

Evaluation of antimicrobial resistance awareness and related factors among university students in health-related departments



Sağlıkla ilgili bölümlerdeki üniversite öğrencileri arasında antimikrobiyal direnç farkındalığı ve ilişkili faktörlerin değerlendirilmesi

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Abstract

Antimicrobial resistance is an important public health threat. The aim of the study was to evaluate antimicrobial resistance awareness and associated factors among university students studying in health-related departments. The study was a cross-sectional study conducted in university students studying in health-related departments at Bilecik Şeyh Edebali University. The questionnaire used in the study included sociodemographic characteristics of the students, statements about antimicrobial resistance awareness, factors that may be related with antimicrobial resistance awareness, and the sources they heard about antibiotic or antimicrobial resistance. Chi-square test and multiple logistic regression analysis were used to analyze the data. In the study group, 20.1% of the students had adequate antibiotic knowledge and 19.6% had an appropriate antibiotic use attitude. Of the students 88.1% had inadequate antimicrobial resistance awareness. In multiple logistic regression analysis, the frequency of adequate antimicrobial resistance awareness OR (95% Confidence Interval) was 5.86 (2.69-12.75) times higher in students studying at the Faculty of Medicine than in students studying at the Vocational School of Health Services, and 2.90 (1.69-4.97) times higher in students with adequate antibiotic knowledge than in students with inadequate antibiotic knowledge. In the study, antimicrobial resistance awareness was inadequate in the majority of the students. The fact that antimicrobial resistance awareness was higher in students with adequate antibiotic knowledge and in those studying at faculties that provide more detailed and intensive health information indicates that professional training on rational antimicrobial use may be useful in raising awareness.

Keywords: Antimicrobial resistance, awareness, university students, health-related departments

Özet

Antimikrobiyal direnç önemli bir halk sağlığı tehdididir. Çalışmada sağlıkla ilgili bölümlerde öğrenim gören üniversite öğrencilerinde antimikrobiyal direnç farkındalığı ve ilişkili faktörlerin değerlendirilmesi amaçlandı. Çalışma, Bilecik Şeyh Edebali Üniversitesinde sağlıkla ilgili bölümlerde öğrenim gören öğrencilerde gerçekleştirilen kesitsel tipte bir araştırmadır. Çalışmada kullanılan anket form bireylerin sosyodemografik özellikleri, antimikrobiyal direnç farkındalığı ile ilgili önermeleri, antimikrobiyal direnç farkındalığı ile ilişkili olabilecek faktörleri ve antibiyotik ya da antimikrobiyal direnci duydukları kaynakları içermekteydi. Verilerin analizinde kıkare testi ve çoklu lojistik regresyon analizi kullanıldı. Çalışma grubundaki öğrencilerin %20,1'inin antibiyotik bilgi düzeyi yeterli olup, %19,6'sı uygun antibiyotik kullanma tutumuna sahipti. Öğrencilerden %88,1'inin antimikrobiyal direnç farkındalığı yetersizdi. Çoklu lojistik regresyon analizinde yeterli antimikrobiyal direnç farkındalığı sıklığı OR (%95 Güven Aralığı) Tıp Fakültesinde öğrenim görenlerde Sağlık Hizmetleri Meslek Yüksekokulunda öğrenim görenlerden 5,86 (2,69-12,75), antibiyotik bilgi düzeyi yeterli olanlarda yetersiz olanlardan 2,90 (1,69-4,97) kat daha fazla idi. Çalışmada öğrencilerin çoğunluğunda antimikrobiyal direnç farkındalığı yetersizdi. Antibiyotik bilgi düzeyi yeterli olanlarda ve daha detaylı, yoğun sağlık bilgisi alan fakültelerde öğrenim görenlerde antimikrobiyal direnç farkındalığının daha yüksek olması akılcı antimikrobiyal kullanımı ile ilgili verilecek profesyonel eğitimlerin farkındalığı artırmada faydalı olabileceğini göstermektedir.

