

CLINICAL REVIEW

Antibiotic Use and Resistance Awareness, Knowledge, and Attitude among Lebanese Population: A cross-sectional survey

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ABSTRACT

OBJECTIVE

This study aims to explore public knowledge, attitudes, and awareness of antibiotic use and resistance in Lebanon.

METHODS

A cross-sectional analysis was conducted among the entire provinces of Lebanon. Online surveys and face-to-face interviews were carried out by the researcher from October to December 2023.

RESULTS

The sample size was 457, most female 275 (60.2%). Almost all of the participants 435 (95.2%) used an antibiotic at least once in the past year, with self-medication 287 (62.8%) being the major source for antibiotic initiation, used mainly for the treatment of sore throat 208 (45.5%). 341 (74.6%) believed that antibiotics will always kill the same bacteria previously killed if used again. A multivariate logistic regression analysis revealed that age (p-value = 0.011), gender (p-value = 0.012), education level (p value= 0.000), and medical background (p value = 0.000) were significant.

CONCLUSION

The findings showed a lack of awareness and knowledge regarding the correct use of antibiotics and their resistance among the Lebanese population. This study revealed that younger age, female gender, and higher education along with medical background knowledge had a significant effect on awareness.

KEYWORDS

Antibiotic resistance (AR); Awareness; Knowledge; Over-use; Self-medication

ABBREVIATIONS

AR	:	Antibiotic resistance
AB	:	Antibiotic
WHO	:	World Health Organization
OTC	:	Over the counter
EARS-Net	:	The European Antimicrobial Resistance Surveillance Network
EU	:	European Union
ECDC	:	The European Centre for Disease Prevention and Control
SOB	:	Shortness of breath

INTRODUCTION

Antibiotic Resistance

Antibiotics are one of the most affordable, life-saving medications that also aid in the extension of people's lives. However, this therapeutic achievement is currently in jeopardy due to the notable rise in antibiotic resistance among prevalent bacterial infections, endangering the successful outcomes of critically ill patients [1]. In actuality, one of the three biggest threats to global health in the twenty-first century, according to the World Health Organization, is antibiotic resistance [2].

Antibiotic resistance (AR) is a state in which the bacteria evolve resistance to antibiotics used to treat the diseases they cause [3]. Bacteria can acquire the genetic information encoding resistance from other bacteria or undergo de novo gene mutations to develop resistance to antibiotics. The widespread use of antibiotics creates a selection pressure that allows bacteria with resistant genes to proliferate and thrive. AR is linked to several causes, such as inappropriate (over- or under-) antibiotic use -including self-medication [4]. The overuse of antibiotics is a major factor contributing to AR. The World Health Organization (WHO) defines rational medicine use as providing patients with the right drugs for the right indications at the right doses for their unique needs, for a reasonable amount of time, at the lowest possible cost to them and society. When one or more of these requirements are not met, the use of medications becomes irrational or unnecessary [5]. Self-medication, which is defined as using prescription drugs without a doctor's prescription or treating ailments according to advice from unqualified professionals [6], is the primary reason for AR, adding that it may increase the risk of experiencing uncontrollable side effects or drug reactions, misdiagnosing, and delaying receiving medical attention.

Impact of Resistance

The rapid spread of multi-resistant bacteria, which has been seen in multiple countries and for which there is now no therapy, is a particular cause for concern. The European Antimicrobial Resistance Surveillance Network (EARS-Net) data revealed notable regional variations in the percentage of resistance to different antibiotic classes [7]. The effects of AR on one's health and finances are dire. Currently, drug-resistant diseases cause 700,000 deaths worldwide annually. By 2050, it is predicted that there will be 10 million of them, and if nothing is done, the global costs could reach US \$100 trillion [8]. Approximately €1.5 billion is lost to society yearly as a result of the 25,000 people who pass away in the European Union (EU) alone each year from diseases brought on by multi-resistant bacteria. It is predicted that multi-resistance will cause cumulative losses of USD 2.9 trillion annually by 2050 [9].

