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Knowledge and attitude towards antibiotic use and resistance among Arab population: a questionnaire-based study of 11 countries from the Middle East and North Africa

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Abstract

Objectives: Antibiotic usage has evolved over the years among the Arab population, and it has also gone under misuse resulting in the development of antimicrobial resistance (AMR). Therefore, the current study aimed to address this issue by evaluating the level of knowledge and attitude of Arab population towards antibiotic usage and AMR to develop a pathway to reduce the risk of antibiotic resistance.

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Methods: A cross-sectional study was carried out among Arab population, including 11 countries from the Middle East and North Africa. A validated and translated questionnaire, consisting of 34 questions, was adopted to achieve the study objectives. Two phases of data collection (online and offline) were performed, and SPSS was used for data analysis.

Key findings: Three thousand three hundred and nineteen participants were successfully recruited, and the mean age was 37.6 ± 11.73. Approximately 63% of participants wrongly answered they should stop antibiotics when they feel better, and 73.3% of them thought antibiotics could treat cold and flu. Nearly half of the respondents indicated that they were uncertain of how antibiotic resistance affects the body (48.1%), and they were unaware if it could affect them or their families (63.1%). While the majority of the respondents were prescribed antibiotics by a doctor, over half of them were not given any advice on how to take them. Our data showed a significant relationship between respondents' demographic data (e.g. country, age and education) and their knowledge and attitude.

Conclusions: Participants had poor knowledge of antibiotics and AMR; thus, efforts are needed to conduct health campaigns in public places and create and implement programmes aiming to raise knowledge and awareness of people in the Arab regions. These could aid to curb the risk of antibiotic resistance and increase the chance of successful treatment for infectious diseases.

Keywords: antibiotics; antibiotic resistance; knowledge; attitude; Arab population

Introduction

Antibiotic use is a crucial issue in the health sector because despite the progression in developing effective antibiotics against different illnesses; this progress seems to be countered by antibiotic resistance.[1] Antibiotic resistance is a growing concern in the global health sector. It stems largely from the misuse of antibiotics, causing germs such as bacteria and fungi being resistant to the drugs designed to kill them. It is a global public health issue with an annual mortality rate of up to 1.27 million people worldwide.[2] The mechanism by which antibiotics work requires careful administration and management of the drug intake to ensure that it is consistent with the ailment being treated. This would ensure that the user of the antimicrobial recovers well from the ailment and does not develop any resistance towards the drug so that in the future, they might still be able to be treated by that drug.[3] Antibiotic resistance is fatal as infections would be unresponsive to the drugs designed to kill them, which would then call for alternative treatment methods which would be unavailable in most cases. Therefore, patients who develop antibiotic resistance place themselves at risk of not finding effective treatment in the future as the potency of the drugs is challenged by the built resistance.

Previous studies have explored the attitudes and knowledge which people have towards antibiotic use and resistance. The study by Nisabwe *et al.* (2021) was conducted among university students in Kenya, and the study reflected that these students within tertiary institutions had high levels of awareness towards the use of antibiotics.[4] However, their attitude towards antibiotics use and resistance was slightly influenced by a lack of knowledge of how resistance develops and its long-term repercussions. A similar study was undertaken among young Italian doctors by DiGenarro *et al.* (2020), and it reflected that high levels of knowledge on antibiotic use and resistance were related to the experience they gained in treating diseases, with attention to how patients with cases of antimicrobial resistance (AMR) responded to treatment.[5] Therefore, these studies show a common trend of the usage of antibiotics yet with limited knowledge of their functionality and any potential hazards of antibiotics misuse leading to resistance.

Several studies have been conducted in low-to-middle countries, and they have yielded a wide range of results. However, this study's novelty lies in the population of study in which the research is conducted. The study focuses on Arab countries, which bring in a new perspective on the knowledge and attitudes held towards antibiotics, due to the rising cases of AMR within this geographical area. Unlike other studies within this region, which have focussed on specific groups in their studies such as doctors, university students of farm owners and workers; this study focuses on the general population among these Arab populations. The inclusion of the general population in this study will be the novelty of this study as it seeks to highlight whether the knowledge and attitude towards antibiotics use and resistance is influenced by the demographic profile of the respondents and to what extent.