Anahtar Kelimeler: Antimikrobiyal direnç, farkındalık, üniversite öğrencileri, sağlıkla ilgili bölümler

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Introduction

Antimicrobial resistance is the development of resistance in microorganisms against an antimicrobial drug to which they were previously susceptible (1). Misuse and overuse of antimicrobial drugs, lack of awareness of the magnitude of antimicrobial resistance, lack of strong antimicrobial resistance surveillance systems and inadequate infection prevention and control programs are among the main factors in the global increase in antimicrobial resistance (2). Antibiotic resistance, which is included in antimicrobial resistance, is more worrying due to the rapid development of resistance to many new antibiotics used to treat bacterial infections (3, 4). Historically, the development and use of each new antibiotic has been followed by the emergence of resistant strains. The decline in the discovery of new antibiotics, the decreasing efficacy of existing antibiotics, the misuse of these antibiotics, and inadequate access to drugs where resources are limited have made antimicrobial resistance an important problem (3). The lack of effective antimicrobials for the prevention and treatment of infections makes medical procedures such as organ transplantation, cancer chemotherapy, diabetes management and major surgeries very high risk (2).

Antimicrobial resistance is a growing global health and development threat throughout the world. World Health Organization (WHO) reported that antimicrobial resistance is one of the top 10 global public health threats facing humanity (5). Antimicrobial resistance is one of the leading causes of death worldwide and is reported to be responsible for approximately 1.27 million deaths and associated with 4.95 million deaths in 2019 (6). Antimicrobial resistance also burdens the global economy with economic losses due to

decreased productivity caused by disease and higher treatment costs. According to World Bank estimates, it is estimated that antimicrobial resistance may lead to an additional healthcare cost of USD 0.33 to 1.2 trillion globally by 2050 and a gross domestic product loss of USD 1 trillion to 3.4 trillion per year by 2030 (7).

Healthcare professionals have an important role in maintaining the potency of antimicrobial drugs. Inadequacies in hygiene and infection prevention and control in hospitals lead to the spread of resistant infections. In addition, reasons such as healthcare professionals' lack of up-to-date knowledge, inability to identify the type of infection, submission to patient pressure to prescribe antibiotics, and fear of possible future complications in their patients may lead to misuse and overuse of these drugs (8, 9). Since misuse and overuse of antimicrobial drugs by individuals is one of the main reasons for the development of antimicrobial resistance (2), information and health education given to patients by healthcare professionals may encourage rational antimicrobial use by patients. In fact, the WHO Global Action Plan on Antimicrobial Resistance recommends raising awareness about antimicrobial resistance through effective communication, education and training as the first goal. It is recommended that antimicrobial resistance be made a core component of continuing education and development in health sectors and agricultural practices (8). In this context, it is important to determine the level of antimicrobial resistance awareness in future healthcare professionals in order to make recommendations for the pre-graduation education and training curricula of healthcare professionals.

The aim of the study was to evaluate antimicrobial resistance awareness and related factors among students studying in health-related departments (faculty of

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medicine, faculty of health sciences, vocational school of health services) at Bilecik Şeyh Edebali University.

Material and Method

The study is a cross-sectional study conducted in university students studying in health-related departments (Faculty of Medicine, Faculty of Health Sciences, Vocational School of Health Services) at Bilecik Şeyh Edebali University during the 2023-2024 academic year. Ethical approval from Bilecik Şeyh Edebali University Non-Interventional Clinical Research Ethics Committee (date February 23, 2023, number 3) and necessary administrative permissions were obtained. The study was supported by Bilecik Şeyh Edebali University Scientific Research Projects (Project number 2023-01.BŞEÜ.33-05).

In the study, the sample size was calculated as at least 384 students, assuming an antimicrobial resistance awareness frequency of 50%, a margin of error of 5%, and a confidence interval of 95%. During the implementation phase of the questionnaire, students studying at the Vocational School of Health Services and students in the first three years of their education at the Faculties of Medicine and Health Sciences were informed about the subject and purpose of the study, and the link address of the digitized questionnaire form was sent as a message to the student Whatsapp groups. Students who agreed to participate in the study were expected to fill in the questionnaire forms online by themselves. The study group consisted of 662 students aged 18 and over.

