 16.80		77.62 ± 14.68	
Monthly income (million VND)							
<3	142	71.47 ± 21.64	<0.001*	70.93 ± 17.72	0.243	76.27 ± 16.15	0.276
3-< 5	110	61.66 ± 23.80		68.41 ± 16.00		74.29 ± 16.06	
5-<10	132	68.08 ± 20.69		67.52 ± 16.04		76.02 ± 16.72	
≥10	205	63.28 ± 22.06		70.39 ± 17.02		77.91 ± 14.71	
Do you participate in health insurance?							
Yes	566	66.36 ± 22.18	0.085	69.27 ± 16.93	0.056	76.32 ± 15.84	0.518
No	23	57.96 ± 23.37		75.27 ± 12.30		78.80 ± 14.51	
In the past year, have you used antibiotics?							
Yes	442	67.21 ± 21.63	0.047*	68.66 ± 16.61	0.046*	74.55 ± 15.28	<0.001*
No	147	62.47 ± 23.82		72.07 ± 17.19		82.01 ± 16.02	
Who is the source of antibiotic information provided?							
From Doctor/ Pharmacist/ Medical staff	488	66.99 ± 22.05	0.090	69.64 ± 16.87	0.285	76.41 ± 15.66	0.080
From family members	43	61.23 ± 19.68		66.20 ± 16.66		72.38 ± 14.47	
From the internet	35	65.55 ± 20.47		72.95 ± 16.46		78.57 ± 18.18	
Other:	23	55.30 ± 30.35		67.52 ± 15.85		80.84 ± 16.36	

Notes: p-value < 0.05

Table V. Linear regression models for knowledge, attitude, and practice domain

Demographic characteristics	Knowledge			Attitude			Behavior		
	β^a	SE ^b	<i>p</i> - value	β	SE	<i>p</i> - value	β	SE	<i>p</i> - value
Age	-0.026	0.016	0.103	-0.020	0.018	0.267	-0.021	0.021	0.310
Gender							0.677	0.417	0.105
Level education	0.222	0.473	0.639	0.870	0.624	0.164	-0.191	0.600	0.750
Marital status	0.082	0.463	0.858				0.367	0.593	0.536
Living area							-0.400	0.452	0.377
Job	-0.296	0.145	0.041*				0.051	0.184	0.782
Number of family members							0.209	0.274	0.445
Monthly income	0.024	0.198	0.902				0.195	0.250	0.434
Do you participate in health insurance?							0.590	1.062	0.579
In the past year, have you used antibiotics?	-0.653	0.389	0.094	1.043	0.510	0.041*	2.400	0.492	<0.001*
Antibiotic information sources are provided	-0.417	0.222	0.061				-0.055	0.281	0.845

Notes: ^a β : Regression coefficient; ^bSE: Standard error

Table VI. Correlation between Knowledge, Attitude, and behavior of Respondents towards Antibiotics

	Correlation coefficients	p-value
Knowledge - Attitude	0.356	<0.001*
Knowledge - Behavior	0.296	<0.001*
Attitude - Behavior	0.549	<0.001*

Those with higher education levels (70.47 ± 17.04), healthcare workers (73.08 ± 15.39), and individuals who have not used antibiotics in the past year (72.07 ± 17.19) also displayed the highest attitude scores (Table IV). The average behavior score is 76.42 ± 15.79 (Table III), with healthcare workers (81.41 ± 14.30) and individuals who did not use antibiotics in the past year (82.01 ± 16.02) exhibiting higher behavior scores than others (Table IV).

The linear regression analysis revealed three significant findings with profound implications: individuals' occupation significantly correlates with their knowledge of antibiotics, suggesting that different professions are associated with varying levels of antibiotic knowledge. Additionally, whether individuals have used antibiotics in the past year significantly correlates with both their attitudes and behaviors towards antibiotic usage. This indicates that past antibiotic use influences both how individuals perceive and use antibiotics in the future (Table V).