Despite the classification of antibiotics, it can be noted that the usage of antibiotics is still loosely regulated. It has been noted that people often manage to gain access to antibiotics that they have not been prescribed and use them as part of self-medication.[6] According to WHO report from 19 Arab countries, it is found that third-generation cephalosporin and fluoroquinolone resistance in *Escherichia coli* and *Klebsiella pneumoniae* was common with more than 50% of the strains being resistant across all countries.[7] This is probably because people in the Arab regions easily can easily get antibiotics from a friend or relative's treatment, discontinue their course of antibiotics as soon as they feel better or even acquire them from health facilities through unscrupulous means.[8] While these actions have proven to be detrimental in the long run, people still misuse antibiotics, which alludes to how people might have limited knowledge of the functionality of antibiotics.[9] People might have developed a negative attitude towards the usage of antibiotics, which makes them perceive that it might be proper to use them without knowledge of their full connotations.[10]

It is essential to probe into the knowledge and attitude towards the use and resistance of antibiotics among population in low-to-middle-income countries. There is evidence that among these populations, there are high rates of self-medication which results in the repetitive use of drugs without a medical prescription, especially antibiotics.[11–13] This happens when people can easily access the antibiotics while also not having sufficient information on the proper use and administration of this drug. As a result, one would get antibiotics and use them to treat themselves based on their own discretion instead of medical guidance. While these actions might offer temporary relief in the short-term; the long-term effects, such as antibiotic resistance, are detrimental to health and pose a threat to the progress in the health-delivery system.[14] Therefore, addressing this issue would call for a probe into people's knowledge and attitude towards antibiotics. This study aimed to evaluate the knowledge and attitude towards antibiotic use and resistance, and to determine the factors that significantly affect them among Arab population in the Middle East and North Africa.

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Methods

Study design and population

A questionnaire-based, cross-sectional study was carried out in 11 Arab countries in the Middle East and North Africa, including Iraq, Jordan, United Arab Emirates, Oman, Yemen, Lebanon, Saudi Arabia, Egypt, Tunisia, Algeria and Sudan. The rationale of selecting these countries as a sample of Arab population is because their societies have various cultures, habits and beliefs.[15] These varied cultures, habits and beliefs reflect in their choice and methods of treatments when they have ailments; with some preferring strict medical guidance and others exercising self-medication. Thus, a general insight into their people's knowledge and attitude towards antibiotics and antibiotic resistance can be formed. The inclusion criteria were Arab adults (≥18 years old) who have taken any kind of antibiotic before. People who were (a) working or studying in the medical field; (b) unwilling or hesitant to participate in this study and (c) unable to think, read and pay attention (based on the researchers' observation) were excluded from this study. Participants were recruited if they had known the meaning of antibiotic (i.e. to treat/cure bacterial infection) and have used at least one type of antibiotic. The Raosoft sample size calculator was used with a 5% error margin, a 95% confidence interval and a 50% expected response to calculate the required sample size in this study.[16] Thus, the minimum sample size estimated for the study was 385. However, 3319 participants were recruited to generalise the findings and reduce the risk of response bias.

Study instrument and translation

The survey instrument was developed based on previous literature in relation to antibiotic and antibiotic resistance.[17,18] Three researchers reviewed the questionnaire tool to evaluate the questions' appropriateness, relevancy, clarity and adequacy. The survey instrument consisted of 34 questions, including socio-demographic characteristics (six questions), knowledge about antibiotics (four items) and antibiotic resistance (eight items) making up a total of 12 items for knowledge, and attitude about antibiotics (seven questions). The original form of the survey was written in the English language. After that, a certified translator translated it into Arabic and put it through a backwards-to-forwards translation process. Translators who had sector-specific knowledge and experience in translating surveys where their mother tongues were Arabic, performed the forward translation. A second translator whose native language is English was brought in to translate the questionnaire back into the original language after the authors had received the first translation. The authors took steps to ensure that the back translator had no connection to the first translator, either professionally or personally. When the original questionnaire and the back-translated questionnaire were compared, reconciliation was carried out. Discrepancies were identified and categorised as either minor (such as wording issues) or significant such as grammatical errors, i.e. changes in the meaning of a question. Before they were finalised, the translations were double-checked by two experts for accuracy and meaning. The authors and the two translators met to resolve any differences and come to an agreement on the final version. After each question or concern was raised, one of the co-authors kept track of them. Twenty people took part in preliminary testing to ensure the content, design, readability and comprehension of the final version. The questionnaire was reworked to make it easier to understand and more accurate. The validity and reliability of the research were established by conducting a pilot study among 30 previously antibiotic consumers. Cronbach's α values were 0.85 and 0.92, respectively, for reliability and internal consistency in this study. As a result, the questionnaire's reliability and validity were both confirmed.