Awareness

Research shows that even in wealthier nations, there is little public knowledge about AR, and that this problem is worse in low- and middle-income nations where the use of antibiotics without a prescription is common. This phenomenon leads to the necessity of public awareness promotion about AR [10]. There is constant evidence that nations with increased antibiotic usage also have higher rates of antibiotic resistance in common infections based on surveillance network data [7].

Some industrialized nations have started awareness-raising campaigns to combat AR globally, including the USA, Canada, Australia, and the majority of European nations. A few studies have also evaluated the public's understanding and awareness of augmented reality [11]. However, more data regarding public knowledge of AR in certain contexts is necessary to contextualize and maximize the effectiveness of interventions [12]. Individuals frequently have misconceptions and a limited grasp of AR. Many people think they have little to do with the development of AR and are unaware that bacteria, not people, are the ones that become resistant [13].

It is crucial to provide information at all levels - community, healthcare, and individual—to guarantee the prudent use of antibiotics and stop the spread of AR. Public education efforts should focus especially on the countries with the greatest rates of antibiotic resistance. The European Centre for Disease Prevention and Control (ECDC) has been organizing "European Antibiotic Awareness Day" since 2008. This program serves as a forum and source of assistance for national initiatives aimed at increasing public awareness of the responsible use of antibiotics [14].

Aim of the Study

There hasn't been much research on public knowledge of AR in Lebanon, where there is a diverse population with varying cultural approaches to illness treatment. Antibiotics in Lebanon can be bought without a prescription [15]. As a result, since they are freely available to the public through all pharmacies without a prescription, it is anticipated that antibiotic misuse will be widespread among Lebanese. Regarding the usage of antibiotics and antibiotic resistance in Lebanon's various socioeconomic areas, little is known regarding patients' awareness and knowledge. Consequently, the purpose of this study is to identify any relevant risk variables and investigate general public awareness, attitude, and knowledge regarding antibiotic use and resistance in Lebanon.

This is the first study of its kind that looked at people's awareness, attitudes, and knowledge regarding the use of antibiotics and AR in both affluent and impoverished communities. Thus, this study may be used as a starting point for future initiatives to encourage this population's appropriate usage of antibiotics.

METHODS

Study Design and Sample

This is a cross-sectional analysis conducted from October to December 2023 in Lebanon. The provinces covered included Mount Lebanon, Beirut, South, North, and Bekaa. The sample size collected was 457. The age of participants had to be above 18 years old to be included in the study, in addition to being able to read and/or understand information when said to them.

Data Collection

Sampling occurred through online surveys (a questionnaire was sent through WhatsApp, and emails) and face-to-face interviews (conducted within pharmacies dispersed over the entire country). From each province, 3

pharmacies were chosen, and covered by the researcher for 2 weeks. Oral consent was obtained prior to the interview, whereas the surveys provided online included a consent section before the filling of the survey.

With permission from the authors, the survey's design was based on a previously published and validated questionnaire about the general public's knowledge and awareness of the use of antibiotics and AR [16]. The questionnaire was altered to fit the objective of the study. The researcher was trained on the questionnaire and interview process by experienced investigators in the infectious field prior to their placement in pharmacies. Participants were informed of the study's objective before commencement. The questionnaire is composed of four main sections: demographic questions (age, gender, area of residency, educational level, medical background, and whether the participant has any chronic diseases), awareness assessment (times antibiotics were consumed, who advocated their use, reason, and length of their use), knowledge assessment questions (the effect of AB on some diseases, when to stop, and resistance factors), and attitude assessment questions (supply of antibiotics, duration of use, counseling, and solutions done when antibiotics do not provide the intended effect)

Ethical Consideration

Study approval Ethical approval was provided by the institutional review board of the Lebanese International University, School of Pharmacy, Lebanon (Ref: 2023RC-031-LIUSOP)

Statistical Analysis

Descriptive analysis –frequency- was used for the analysis of the qualitative data, whereas inferential analysis, mean and standard deviation (SD) were used for the quantitative data. Multivariable logistic analysis was used to detect the awareness, knowledge, and attitude of the participants with the significant value having a p-value less than 0.05 and a confidence interval of 95% or more. SPSS version 25 was used for the analysis. The dependent variables were those relating to the knowledge of antibiotic use, whereas the independent variables were the remaining questions. the 5-Likert scale was used to assess the attitude of the participants. Predictors were assessed against 2 main questions “Antibiotics treat coughs and colds” for antibiotic use, and “Antibiotics will always kill the same bacteria previously killed if used again” to detect knowledge about resistance. This is based on a similar study conducted by Abdel-Qader et al., in Jordan [17].