The Spearman correlation analysis results show significant positive correlations between knowledge - attitude (0.356), knowledge - behavior (0.296), and attitude - behavior (0.549) with $p < 0.001$ (Table VI).

Regarding antibiotic usage, a significant 49.75% of residents of Ho Chi Minh City (HCMC) exhibited high knowledge levels. However, there remains a misunderstanding among the population that "Antibiotics can be used to treat viral infections" (41.25%), a figure higher than that reported by Hidayah Karuniawati et al. (12.91%) and similar to findings from Joanne Sobeck et al. in the US in 2021 (43%) (Karuniawati et al., 2021; Sobeck et al., 2022). This suggests that residents may misconceive antibiotics as effective against viruses and bacteria or struggle to differentiate between bacterial and viral infections. Additionally, for the statement "Antibiotics are used to eradicate bacteria" (69.27%), the percentage is lower compared to Hidayah Karuniawati et al. (91.27%) (Karuniawati et al., 2021). This indicates a need for more understanding of the role of antibiotics among the surveyed population. Therefore, there is a critical need for further educational campaigns to enhance community knowledge about antibiotic usage and antibiotic resistance.

Regarding attitudes towards antibiotic usage, 51.44% of the population in HCMC exhibited high levels of positive attitudes. For the statement, "I use antibiotics hoping they will speed up the recovery from my cold," the percentage of those

who disagree is 46.52%, higher than the approximately 30% reported by Hidayah Karuniawati et al. (Karuniawati et al., 2021). Such low percentages may indicate that residents still misunderstand the role of antibiotics and are misusing them. A total of 66.38% of the population in HCMC demonstrates high levels of behavior related to antibiotic usage. However, a significant 21.39% still indicate that they never purchase antibiotics from pharmacies without a doctor's prescription, which is lower than similar studies in Indonesia (40%) (Karuniawati et al., 2021). This suggests a potential gap in the enforcement of existing pharmaceutical regulations. Regarding self-adjustment of antibiotic dosage during use and taking leftover antibiotics when feeling similar symptoms, the percentages of those who never engage in these behaviors are 66.39% and 46.18%, respectively. These results are consistent with findings in Colombia (60%) and Indonesia (45%) (Karuniawati et al., 2021; Sampedro Restrepo et al., 2023).

The average scores of antibiotic usage knowledge among different participant groups indicate significant differences based on age, education level, marital status, living area, occupation, income, and recent antibiotic usage within the past year in HCMC, showing a statistically significant relationship with antibiotic usage knowledge ($p < 0.05$). This suggests that these demographic factors influence people's understanding of antibiotic use in HCMC. In contrast, research conducted in Indonesia found associations between antibiotic knowledge and gender, living area, education level, and income ($p < 0.05$) (Karuniawati et al., 2021). This highlights regional differences in the factors influencing antibiotic knowledge in different countries. Regarding attitudes towards antibiotic usage, our study revealed significant differences based on age, education level, occupation, and recent antibiotic usage ($p < 0.05$). Similarly, research in Indonesia found associations with gender, living area, education level, and income ($p < 0.05$) (Karuniawati et al., 2021), indicating common factors influencing attitudes toward antibiotic usage across populations. When examining antibiotic usage behaviors, our findings indicate significant differences based on occupation and recent antibiotic usage ($p < 0.05$). This aligns with research from Indonesia, which also found associations with gender, age group, marital status, living area, education level, and income ($p < 0.05$) (Karuniawati et al., 2021), emphasizing the

multifaceted influences on antibiotic usage behaviors in diverse populations.

The Spearman correlation analysis results indicate significant positive correlations between knowledge and attitude (0.356), knowledge and behavior (0.296), and attitude and behavior (0.549) with a p-value of < 0.001 . This suggests that higher knowledge about antibiotic usage corresponds with more positive attitudes and behaviors toward antibiotic use among the surveyed population in HCMC. Additionally, Anant Nepal et al. (2019) reported correlations of 0.649, 0.428, and 0.370 with p-values < 0.001 (Nepal et al., 2019).