Data collection procedure

Data collection was performed in two phases as follows:

(a) In the first phase, questionnaire items were created as an online survey using the SurveyMonkey platformdue to Covid-19 movement restrictions from August 2021 to December 2021. The survey link was distributed among the target population using a nonprobability convenience sampling technique, which is a technique that includes all subjects that are available to be selected by a researcher to better represent the entire population.[19] Generalisation from a convenience sample to its population is usually possible when the sample was randomly drawn from that population as applicable in our study.[20] Besides, snowball sampling technique was also used to recruit the participants where they disseminated the survey link among the people they know. Social media apps like Facebook, Instagram and Twitter were used to send an official invitation to participate in the survey; as well, messaging applications like WhatsApp and Telegram were used to distribute the survey link. The introductory page of the online form included information about the study and a letter asking participants for their permission to participate. Participants received weekly reminders to complete the survey, and 2354 participants were successfully recruited from the first phase of data collection out of 3250 who were initially invited (response rate = 72.4%).

(b) Manual data collection was carried out to increase the response rate and access to people, especially in rural areas, who do not have an internet connection easily. The method of sampling was also nonprobability convenience sampling technique. Nine hundred sixty-five participants who fulfilled the inclusion criteria were invited and agreed to participate in the study out of 1500 (response rate = 64.3%). The researchers had explained to respondents about the goal and objective of this study. Besides, respondents were given a copy of the consent form explaining the study's aim and procedures. Respondents started to fill up the questionnaires after receiving their consent forms with signatures, and they were assured of confidentiality. Besides, researchers put a drop-off box at the study setting so that participants could return the completed survey once they had done it. Participants were notified about the location of the drop-off box when they agreed to participate in the study. This was done to ensure anonymity, and there was no prorated payment for respondents, and they had the option of accepting or rejecting the participation in the study based on their preferences. Data collection took place over approximately 3 months (February to April 2022) following an initial 1-month period of planning and field mapping. The questionnaire took an average of 10–15 minutes to be completed by the respondents.

Data analysis

The survey responses for all 3319 participants were collated in Microsoft Excel, and the data were analysed using SPSS. Results were presented in terms of frequency and percentage, with a 95% confidence interval assigned to determine the

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significance of the findings. Adapted from a previous study, a scoring system was used to evaluate the knowledge and attitudes of those polled about antibiotics.[17] One mark was given for a correct answer for each part of the questionnaire and a zero for an incorrect answer or for those who answered: 'I don't know'. Poor (0–5), fair (6–10) and good (11-12) were the three levels of knowledge cutoff scores. Positive and negative attitudes were scored from 0 to 4, and 5 to 7, respectively. The attitude score was computed as a continuous variable by summing the respondent's responses to six statements. For each correct answer ('yes' for a positive attitude and 'no' for a negative attitude), a point '1' was given, and a point '0' was given for each incorrect or uncertain answer, with a maximum correct score of 6 available to each respondent. The chi-square test was used for inferential statistical analysis to assess the relationship between the dependent variables (level of knowledge and attitude) and the independent variables (demographic characteristics).

Key Findings

Socio-demographic characteristics of respondents

The study explored the socio-demographic characteristics of the respondents, and the mean age of the respondents was 37.6 ± 11.73. Most of the participants were from Iraq (13.9%), Saudi Arabia (11.8%) and Oman (10.6%). Male respondents (55.9%) were more than female (44.1%), and their ethnicity was predominantly of Arab descent (82.9%), as shown in Table 1.