RESULTS

Of the 250 questionnaires sent online, 174 responded (69.6% response rate). Moreover, of the 300 approached participants at the pharmacies, 283 responded (94.33% response rate). The total sample is then 457. Table 1 represents the demographic characteristics of the participants. The participants' mean age was 43 years \pm 1.19. Most of the participants were female 275 (60.2%), residing in Mount Lebanon 212 (46.4%), with 167 (36.5%) holding a bachelor's degree as their highest earned education. Of which 334 (73.1%) had no medical background. And 225 (49.2%) are living with a chronic medical condition.

Table 2 targets the assessment of the participants, where it was seen in the awareness assessment that in the past year almost all of the participants 435 (95.2%) used an antibiotic at least once. It was shown that self-medication 287 (62.8%) was the major source of antibiotic initiation. Most of the participants stated that they stopped the course of treatment when their symptoms improved by 290 (63.5%). The use of antibiotics was mainly for the treatment of sore throat 208 (45.5%) and common cold 130 (28.4%). In the knowledge assessment, it was shown that most of the participants 305 (66.7%) believed that antibiotics are effective against viral infections, 446 (97.6%) against bacterial infections, and 117 (38.7%) against fungal infections. In addition 314 (68.7%) of the

participants stated that antibiotics work on cough and cold, and 317 (69.4%) believed that antibiotics increase the speed of recovery from cold. Furthermore, a huge portion of 341 (74.6%) believed that antibiotics will always kill the same bacteria previously killed if used again. Adding to that most of the participants 306 (67%) did not know that antibiotics also kill bacteria that normally live in the skin and gut. 216 (47.3%) believed that brand antibiotics have a superior effect over generic ones. 309 (67.6%) of the participants denied the idea of stopping the antibiotics immediately without consulting a doctor or pharmacist in case they experienced side effects (such as nausea, and diarrhea), unlike those 312 (68.3%) who stated that the medication should be directly stopped if allergic reactions (rash, and shortness of breath) were experienced. Furthermore, half of the participants 230 (50.3%) knew that overuse of antibiotics is the most important reason for the resistance of bacteria. 152 (33.3%) thought that incomplete antibiotic courses cause resistance. Finally, almost half of the participants 223 (48.8%) acknowledged the fact that resistance occurs when bacteria evolves and decreases/eliminates the effect of antibiotics. Regarding the attitude assessment, the answers were submitted using a 5-Likert scale. Most of the participants 302 (66.1%) stated that they do not complete the course of treatment with antibiotics when they feel better and that 225 (49.3%) prefer having access to antibiotics without seeking medical advice. Also, 258 (56.5%) preferred having antibiotics as an OTC medication. Pharmacists were believed to be well knowledgeable and able to provide the appropriate antibiotic treatment by almost all of the participants 371 (81.2%). Adding to that, 235 (51.4%) preferred to store antibiotics for future use. 203 (44.4%) and 256 (56%) stated that they directly use antibiotics to treat sore throat and fever respectively.

Age (years)	Range	73-18
	18-30	138 (30.2%)
	31-40	96 (21%)
	41-50	92 (20.1%)
	More than 50	131 (28.7%)
Gender	Female	275 (60.2%)
	Male	182 (39.8%)
Area of Residency	Mount Lebanon	212 (46.4%)
	Beirut	88 (19.3%)
	North	80 (17.5%)
	South	60 (13.1%)
	Bekaa	17 (3.7%)
Educational Level	Intermediate or less	86 (18.8%)
	High school	146 (31.9%)
	Bachelor	167 (36.5%)
	Masters	53 (11.6%)
	PhD	5 (1.1%)
Medical Background	No	334 (73.1%)
Chronic disease	Yes	225 (49.2%)
	No	232 (50.8%)

Table 1: Participants Demographics (n = 457).

