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Antibiotic Knowledge, Perception, and Practice of Intern Doctors in Turkey: A Survey Study

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ABSTRACT

Background: This study aimed to measure intern doctors' knowledge, attitudes, and perceptions about antibiotic treatment and determine the situation on the subject.
Methods: A 34-question questionnaire was prepared for the study, and volunteers were administered the questionnaire face-to-face or via a Google form on a mobile WhatsApp application. Prospectively, 221 volunteer physicians participated in the survey conducted between March 15 and 22, 2024, in Turkey.
Results: Of the participants, 118 (53.4%) were male and 103 (46.6%) were female. The mean age (mean ± SD) was 24 years (24.46 ± 1.83). Many participants had good antibiotic knowledge but a poor antibiotic use percentage. The knowledge that misuse of antibiotics causes resistance was quite high, and there were deficiencies in the mechanisms of resistance. The misconceptions identified were stopping treatment when the clinical condition improved, regardless of the duration, or giving treatment every time the fever was high. There was a significant and positive correlation between age level-antibiotic knowledge and age-level-resistance awareness (rs=0.190, p=0.002 and rs=0.152, p=0.007, respectively). A significant difference was also found between gender-attitude scores (p=0.004). There was a significant (rs=0.247, p=0.003) and positive correlation between antibiotic knowledge and resistance awareness, and a significant (rs=0.610, p<0.001) and positive correlation between antibiotic knowledge and attitude and perception scores.
Conclusion: To increase the intern doctors' resistance awareness and decrease their wrong attitudes and perceptions, social programs, practical applications, and patient-oriented practices, together with some educational program curriculum changes, are needed.

1. Introduction

Increased antibiotic resistance is directly associated with treatment failure, recurrent infections, cost, increased mortality, and morbidity. This resistance problem has become an increasing public health concern. Globally, there is concern that by 2050, approximately 10 million people will be lost due to resistance problems. The World Health Organization and many countries around the world are trying to develop antimicrobial resistance prevention strategies. Antimicrobial resistance can be easily detected by standard microbiological tests [1, 2, 3, 4]. Pathogens can build resistance to antibiotics in many different ways. In antibiotic treatment management, knowing these resistance pathways and other factors that stimulate resistance to use appropriate antibiotics at appropriate times and doses [5]. The use of antibiotics in animal foods, unnecessary and excessive usage during the COVID-19 pandemic, and irrational usage of antibiotics on different spectra, such as surgical prophylaxis or inappropriate empirical treatment, especially in our country, are important factors that increase the development of resistance [6, 7, 8, 9]. A lack of time to evaluate patients, different knowledge levels of physicians, febrile patients, fear of complications, parental expectations of antibiotics, and undetailed physical examination findings are other factors that increase inappropriate antibiotic usage [10, 11, 12]. Our country has a very high rate of antibiotic usage. After graduation, intern doctors prescribe antibiotics at a high rate in emergency services and family physicians. Therefore, this study aimed to analyze intern doctors' knowledge, perception, and practices about antibiotics.

2. METHODS

The study was planned as a prospective, observational cross-sectional survey study between March 15-22, 2024 in Turkey, voluntarily. The interns in our center and semester 5 students who had a short transition period to internship were included in the study. Students were personally contacted during the internship or through their phone numbers registered in the hospital data processing and the questionnaire was applied with an information message. The minimum sample size was calculated as 221 with a 5% margin of error, 95% confidence interval, and 50% distribution

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of responses. The following formula was used to calculate the sample size [13]:

$$X = Z\left(\frac{c}{100}\right)^2 r(100-r)$$
$$N = \frac{Nx}{(N-1)E^2 + x}$$
$$E = \sqrt{\frac{(N-n)x}{n(N-1)}}$$

Where n is the sample size, E is the margin of error, N is the population size, r is the fraction of responses, and Z (c/100) is the critical value for confidence level c.

The questionnaire was prepared in a Word file, and a Google survey form was shared with volunteers both face-to-face and via the WhatsApp application through the registered telephone number of the intern. The questionnaire has been validated and previously implemented in other countries such as Pakistan and Uganda [14, 15, 16]. An English-language version of the questionnaire guide was uploaded as a supplementary file. The study questionnaire was composed of five main sections. In the introduction section, general information about the questionnaire was given, and voluntary consent was requested. Demographic data was collected in the first section. In the second section, six questions about general antibiotic knowledge were asked, and in the third section, 10 questions about antibiotic resistance were asked. Participants were asked to respond yes, no, or not sure. In the fourth section, five questions were asked to evaluate resistance awareness. The participants were asked to respond as do not know, partially know, know well, or know very well.