Table 1 Socio-demographic characteristics of respondents (*n* = 3319)

Characteristics		Frequency (%)
Country	Iraq	461 (13.9)
	Saudi Arabia	394 (11.8)
	Oman	354 (10.6)
	Tunisia	341 (10.3)
	Algeria	322 (9.7)
	Egypt	319 (9.6)
	Yemen	282 (8.5)
	Jordan	257 (7.7)
	Sudan	237 (7.3)
	Lebanon	207 (6.2)
	UAE	145 (4.4)
Gender	Male	1854 (55.9)
	Female	1465 (44.1)
Age (mean ± SD = 37.6 ± 11.73)	18–39 years (young adult)	1493 (44.9)
	40–59 years (middle adults)	1064 (32.1)
	≥60 years (older adult-elderly)	762 (23.0)
Ethnicity	Arab	2751 (82.9)
	Others	568 (17.1)
Educational level	Uneducated	254 (7.7)
	Primary	481 (14.5)
	Secondary	949 (28.5)
	Tertiary	1635 (49.3)
Marital status	Single	1326 (39.9)
	Married	1695 (51.2)
	Others	298 (8.9)

Knowledge of respondents about antibiotics use

The respondents indicated limited knowledge about the best time to discontinue antibiotics usage, with only over a quarter of the respondents providing the correct answer (26.4%). Additionally, the respondents mainly displayed uncertainty on whether they should acquire antibiotics that were given to a family member (69.3%) and whether they could repeat antibiotics that previously helped them when they were sick before (54.2%).

In addition, the participants were asked whether they knew which diseases which are curable using antibiotics and which are not. They either gave the incorrect answer or they do not know whether diseases such as HIV/AIDS, Cold and flu, body aches and headache are curable by antibiotics (Table 2). This reflects limited knowledge and a high level of uncertainty about which illnesses might be properly treated by antibiotics, paving the way for the misuse and eventual resistance towards these drugs.

Furthermore, this study queried the participants' knowledge about antibiotic resistance, revealing their knowledge sources in Figure 1. Most of the participants heard of the term 'antibiotic resistance' from their pharmacist (30%), followed by their doctor/nurse (24%) and from the internet (22%).

Knowledge of respondents about antibiotics resistance

Nearly half of the respondents indicated that they were uncertain of how antibiotic resistance affects the body (48.1%) and how many infections are becoming increasingly resistant to antibiotics over time (66.0%). The respondents also indicated that while they might perceive misuse of antibiotics as improper, they are uncertain if it can affect them or their family (63.1%) and are uncertain if it is a global issue (60.1%) as shown in Table 3. These findings are reflective of the limited information which people might have towards the AMR.

Moreover, when participants were asked about the actions required to address the problem of antibiotic resistance (Table 3), they agreed that pharmaceutical companies should develop new antibiotics (47.6%), and people should wash their hands regularly and parents should ensure that their children's vaccinations are up to date. However, they showed uncertainty on whether people should take antibiotics only when prescribed by a doctor (53.8%), whether doctors should only prescribe antibiotics as needed (52.7%) and whether farmers should give antibiotics to food-producing animals (58.5%).

The attitude of respondents towards antibiotics

The attitude of the respondents towards antibiotics was measured, and the results are displayed in Table 4. While the majority of the respondents were prescribed the antibiotics by a doctor (65.9%); over half of them were not given any advice on how they should take the drugs (55.9%) though they indicated that they would have required it (54.8%). While the major source of getting antibiotics was shown to be from the hospital with a prescription (47.6%); there are respondents who accessed the antibiotics from a pharmacy without a prescription (10.5%).

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Table 2 Participants' knowledge about antibiotics (n = 3319)

Question	Responses; n (%)		
When do you think you should STOP taking antibiotics once you've begun treatment?	When you feel better	When you've taken all antibiotics as directed[a]	I don't know
	2095(63.1)	870(26.2)	354(10.7)
Statement	True	False [a]	I don't know
'It's OK to use antibiotics that were given to a friend or family member, as long as they were used to treat the same illness'	540(16.3)	479(14.4)	2300(69.3)
'It's OK to buy the same antibiotics, or request from a doctor, if you're sick since they have helped you get better when you had the same symptoms BEFORE'	768(23.2)	751(22.6)	1800(54.2)
	Responses; n (%)		
Question	Yes	No	Don't know
Do you think these conditions can be treated with antibiotics?			
a) HIV/AIDS	1034 (31.2)	1300 (39.2)[a]	985 (29.6)
b) Gonorrhoea	1588 (47.8)[a]	800 (24.1)	931 (28.1)
c) Bladder infection or urinary tract infection (UTI)	752 (22.6)[a]	472 (14.2)	2095 (63.2)
d) Diarrhoea alone	983 (29.6)	916 (27.6)[a]	1420 (42.8)
e) Cold and flu	1315 (39.6)	875 (26.3)[a]	1129 (34.1)
f) Body aches	675 (20.3)	951 (28.7)[a]	1693 (51.0)
g) Headache	2076 (62.5)	743 (22.4)[a]	500 (15.1)