Figure 1 represents the awareness of participants in three categories: True, false, and don't know. More than half of the participants were unsure that antibiotic resistance is increasing 262 (57.4%), similarly, 302 (66.1%) believed that taking antibiotics regularly does not contribute to resistance. 186 (40.7%) stated that resistant bacteria can spread from one person to another and 248 (54.3%) admitted that resistant bacteria is harder to treat. The majority of the participants 346 (75.7%) mentioned that antibiotics are OTC products, and can hence be sold without prescription. Moreover, 337 (73.7%) were unaware that people can stop or decrease the resistance.

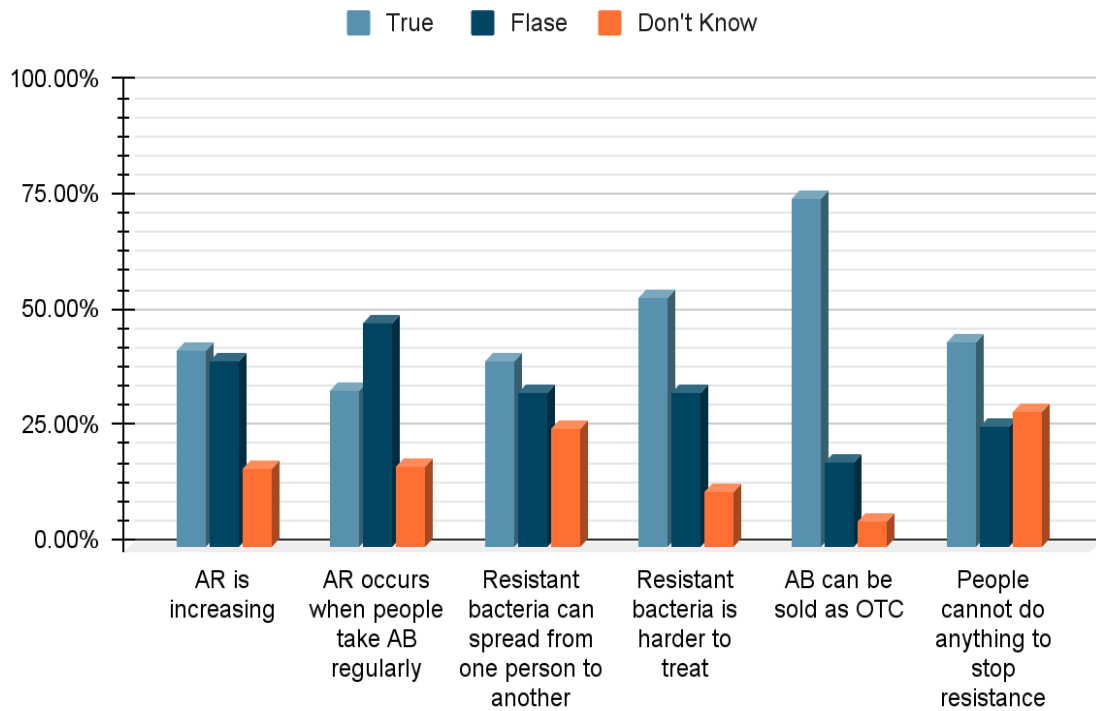


Figure 1: Participants' Awareness. Patient's awareness is measured against a series of questions about the nature of resistance.

Figure 2 shows the different solutions stated by the participants if the antibiotic does not produce the desired effect after a couple of days. More than half of the participants agreed that they would refer to the advice of pharmacist/doctor 253 (55.4%), followed by those who prefer to directly change to a different antibiotic 198 (43.3%).