Notwithstanding the above-mentioned achievements, several limitations of this study should be acknowledged. First, our study primarily sampled individuals aged 18-24 and 25-34, comprising 61.8% of respondents, with an uneven distribution. Therefore, the research results may only partially generalize knowledge, attitudes, and behaviors regarding antibiotic use across the entire population of HCMC. Second, the sampling methods used in our study included both face-to-face and online approaches. The online format posed challenges for participants needing more assistance in clarifying the questionnaire content, potentially affecting their responses. Finally, the study's findings assess factors related to knowledge, attitudes, and behaviors regarding antibiotic use among the city's residents. However, it is important to note that these findings are incomplete, and policymakers and researchers may require additional information and data not covered or collected in this study for comprehensive decision-making and further investigations.

CONCLUSION

This study provides important insights into current knowledge, attitudes, and behaviors regarding antibiotic use and antibiotic resistance in Vietnam, highlighting gaps and misuse in antibiotic practices. The findings are not only valuable for policymakers but also for the general public, as they contribute to enhancing community awareness of antibiotic resistance and provide valuable information for individuals to make informed decisions about their health.

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CONFLICT OF INTEREST

The author reports no conflicts of interest in this work.

REFERENCES

- Alnemri, A. R., Almaghrabi, R. H., Alonazi, N., & Alfrayh, A. R. (2016). Misuse of antibiotic: A systemic review of Saudi published studies. *Curr Pediatr Res*, 20(1&2), 169-173. www.currentpediatrics.com.
- An, N. V., Hai, L. H. I., Luong, V. H., Vinh, N. T. H., Hoa, P. Q., Hung, L. V.,...Kien, H. T. (2024). Antimicrobial resistance patterns of *Staphylococcus aureus* isolated at a General Hospital in Vietnam between 2014 and 2021. *Infection and Drug Resistance*, 259-273. <https://doi.org/10.2147/IDR.S437920>. eCollection 2024.
- Awad, A. I., & Aboud, E. A. (2015). Knowledge, attitude and practice towards antibiotic use among the public in Kuwait. *PloS one*, 10(2), e0117910. <https://doi.org/10.1371/journal.pone.0117910>
- Barnsteiner, S., Baty, F., Albrich, W. C., Flury, B. B., Gasser, M., Plüss-Suard, C.,...Kohler, P. (2021). Antimicrobial resistance and antibiotic consumption in intensive care units, Switzerland, 2009 to 2018. *Eurosurveillance*, 26(46), 2001537. <https://doi.org/10.2807/1560-7917.ES.2021.26.46.2001537>
- Bentley, R., & Bennett, J. (2003). *What is an antibiotic? Revisited*. In: Laskin, AI Bennett, JW Gadd, GM.
- Brown, T. A. (2015). *Confirmatory factor analysis for applied research*. Guilford publications.
- Daniel, W. (1999). *Biostatistics: A Foundation for analysis in the health sciences*, 7th edR Wiley. *New York*, 141(2).
- Department of Population and Family Planning. (2023). *What is the total population of Ho Chi Minh City?* Retrieved 21/08 from <https://dansohcm.gov.vn/tin-chuyen-nghanh/12033/tong-dan-tp-hcm-hien-nay-bao-nhieu/>
- Gravetter, F., & Wallnau, L. (2017). *Statistics for The Behavioral Sciences 10th. Statistic for The Behavioral Science*.
- Higueta-Gutiérrez, L. F., Roncancio Villamil, G. E., & Jiménez Quiceno, J. N. (2020). Knowledge, attitude, and practice regarding antibiotic use and resistance among medical students in Colombia: A cross-sectional descriptive study. *BMC public health*, 20, 1-12. <https://doi.org/10.1186/s12889-020-09971-0>
- Hooper, D. (2012). Exploratory factor analysis. In: Chen, H. (Ed.). *Approaches to Quantitative Research – Theory and its Practical Application: A Guide to Dissertation Students*. Technological University Dublin.
- Karuniawati, H., Hassali, M. A. A., Suryawati, S., Ismail, W. I., Taufik, T., & Hossain, M. S. (2021). Assessment of knowledge, attitude, and practice of antibiotic use among the population of Boyolali, Indonesia: a cross-sectional study. *International journal of environmental research and public health*, 18(16), 8258. <https://doi.org/10.3390/ijerph18168258>
- Klein, E. Y., Van Boeckel, T. P., Martinez, E. M., Pant, S., Gandra, S., Levin, S. A.,...Laxminarayan, R. (2018). Global increase and geographic convergence in antibiotic consumption between 2000 and 2015. *Proceedings of the National Academy of Sciences*, 115(15), E3463-E3470. <https://doi.org/10.1073/pnas.171729511>
- Ministry of Health. (2015). *Instructions for using antibiotics*.
- Ministry of Health. (2017). *Decision No. 4041/QĐ-BYT dated September 7, 2017 of the Minister of Health on promulgating the Project to strengthen control of prescription and sale of prescription drugs for the period 2017-2020*. Ministry of Health
- Mouhieddine, T. H., Olleik, Z., Itani, M. M., Kawtharani, S., Nassar, H., Hassoun, R.,...Mortada, I. K. (2015). Assessing the Lebanese population for their knowledge, attitudes and practices of antibiotic usage. *Journal of infection and public health*, 8(1), 20-31. <https://doi.org/10.1016/j.jiph.2014.07.010>
- Murray, C. J., Ikuta, K. S., Sharara, F., Swetschinski, L., Aguilar, G. R., Gray, A.,...Wool, E. (2022). Global burden of bacterial antimicrobial resistance in 2019: a systematic analysis. *The Lancet*, 399(10325), 629-655. [https://doi.org/10.1016/S0140-6736\(21\)02724-0](https://doi.org/10.1016/S0140-6736(21)02724-0)