[a]Correct option

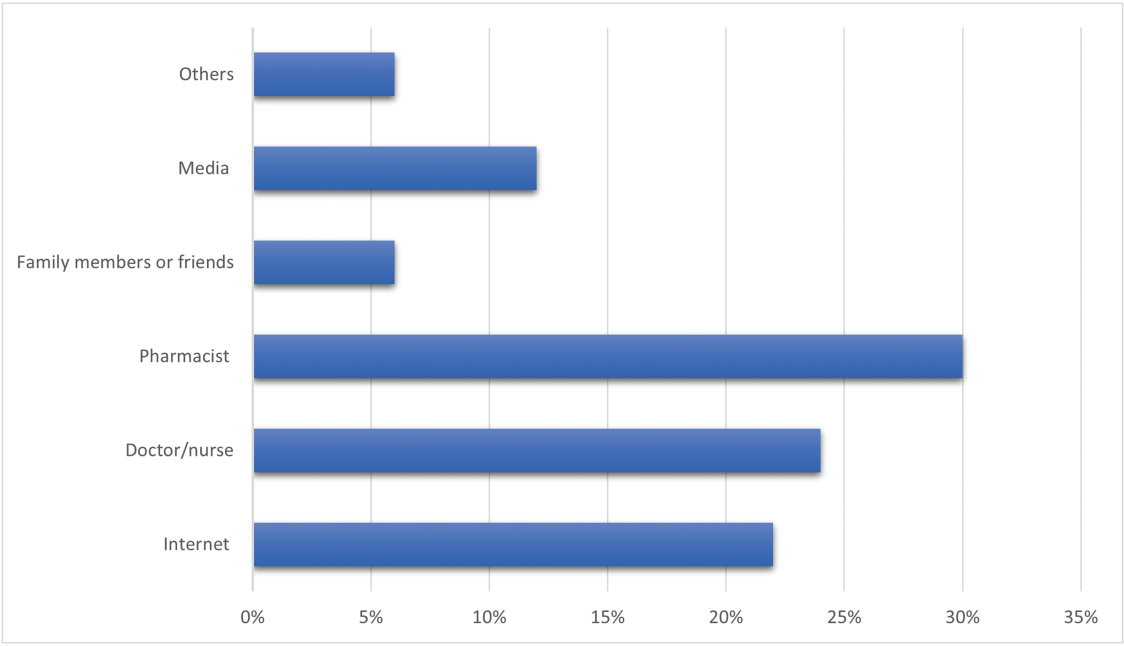

Figure 1 Sources of knowledge about antibiotics.

Association between socio-demographic characteristics with the level of knowledge and attitude of respondents about antibiotics and AMR

The association between socio-demographic characteristics and the level of knowledge and attitude of respondents about antibiotics and antibiotic resistance was tested, and the results are given in Table 5. There is a significant relationship between one's country of origin and their knowledge or attitude towards antibiotics and AMR (P = <0.0001). Ethnicity has also showed a statistically significant relationship with participants' level of knowledge and attitude (P = 0.04). Moreover, a significant relationship exists between gender and knowledge and attitude towards antibiotics and AMR. While there is a significant association between age and knowledge, there is also an association between age and attitude.

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Table 3 Participants knowledge about antibiotic resistance (n = 3319)

Statement	Responses; n(%)		
	Yes	No	I don't know
Antibiotic resistance occurs when your body becomes resistant to antibiotics and they no longer work as well	920 (27.7)	804 (24.2)	1595 (48.1)
Many infections are becoming increasingly resistant to treatment by antibiotics.	780 (23.5)	350 (10.5)	2189 (66.0)
If bacteria are resistant to antibiotics, it can be very difficult or impossible to treat the infection they cause	1000 (30.1)	1860 (56.0)	459 (13.9)
Antibiotic resistance could affect me or my family	724 (21.8)	500 (15.1)	2095 (63.1)
Antibiotic resistance is currently a global issue	750 (22.6)	574 (17.3)	1995 (60.1)
Antibiotic resistance is only a problem for people who take antibiotic regularly	1892 (57.0)	390 (11.8)	1037 (31.2)
Bacteria which are resistant to antibiotics can spread from person to person.	2045 (61.6)	418 (12.6)	956 (25.8)
Antibiotic-resistant infection could make medical procedures like surgery, organ transplant and cancer treatment much more dangerous.	817 (24.6)	850 (25.6)	1652 (49.8)