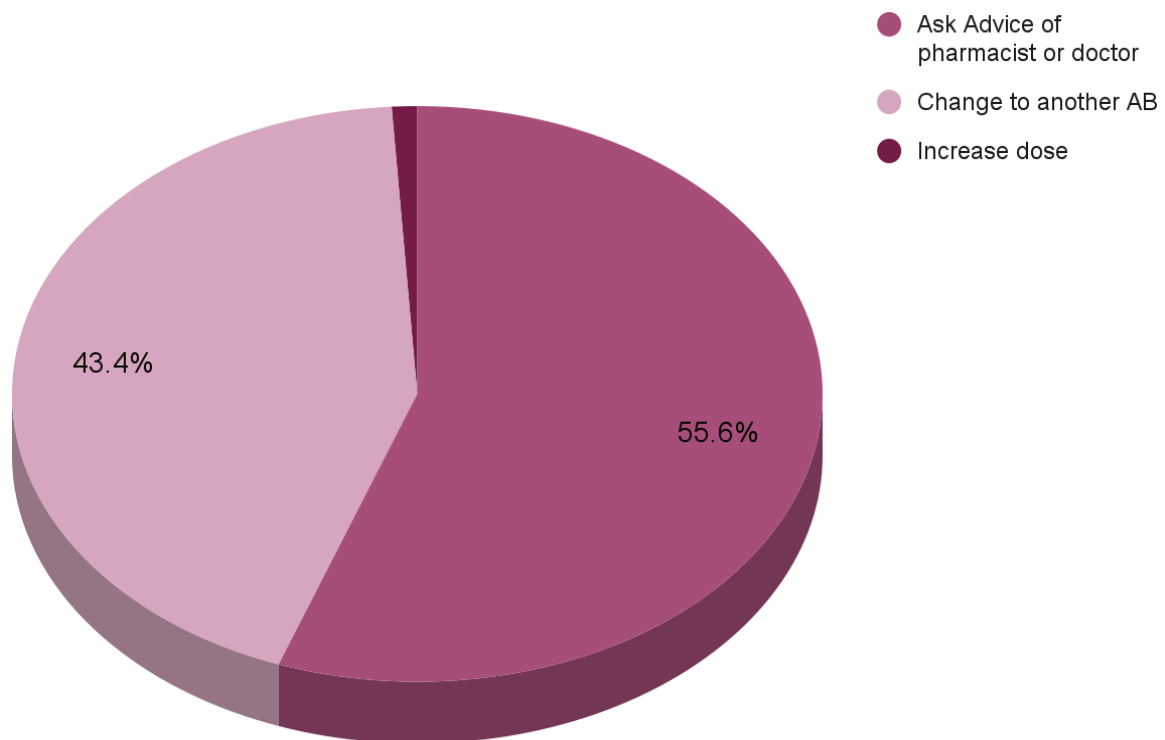


Figure 2: Solutions when the Antibiotic does not work. This figure shows the solutions adapted by the participants whenever the antibiotic used does not provide the desired effect within 72 hours of use.