In accordance with the aim of the study, a questionnaire form was prepared by utilizing the literature (9-13). The questionnaire form included sociodemographic characteristics of the participants, statements related to antimicrobial resistance awareness, sources of hearing about antibiotics or antimicrobial resistance, and factors that may be related to antimicrobial resistance awareness (antibiotic use attitudes, antibiotic knowledge statements). In the study, antibiotic knowledge level was evaluated with nine five-point Likert-type statements. After the reverse coding of negative statements, those who received

at least 36 ($\geq 80\%$) out of the maximum possible score of 45 were categorized as having adequate knowledge level, while those with a total score of <36 ($<80\%$) were classified as having inadequate knowledge level. When evaluating the statements about antibiotic use, not stopping the use of antibiotics when feeling better, not keeping leftover antibiotics from a treatment thinking that they would be useful later, and not using leftover antibiotics in case of flu or cold without consulting a doctor were accepted as appropriate antibiotic use attitudes. The statements related to antimicrobial resistance awareness were evaluated with 13 five-point Likert-type items ranging from 1-strongly disagree to 5-strongly agree. The total Cronbach's alpha value of the items was 0.80, and in the total score obtained after reverse coding of negative items, those who scored at least 52 ($\geq 80\%$) out of 65, which is the maximum score that can be obtained, were categorized as having adequate awareness of antimicrobial resistance, while those with a total score <52 ($<80\%$) were classified as having inadequate awareness. The binary categorization of the total scores obtained was adapted from Bloom's cut-off criteria and other similar studies (14-17). The family income level of the students was evaluated as 'good', 'moderate' and 'poor' according to the students' own perceptions.

The data obtained in the study were transferred to the computer and evaluated in IBM SPSS (version 15.0) package program. Descriptive statistics were given as mean and standard deviation for numerical variables and as number and percentage for categorical variables. Chi-square test and multiple logistic regression analysis were used to analyze the data.

Results

The ages of the students in the study group ranged between 18-38 years and the mean $\pm$ SD age was 20.0 $\pm$ 2.2 years. 71.8% (n=475) of the students were female and 40.7% (n=269) were studying at the Faculty of Health Sciences. Of the students 21.9% (n=145) reported having a healthcare professional in their family. The distribution of the study group according to sociodemographic characteristics is given in Table 1.

Table 1: Distribution of the students in the study group according to their sociodemographic characteristics

Sociodemographic Characteristics	n	%
Academic Unit		
Faculty of Health Sciences	269	40.7
Vocational School of Health Services	267	40.3
Faculty of Medicine	126	19.0
Age		
<20	324	48.9
≥20	338	51.1
Gender		
Male	187	28.2
Female	475	71.8
Family income		
Good	70	10.6
Moderate	543	82.0
Poor	49	7.4
Presence of a healthcare professional in family		
No	517	78.1
Yes	145	21.9

When the antibiotic knowledge level of the students was evaluated in the study, 20.1% (n=133) of the students had adequate antibiotic knowledge. Of the students 33.1% (n=219) agreed with the statement “Penicillin and amoxicillin are antibiotics” and 27.7%

(n=183) of the students strongly disagreed with the statement “Antibiotics are powerful drugs to destroy viruses”. The distribution of students’ responses to the antibiotic knowledge level statements is given in Table 2.

Table 2: Distribution of students' responses to antibiotic knowledge level statements