Discussion

The inappropriate use of antibiotics among members of the Arab community has developed over time, which has contributed to an increase in the number of instances of AMR despite the limited amount of corrective action taken to address this worldwide health concern. An examination of the public's views of antibiotic usage and AMR is required as a necessary step in the process of formulating a plan for addressing this problem. Thus, the current study is the first of its kind to be carried out internationally in multi-Arab countries aiming to determine the knowledge and attitude towards antibiotic use and resistance to develop a pathway to solve this problem.

Our findings showed that participants had poor knowledge of antibiotic use, where most of them still wrongly believed that antibiotics could be used to treat minor illnesses such as headaches, body aches and cold/flu. This is as a result of how antibiotics are being used by more and more people as a kind of self-medication for illnesses like the common cold and the flu. This trend has reached epidemic proportions in today's culture. Antibiotics are not the appropriate treatment for viral illnesses like colds and the flu; rather, other types of medicine, such as antivirals or anti-inflammatory drugs, should be used. It is possible that this may provide some short-term comfort; nonetheless, this would be an inappropriate strategy.[14] Some individuals have been making inappropriate use of antibiotics for a variety of reasons, the most common of which is a lack of awareness about the implications of their conduct. When they are feeling under the weather, a sizeable percentage of individuals may self-medicate with antibiotics, even in the absence of any appropriate medical supervision or standard operating procedure. This irrational use of antibiotics has been one of the main accelerators of the development of AMR in the Arab community.[21] This is supported by studies that have found that there is an irrational use of antibiotics in the Arabic-speaking community, citing low levels of knowledge and limited collaboration between patients and healthcare providers as one of the main drivers of this behaviour.[22, 23]

In addition, it is essential to probe into the source from which these people access the antibiotics that they often misuse. This study finds that only a few people get antibiotics from a doctor or qualified health personnel through a proper prescription. A possible reason for this is the majority of individuals have been able to get antibiotics from a third party, which would most likely be a leftover supply from an incomplete treatment course or from a pharmacy without a prescription, as these antibiotics have been obtained by these persons. This highlights the views in the study of Abood *et al.* (2018) that over-the-counter medication sales can have negative effects on medication administration if they are not strictly regulated, as evidenced by how people can get antibiotics without a prescription.[24] Moreover, our findings reported that apart from doctors, nurses, pharmacists and other authorised healthcare officials, people also access information about antibiotic resistance from the internet and the media along with their friends and relatives. While it is imminent that the sources of information continue to expand, this is a concern as it leads to the spread of incomplete or even wrong information. There are several cases where there is information in the media that incorrectly describes how the medication works, particularly antibiotics.[25] As a consequence of this, individuals may stumble across this information and believe it; this is particularly true when it is provided in an enticing way that persuades people that they are being rightly directed. These notions are consistent with the study of Schifano *et al.* (2021) and Marathe *et al.* (2020), which questions the role of third-party service and information providers in supporting global healthcare policies.[25, 26] It can be argued that third-party service and information providers have countered the progress in the medical field by either providing the wrong information or providing a gateway to misuse of medication.[27]

Despite the role of third-party service and information providers interfering with public health policies, the current study showed that there are instances when the doctors or nurses issuing prescriptions of antibiotics do not provide comprehensive guidance on how to take these drugs, which leads to the regular misuse of these drugs. Given this, it is clear that medical professionals need to improve the amount of work they put into teaching their patients about the correct manner to take antibiotics.[28] This will guarantee that the patients are appropriately treated for their condition and that they will not engage in behaviours that contribute to the development of AMR, such as stopping treatment in the middle of the process or accepting a prescription written for someone else. While this is reflective of how healthcare personnel is responsible for the administration of drugs, it contrasts with the study of Ali *et al.* (2020), which states that once patients gain access to the medication, they hold the responsibility for their

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Table 4 Attitude of participants towards antibiotics (n = 3319)