Awareness Score					
Times ABs were consumed in the past year	None	22 (4.8%)			
	Once	141 (30.9%)			
	Twice	180 (39.4%)			
	Three or more	114 (24.9%)			
Who advocated the use of ABs	Self-Medication	287 (62.8%)			
	Physician Prescription	106 (23.2%)			
	Pharmacist counseling	64 (14%)			
AB length of use	Until symptoms improve, then stop	290 (63.5%)			
	Until the course ended	162 (35.4%)			
	If no improvement in the initial couple of days, I stop	5 (1.1%)			
Reasons for AB use	Sore throat with fever	208 (45.5%)			
	Common cold	130 (28.4%)			
	Infectious disease	108 (23.6%)			
	Cough	8 (1.8%)			
	Stuffy nose	3 (0.7%)			
Knowledge Score		Yes	No		
AB can be used to treat viral infections		305 (66.7%)	152 (33.3%)		
AB can be used to treat bacterial infections		446 (97.6%)	11 (2.4%)		
AB can be used to treat fungal infections		117 (38.7%)	280 (61.3%)		
AB treats cough and cold		314 (66.7%)	143 (31.3%)		
AB helps recover faster from cold		317 (69.4%)	140 (30.6%)		
AB will always kill the same bacteria previously killed if used again		341 (74.6%)	116 (25.4%)		
AB also kills the normal flora living on the skin and in the gut		151 (33%)	306 (67%)		
Brand AB is more effective than generic ones		216 (47.3%)	241 (52.7%)		
Experiencing side effects (Nausea, Diarrhea...) require direct stopping of AB		148 (32.4%)	309 (67.6%)		
Experiencing allergic reactions (Rash, SOB...) require direct stopping of AB		312 (68.3%)	145 (31.7%)		
Overuse of AB causes resistance		230 (50.3%)	227 (49.7%)		
Uncompleted AB course causes resistance		152 (33.3%)	305 (56.7%)		
		223 (48.8%)	234 (51.2%)		
Resistance occurs when bacteria evolves and decreases or eliminates the effect of AB	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Attitude Score	134 (29.3%)	149 (32.6%)	19 (4.2%)	60 (13.1%)	95 (20.8%)
I prefer having access to AB without seeking medical advice	101 (22.1%)	65 (14.2%)	66 (14.4%)	93 (20.4%)	132 (28.9%)
I prefer having AB as an OTC medication	73 (16%)	43 (9.4%)	83 (18.2%)	122 (26.7%)	136 (29.8%)
Pharmacists are well knowledgeable and able to provide the appropriate AB treatment	10 (2.2%)	17 (3.7%)	59 (12.9%)	262 (57.3%)	109 (23.9%)
I prefer to store leftover AB for future use	56 (12.3%)	74 (16.2%)	92 (20.1%)	113 (24.7%)	122 (26.7%)
I directly treat sore throat with AB	83 (18.2%)	136 (29.8%)	35 (7.7%)	92 (20.1%)	111 (24.3%)
I directly treat fever with AB	78 (17.1%)	55 (12%)	68 (14.9%)	144 (31.5%)	112 (24.5%)

Table 2: Assessment of Participants (n = 457).

Table 3 represents the multivariate logistics regression analysis of the participants' independent characteristics about their knowledge and awareness of antibiotic use and resistance. The analysis revealed that age (p value= 0.011), gender (p value= 0.012), education level (p value= 0.000), and medical background (p value= 0.000) were significant towards the knowledge and awareness of antibiotic use and resistance with odds ratio (95% confidence interval) of 1.573 (1.151-10.752), 0.459 (0.210-0.811), 5.198 (0.240-34.171), and 0.044 (0.028-1.21) respectively.

Characteristics	β (SE)	OR (95% CI)	P-value
Age	0.48 (0.179)	1.573 (1.151-10.752)	0.011*
Gender	-0.778 (0.389)	0.459 (0.210-0.811)	0.012*
Area of residency	-0.308 (0.193)	0.735 (0.054-1.399)	0.111
Education Level	1.648 (0.290)	5.198 (0.240-34.171)	0.000*
Medical Background	-3.128 (0.377)	0.044 (0.028-1.21)	0.000*
Chronic disease	0.561 (0.4)	2.530 (0.495-2.478)	0.052

Table 3: Multivariate logistics regression analysis.

DISCUSSION

A study conducted in two hospitals in Lebanon showed that resistance was 53.7% of which 39.9% were of multidrug resistance and 13.8% for extreme drug resistance [18]. The findings of this study showed a lack of awareness and knowledge regarding the correct use of antibiotics and their resistance among the Lebanese population in Lebanon. Where most of the participants 68.7% believed that antibiotics can be used to treat cough and cold, and 74.6% believed that the antibiotic will always kill the same bacteria previously killed if used again. This is similar to another study conducted in Kuwait where roughly half of those in Kuwait knew very little about the use of antibiotics and AR [19]. This shows that antibiotic-related public knowledge, attitudes, and beliefs have a major role in the irrational use of antibiotics. Raising awareness of antibiotic use and resistance among Lebanese communities is necessary.

This study revealed that age, gender, and education had a significant effect on awareness. Whereas the younger age showed an increase in the lack of knowledge. Adding to the female gender showed more tendency to use antibiotics for the wrong indication. Finally, education and medical background also showed significance, where educated people and those with medical backgrounds showed more awareness of the use and knowledge of antibiotics. These findings are similar to another Polish study conducted by Mazinska et al., [20]. Additionally, compared to other age groups, this younger age group was shown to self-medicate more. This demonstrates the importance of antibiotic awareness campaigns and education initiatives for boosting public awareness and averting health issues.