Antibiotic Knowledge Statements	Strongly Disagree n (%)	Disagree n (%)	Undecided n (%)	Agree n (%)	Strongly Agree n (%)
Penicillin and amoxicillins are antibiotics.	16 (2.4)	51 (7.7)	276 (41.7)	219 (33.1)	100 (15.1)
Aspirin is an antibiotic.	164 (24.8)	245 (37.0)	132 (19.9)	102 (15.4)	19 (2.9)
Paracetamol is an antibiotic.	166 (25.1)	141 (21.3)	250 (37.8)	85 (12.8)	20 (3.0)
Antibiotics are powerful drugs that destroy bacteria.	25 (3.8)	57 (8.6)	70 (10.6)	357 (53.9)	153 (23.1)
Antibiotics are powerful drugs that destroy viruses.	183 (27.7)	145 (21.9)	126 (19.0)	161 (24.3)	47 (7.1)
Antibiotics accelerate the healing of colds and coughs.	45 (6.8)	133 (20.1)	141 (21.3)	293 (44.3)	50 (7.5)
Antibiotics reduce all kinds of pain and inflammation.	129 (19.5)	287 (43.4)	140 (21.1)	95 (14.3)	11 (1.7)
Antibiotics can destroy the beneficial bacteria in our bodies.	15 (2.3)	41 (6.2)	136 (20.5)	330 (49.9)	140 (21.1)
Overuse of antibiotics can cause side effects such as diarrhea.	6 (0.9)	21 (3.2)	167 (25.2)	352 (53.2)	116 (17.5)

When the antibiotic use of the study group was evaluated, 19.6% (n=130) of the students had an appropriate antibiotic use attitude. Among the students, 71.8% (n=475) reported that they had used antibiotics in the last year, 30.5% (n=202) reported that they do not stop using antibiotics when they start to feel better, 52.4% (n=347) reported that they do not keep leftover antibiotics from a treatment thinking that they would be useful later, and 70.2% (n=465) reported that they do not use leftover antibiotics in case of flu or cold without consulting a doctor.

In the study, 88.1% (n=583) of the students had

inadequate antimicrobial resistance awareness. The frequency of adequate antimicrobial resistance awareness was higher among students aged 20 years or older and those with adequate antibiotic knowledge. The frequency of adequate antimicrobial resistance awareness was lower in students studying at the Vocational School of Health Services than in other departments. The distribution of students with adequate and inadequate antimicrobial resistance awareness according to the characteristics that may be related to antimicrobial resistance awareness is given in Table 3.

Table 3: Distribution of students with adequate and inadequate antimicrobial resistance awareness according to factors that may be related to antimicrobial resistance awareness

Factors That May Be Associated with Antimicrobial Resistance Awareness	Antimicrobial Resistance Awareness		p*
	Inadequate n(%)	Adequate n(%)	
Academic Unit			
Faculty of Health Sciences	228 (84.8)	41 (15.2)	<0.001
Vocational School of Health Services	257 (96.3)	10 (3.7)	
Faculty of Medicine	98 (77.8)	28 (22.2)	
Age			
<20	297 (91.7)	27 (8.3)	0.005
≥20	286 (84.6)	52 (15.4)	
Gender			
Male	165 (88.2)	22 (11.8)	0.933
Female	418 (88.0)	57 (12.0)	
Family Income			
Good	62 (88.6)	8 (11.4)	0.353
Moderate	481 (88.6)	62 (11.4)	
Poor	40 (81.6)	9 (18.4)	
Presence of a healthcare professional in family			
No	127 (88.2)	18 (11.8)	0.840
Yes	456 (87.6)	61 (12.4)	
Antibiotic knowledge level			
Adequate	98 (73.7)	35 (26.3)	<0.001
Inadequate	485 (91.7)	44 (8.3)	
When was the last time you used antibiotics?			
Never used	36 (90.0)	4 (10.0)	0.907
In the last 1 year	417 (87.8)	58 (12.2)	
More than 1 year ago	130 (88.4)	17 (11.6)	
Antibiotic use attitude			
Appropriate	109 (83.8)	21 (16.2)	0.098
Inappropriate	474 (89.1)	58 (10.9)	

*Chi-Square test

In the multiple logistic regression analysis, the OR (95% Confidence Interval) for the adequacy of antimicrobial resistance awareness was 5.86 (2.69-12.75) times higher in students studying at the Faculty of Medicine than in students studying at the Vocational School of Health Services, and 2.90

(1.69-4.97) times higher in those with adequate antibiotic knowledge than in those with inadequate knowledge. Multiple logistic regression results of the factors associated with antimicrobial resistance awareness in students are given in Table 4.