Question	Response; n (%)				
When did you LAST take antibiotics?	In the last 30 days	In the last 6 months	In the last 1 year		
	2003 (60.3)	875 (26.4)	441 (13.3)		
On that occasion, did you get the antibiotics (or a prescription) from a doctor?	Yes	No	I can't remember		
	2186 (65.9)	384 (11.6)	549 (22.5)		
On that occasion, did you get advice from a doctor, nurse, or pharmacist on how to take them?	Yes	No	I can't remember		
	616 (18.5)	720 (55.9)	850 (25.6)		
When a doctor prescribes antibiotics for you, do you want to receive more information on precautionary measures while taking antibiotics?	Yes	No			
	1820 (54.8)	366 (45.2)			
On that occasion, where did you get the antibiotics?	Hospital or clinic	Pharmacy shop WITH prescription	Pharmacy shop WITHOUT prescription	Use remaining antibiotic from previous infection	Others
	800 (24.1)	1580 (47.6)	350 (10.5)	200 (6.0)	389 (11.8)
Do you prefer to consult a doctor that has declared to use antibiotics responsibly?	Yes	No	I don't know		
	2000 (60.3)	560 (16.9)	759 (22.8)		
When a doctor decided based upon your initial assessment that antibiotic is NOT needed at the moment, would you accept if the doctor tells you to observe for few more days or wait for the diagnostic test's result before deciding whether to prescribe antibiotics or not?	Yes (Accept)	No (Not Accept)	I don't know		
	2108 (63.5)	1211 (36.5)	-		

usage.[28] This is also in alignment with the studies of Hoppe *et al.* (2020) and Campbell *et al.* (2019), which question the role of pharmaceutical companies and the government in regulating the usage of antibiotics and the ultimate prevention of AMR by countering its accelerators.[29, 30]

There is a general misconception of which conditions are curable using antibiotics and which ones are not which is a possible accelerator of antibiotic misuse. While it is expected that individuals may not have comprehensive information about medical conditions and treatments; there are fundamental concepts that one must understand.[31] For instance, the fact that antibiotics are ineffective against the common cold and flu should be common knowledge by now. Antibiotics are not an effective treatment for conditions such as body pains and headaches, thus treating them with antibiotics is not recommended. Antibiotics are not effective in treating HIV/AIDS, which is important information for people to have as it is one of the most frequent diseases. Therefore, this reflects the low level of knowledge which is held regarding the usage of antibiotics; which is consistent with the findings of Chanvatik *et al.* (2019), Attah *et al.* (2020) and Khalid *et al.* (2021), which documented that there is vast wrong information on which diseases are curable by antibiotics and which ones are not.[32–34] Collectively, these studies reflect how essential it is for awareness of disease treatment and control to be accelerated to reverse this detrimental behaviour chain.

Apart from the misconception of the conditions treatable by antibiotics, there are also low levels of knowledge regarding AMR and the health complications which stem from it. A probable reason for this is that, even though some individuals may be conversant with the idea, it is clear that the effect of AMR is widely misunderstood and is also thought to be treatable. Despite this, it is clear that AMR exists. It seems that the majority of people are unaware of the fact that a person who has acquired AMR is at an increased risk of developing an illness such as cancer or undergoing surgery in which the administration of antibiotics is essential for their recovery. On the other hand, since they have AMR, the therapy will not work for them. This goes hand in hand with the mistaken belief that AMR is only found in people who take antibiotics on a regular basis. However, this has been largely disproven as there have been cases of people who have developed AMR after developing it after taking fewer than five instances of antibiotics.[35] These findings support the views expressed in the study of Hunter (2020), Meerza *et al.* (2021) and Knudsen and Kishik (2022) that one of the reasons why AMR is still on the rise is that some people still regard it as an abstract concept from which they are the exception.[36–38] With this attitude, the people would fail to have a sense of urgency in correcting their improper use of antibiotics as they would not anticipate any negative consequences befalling them.