Almost all of our participants consumed antibiotics in the past year. This result is much higher than another study done in Norway where 30% of Norwegians used antibiotics in the previous year [21]. More than half of the participants 62.8% relied on self-medication. These findings are comparable to other studies such as China 45.4% [22], Addis Ababa [23] at 25.4%, Saudi Arabia 63.6% [24], and in the UK and Chile, 75%. The main causes of self-treatment were found to be low levels of education, the prevalence of symptoms from prior experiences, and the availability of the medication at home.

According to a contentious theory, there is currently insufficient concrete scientific data to support the claim that quitting an antibiotic before the end of its prescribed course will raise the likelihood of bacterial resistance [25]. These findings showed that 63.5% of the participants stopped the antibiotics when symptoms improved. This is similar to another study done among Saudi people that stated that 71.1% stopped taking antibiotics when they felt better [24], and 38% in Bangladesh responded the same [26].

In this study, 68.7% of the participants thought that antibiotics treat cough and cold. This is similar to a study conducted in Jordan where over two-thirds of Jordanians [17] believed the same. This results in detrimental behaviors and an unsuitable mindset toward the use of antibiotics.

This study showed that only 42.6% of our participants acknowledged that AR is increasing. This is higher than a study done in Italy, where just 9.8% of the general public correctly recognized AR [27]. The majority of the participants 67% were unaware that antibiotics also kill native bacteria found.

Half of the participants 50.3% believed that overuse of antibiotics causes resistance, which is opposite to a study done in Britain. According to Khoshgoftar et al. [28], the idea that antibiotics are safe medications leads to their widespread misuse.

Almost all of the participants 75.5% believed that antibiotics are OTC products and can be bought without prescription. This is similar to a study that found that 88% and 91%, respectively, of antibiotics sold in rural and urban areas were not prescribed [29]. A study carried out in the Portuguese Algarve region revealed that 7.5% of the 1198 respondents thought it was easy to buy antibiotics without a prescription [30]. In Lebanon, antibiotics can be bought without prescriptions [15].

More than half of our participants stated that they store antibiotics for future use, this is similar to the results of a Bangladesh study where 32.5% [26] kept antibiotics for later use, and 44.7% in Saudi Arabia [24]. Avoiding antibiotic leftovers from previous antibiotic regimens may be a workable way to stop antibiotic self-medication. This can be achieved by educating patients about the importance of throwing away any unused medication or by implementing technological solutions such as encouraging the delivery of the exact quantity of tablets.

Fifty-Six percent of the participants stated that they directly treat the presence of fever with antibiotics. This is similar to additional research done in Bangladesh [26], over 42.0% of respondents use antibiotics for fever. Fever is just the body's natural reaction, unrelated to an infection. This demonstrates that fever is a key factor utilized by people to gauge the severity of their illnesses, and that fever is treated with antibiotics.

Limitations of the study included having most of the participants residing in Mount Lebanon province, however, this is the largest province present in Lebanon. The total sample was 457 which is an acceptable number to provide generalizability to the entire Lebanese population.

CONCLUSION

In conclusion, the study revealed that the Lebanese population showed a lack of knowledge and awareness of antibiotic use and resistance. It was shown that younger age, female gender, and higher education along with medical background knowledge had a significant effect on awareness. Hence, the irrational use of antibiotics is significantly influenced by public knowledge, attitudes, and beliefs about antibiotics. There is a need to educate Lebanese populations about antibiotic use and resistance. This highlights the significance of education programs and campaigns raising public knowledge about antibiotics to prevent health problems. The belief that antibiotics are safe, their availability without prescription in Lebanon, and the mentality of storing them for future use increases the chance of their self-medication and over-use.

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Conflict of Interest

The author declares that there is no conflict of interest.

Data Availability Statement

The data underlying this article will be shared on reasonable request to the corresponding author.

Ethical Consideration

Study approval Ethical approval was provided by the institutional review board of the Lebanese International University, School of Pharmacy, Lebanon (Ref: 2023RC-031-LIUSOP)

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