Table 4: Multiple logistic regression results of factors associated with antimicrobial resistance awareness in students

Parameters	OR	95% CI*	p
Academic Unit (Reference: Vocational School of Health Services)			
Faculty of Health Sciences	3.97	1.92-8.22	<0.001
Faculty of Medicine	5.86	2.69-12.75	<0.001
Age (Reference: <20)			
≥20	1.55	0.91-2.63	0.104
Antibiotic knowledge level (Reference: Inadequate)			
Adequate	2.90	1.69-4.97	<0.001
Antibiotic use attitude (Reference: Inappropriate)			
Appropriate	0.10	0.55-1.80	0.988

*Confidence Interval

Among the students, 53.6% (n=355) reported hearing about antibiotic or antimicrobial resistance from lectures and 41.4% (n=274) from healthcare

professionals. The distribution of the sources from which students heard about antibiotic or antimicrobial resistance is given in Figure 1.

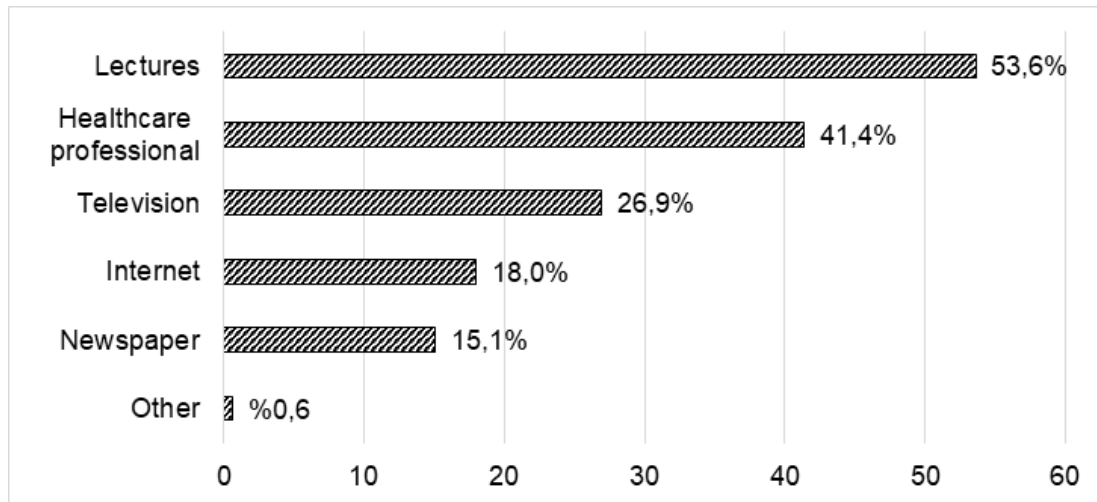


Figure 1: Distribution of the sources from which students heard about antibiotic or antimicrobial resistance (Numbers were evaluated based on individuals)

Discussion

The magnitude of the antimicrobial resistance problem has been demonstrated worldwide and it has been stated that antimicrobial resistance is a global threat that needs to be addressed urgently (4,5). Healthcare professionals, who have an important role in the follow-up of patients and the organization of their treatment, can ensure the protection of the power of antimicrobials by encouraging rational drug use of patients. In this context, the study aimed to determine antimicrobial

resistance awareness and related factors in university students studying in health-related departments, who are the healthcare professionals of the future.

When the antibiotic knowledge level of the students were evaluated in the study, 79.9% of the students had inadequate antibiotic knowledge. Although 77.0% of the students (23.1% “strongly agree”, 53.9% “agree”) believed that antibiotics were powerful drugs in destroying bacteria, the frequency of students who reported that antibiotics

were not powerful in destroying viruses was 49.6% (27.7% “strongly disagree”, 21.9% “disagree”). In similar studies conducted in health-related departments in various countries, the frequency of students who agreed that antibiotics were effective against bacteria was over 90% and the frequency of students who reported that antibiotics were not effective against viruses was over 70% (9,18). Since the study was conducted in students in the first years of university education, the lower level of knowledge may be considered as a reflection of the level of knowledge in the general population.