- Oh, A. L., Hassali, M. A., Al-Haddad, M. S., Sulaiman, S. A. S., Shafie, A. A., & Awaisu, A. (2011). Public knowledge and attitudes towards antibiotic usage: a cross-sectional study among the general public in the state of Penang, Malaysia. *The Journal of Infection in Developing Countries*, 5(05), 338-347. <https://doi.org/10.3855/jidc.1502>
- Sampedro Restrepo, M., González Gaviria, M., Arango Bolaños, S., & Higuera-Gutiérrez, L. F. (2023). Knowledge, attitude and practice regarding antibacterial and their resistance in Medellín-Colombia: a cross-sectional study. *Antibiotics*, 12(7), 1101. <https://doi.org/10.3390/antibiotics12071101>
- Sitotaw, B., & Philipos, W. (2023). Knowledge, Attitude, and Practices (KAP) on Antibiotic Use and Disposal Ways in Sidama Region, Ethiopia: A Community-Based Cross-Sectional Survey. *ScientificWorldJournal*, 2023, 8774634. <https://doi.org/10.1155/2023/8774634>
- Tsang, S., Royse, C. F., & Terkawi, A. S. (2017). Guidelines for developing, translating, and validating a questionnaire in perioperative and pain medicine. *Saudi journal of anaesthesia*, 11(Suppl 1), S80. <https://doi.org/10.4103/sja.SJA 203 17>
- Ursachi, G., Horodnic, I. A., & Zait, A. (2015). How reliable are measurement scales? External factors with indirect influence on reliability estimators. *Procedia Economics and Finance*, 20, 679-686. [https://doi.org/10.1016/S2212-5671\(15\)00123-9](https://doi.org/10.1016/S2212-5671(15)00123-9)
- World Health Organization. (1998). *Programme on mental health: WHOQOL user manual*. <https://iris.who.int/handle/10665/77932>
- World Health Organization. (2021). *Antimicrobial resistance*. World Health Organization. Retrieved August 21, 2023 from <https://www.who.int/en/news-room/fact-sheets/detail/antimicrobial-resistance>
- World Health Organization. (2022). *Global antimicrobial resistance and use surveillance system (GLASS) report: 2022*. <https://www.who.int/publications/i/item/9789240062702>