This brings to light the imminent issue of an unfinished course of antibiotics. This study finds that some people discontinue the usage of antibiotics as soon as they begin to feel better and recover from their illness. Unfinished antibiotic treatment courses are one of the key causes of AMR. They would also give the foundation on which one may share with a third party their leftover medications, which perpetuates the cycle of antibiotic abuse. AMR is one of the major sources of AMR. This brings to light the findings of Davis *et al.* (2020), Broom *et al.* (2021) and Hawkins *et al.* (2022), which highlight that there is a need to monitor patients who have been prescribed drugs to ensure that they complete their course

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Table 5 Association between respondents' demographic and their knowledge and attitude scores towards antibiotic and antibiotic resistance (n = 3319)

Variables	Level of knowledge Respondents (%)				Attitude score Respondents (%)		
	Poor	Fair	Good	*X2^; P*	Positive Attitude	*Negative Attitude*	*X2^; P*
Country	1851 (55.8)	975 (29.4)	493 (14.8)	8.571; <0.001*	1962 (59.1)	1357 (40.9)	<0.001*; 6.413;
Gender	1659 (49.9)	919 (27.8)	741 (22.3)	6.714; 0.02*	2153 (64.9)	1166 (35.1)	7.512; 0.003*
Age	1622 (48.9)	904 (27.2)	793 (23.9)	12.695; <0.001*	1788 (53.9)	1531 (46.1)	4.641; <0.001*
Ethnicity	2187 (65.9)	804 (24.2)	328 (9.9)	10.142; 0.04*	1637 (49.3)	1682 (50.7)	13.236; 0.04*
Education level	1468 (44.2)	1381 (41.6)	470 (14.2)	18.623; <0.001*	1915 (57.7)	1404 (42.3)	14.162; <0.001*

*Value is significant <0.05.
^ Chi square test

of treatment. These researchers found that there is a need to monitor patients who have been prescribed drugs to ensure that they complete their course of treatment.[39–41] While the methods of control may vary at times they might be unavailable, and it can be emphasised that adhering to treatment protocols is beneficial for both present and futuristic health conditions.

Limitations of Study

A larger and consistent sample size from each country would be necessary for the study to gain more information about the variables which affect the users and the rationale behind their usage, which is determined by their knowledge and attitude. This study's limitations stem from its inability to obtain a sufficiently representative sample of the Arab population to draw valid conclusions about antibiotic use among this group. Some restrictions are placed on the research because of how it was conducted. Due to the quantitative nature of the research, the variables included in this study were those that were available in the survey database, since there may have been more linked factors that were not quantified in the survey and should be included in future research. Nonetheless, this study demonstrates the value of evaluating a database comprised a broad representative sample of individuals from several Arab nations by taking into consideration the homogeneity of their population. However, a qualitative research would go farther than any quantitative survey in capturing the nuanced experiences of antibiotic patients, and further studies might consider determining the differences in the level of knowledge and attitude compared to their sociodemographic characteristics.

Conclusion

Participants reported having limited knowledge and a negative attitude towards antibiotic use and resistance. Thus, healthcare personnel should provide patients with comprehensive information on the proper administration and intake of antibiotics. Paired with these efforts to educate patients on proper antibiotic usage, there should also be tighter controls regarding the administration of antibiotics, including extensive evaluation of whether a case can be treated only with antibiotics or not; and reducing the cases of using antibiotics unnecessarily. Additionally, local governments are required to spread awareness about AMR by setting up educational campaigns and following WHO recommendation by ensuring a robust national action plan to tackle antibiotic resistance is in place and regulate and promote the appropriate use and disposal of quality medicines. Thus, they should exercise their discretions cautiously. This shift in knowledge and attitude levels would be essential in moulding actions in alignment with proper drug administration and usage, thus reducing the mounting cases of AMR within the Arab region. Raising awareness of AMR via education and information distribution to stakeholders is central to the WHO Global Action Plan for influencing behaviour change. AMR can be reduced through a multi-pronged strategy that emphasises both efficiency and economy. This strategy should focus on optimising antibiotic use, bolstering surveillance and infection prevention and control, and enhancing education about the appropriate use of antibiotics. This can be done by making antibiotic resistance a central part of healthcare workers' education and training.

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Author Contributions

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Ethical Statement

This study protocol was reviewed and approved by Ethics Committee of Al Rafidain University College, Iraq (EC-70-2021). All procedures performed in this study were in accordance with the ethical standards of the institutional research committee and with the 1964 Helsinki Declaration and its later amendments or comparable ethical standards.

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Consent to Participate

Informed consent was obtained from all individual participants in the study.

Consent to Publish

Participants signed informed consent regarding publishing their de-identified data.

Conflict of Interest

The authors declare that there is no any financial and non-financial competing in relation to the current work.

Data Availability

Data and other materials are available upon request from the corresponding author.

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