When the antibiotic use attitudes of the students were examined, 30.5% of the students reported that they do not stop using antibiotics when they start to feel better, 52.4% reported that they do not keep leftover antibiotics from a treatment thinking that they would be useful later, and 70.2% reported that they do not use antibiotics left over in case of flu or cold without consulting a doctor. In the study by Haque et al. the frequency of the same answers to the same statements were higher than in our study (19). In the study conducted by Scaioli et al. in Italy, it was reported that except the statement about keeping the leftover antibiotics from a treatment frequency of correct answers to other two statements were higher than in our study (9). Since the purchase of antibiotics without a prescription is restricted in Türkiye (20), it is important not to keep leftover antibiotics from previous treatments and not to use them for another illness without consulting a doctor in order to prevent self-use of antibiotics. In this context, since it is important to purchase and start antibiotics under the supervision of a doctor and not to stop antibiotics until the treatment regimen is completed, the proportion of students who answered all three questions correctly, in other words, who had an appropriate antibiotic use attitude, was much lower with 19.6%. The low level of antibiotic knowledge of the students in the study may have caused this result.

In the study, 88.1% of the students had inadequate awareness of antimicrobial resistance. Compared to similar studies conducted in university students in health-related departments (10, 16), awareness was found to be lower in this study. The different results in the studies may be attributed to the differences in the measurement tools evaluating antimicrobial

resistance awareness, the populations in which the studies were conducted and the differences in the management of antimicrobial resistance between countries.

Antimicrobial resistance awareness was 3.97 times higher in students studying at the Faculty of Health Sciences and 5.86 times higher in students studying at the Faculty of Medicine compared to those studying at the Vocational School of Health Services. In a study conducted by Shahpawee et al. on university students, it was reported that the antimicrobial resistance awareness of students studying at the Faculty of Health Sciences was higher than that of students studying at other faculties (Faculty of Business and Economics, Faculty of Science, Arts and Social Sciences) (21). The different results obtained in antimicrobial resistance awareness can be considered as a reflection of the content and intensity of the educational curricula between faculties.

Low level of knowledge about antibiotics and decreased awareness of antimicrobial resistance may lead to incorrect and excessive antibiotic use, which is one of the important causes of resistance development, and may increase the problem of antibiotic resistance (2, 22-24). In the study, it was found that the level of antimicrobial resistance awareness was 2,90 times higher in those with adequate antibiotic knowledge. Similarly, it has been reported in various studies that antimicrobial resistance awareness and antibiotic knowledge level are related (10, 25). The results suggest that increasing the knowledge level of students about antibiotics may be an important approach to increase antimicrobial resistance awareness.

In the study, 53.6% of the students reported having heard about antibiotic or antimicrobial resistance from lectures and 41.4% from healthcare professionals. Similarly, in the study conducted by Haque et al. in medical students, it was reported that 37% of the students heard about antibiotic resistance from general practitioners and 26% from the internet in addition to lectures (19). In an antibiotic awareness study conducted by WHO in the general population in 12 countries, 50% of the participants reported having heard about antibiotic resistance from doctors or nurses and 41% from the media (11). Previous studies reported that

individuals obtain information about antimicrobial resistance from professional information sources, similar to our study.

There are limitations in the explanation of cause and effect relationships due to the cross-sectional nature of the study. Other limitations of the study include the fact that the study was conducted in students of only one university and that the data of the study was based on questionnaire responses that may cause recall bias.

Conclusions

In the study conducted among university students studying in health-related departments, it was found that antimicrobial resistance awareness was inadequate in the majority of students. Similarly, antibiotic knowledge level was inadequate and antibiotic use attitudes were not appropriate in the majority of the students. The fact that antimicrobial resistance awareness was higher in students with adequate antibiotic knowledge and in those who studied in faculties with more detailed and intensive health information shows that professional trainings on rational antimicrobial use may be useful in increasing antimicrobial resistance awareness. Since the majority of the students stated that they heard about antimicrobial resistance in lectures, it is recommended to evaluate the quality and quantity of university programs on antimicrobial resistance to increase awareness in future studies.

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