In the last section, 12 questions were asked to evaluate the attitudes and perceptions of intern doctors about antibiotics. The participants were asked to respond to each question as agree or disagree. Except for the demographic section, the responses received for each section were tabulated as frequencies and percentages. In addition, the second and third sections were scored together by giving 1 point for correct answers and 0 points for incorrect answers or unclear answers. Knowledge about antibiotics questions were evaluated out of 6 points. The score for knowledge about antibiotic resistance was assessed out of 10 points (yes=1 point, no=0 points, not sure=0 points). Statistical evaluation was made over a total score of 16 points. The fourth section examining awareness of antibiotic resistance received 15 points (don't know, partially know, know well=2, know very well=3 points). The last section, which examined the attitudes and perceptions of the intern doctors, was evaluated over 12 points according to the correct answer (Agree=1 point for questions 1-4 and 10-12, disagree=1 point for questions 5-9). Students who provided incomplete information, non-volunteers, intern doctors, and those who were not Semester 5 students were not included in the study.

2.1. Ethics approval and consent to participate

The study was approved by the Abant Izzet Baysal University Non-interventional Clinical Research Ethics Committee Unit. Ethical permission was received at the meeting dated February 20, 2024, and numbered 2024/28 (Approval no: BAIBU-28). The study is a survey. An information paragraph was included for all participants in the questionnaire form. In addition, the voluntary basis was highlighted.

2.2. Statistical analysis

SPSS version 23.0 (IBM, New York, USA) was used to analyze the data. The Kolmogorov–Smirnov test and histogram analysis were used to assess the normality of the data. Categorical variables are presented as numbers and percentages and were compared by the chi-square test or Fisher's exact test, if appropriate. A Bonferroni correction was applied to account for multiple comparisons when analyzing associations between demographic variables and knowledge/attitude scores. The Mann-Whitney U test was used to analyze continuous variables (gender and scores) that did not show a normal distribution. Spearman's rho test (rs) was used to analyze antibiotic knowledge scores and resistance awareness. The significance level was set as $p < 0.05$.

3. Results

Only the age and gender of the participants were questioned in terms of socio-demographic characteristics. Of the study participants, 118 (53.4%) were male, and 103 (46.6%) were female. The mean age (mean ± SD) was 24 (24.46 ± 1.83). The resistance awareness score was calculated as Mean (Min-Max) =5.98 (0-15), antibiotic knowledge score=9.79 (1-16), and attitude score=10.93 (2-12). When the responses to the six questions about general antibiotic knowledge and antibiotic usage were analyzed, it was observed that while a high percentage of correct responses were given for general antibiotic knowledge, the percentage of correct responses was low for questions related to antibiotic usage **(Table 1)**.

In the second part, where antibiotic resistance knowledge was measured, the students were asked 10 questions. The answers given to the questions about how misuse of antibiotics affects resistance were correct at a high rate. However, the rate of correct responses to questions about resistance mechanisms decreased considerably **(Table 1)**.

In the third section, where antibiotic resistance awareness was evaluated, the participants were asked five questions. The participants were generally trusted in their level of knowledge on the awareness and management of antibiotic resistance **(Table 2)**.

In the fourth part, 12 questions were asked to evaluate the participants' attitudes and perceptions about antibiotic stewardship. Most of the students reported that they did not consider antibiotic resistance an important problem. In addition, the rate of those who stated that antibiotics should be started in fever cases was quite high. Another false perception was that antibiotic treatment should be stopped immediately when the patient's clinic is cleared. Again, the number of those who thought that leftover antibiotics should be stored and reused was quite high. The rate of agreement with the correct responses to the other questions about antibiotic management was high **(Table 3)**.

The age of the interns and their antibiotic knowledge scores and resistance awareness scores were evaluated separately. A significant but weak positive correlation was found between age and antibiotic knowledge (rs=0.190, p=0.002). It was observed that antibiotic knowledge scores increased with increasing age. Similarly, a significant but weak positive correlation was found between age and resistance awareness (rs=0.152, p=0.007) **(Figure 1)**. It was determined that awareness increased with increasing age. Resistance Awareness, Antibiotic Knowledge, and Attitude Score were evaluated separately according to gender. While a significant difference was found between the attitude scores and gender (p=0.004), no difference was observed between the other scores **(Table 4)**.

Table 1: Information about antibiotics, usage, and resistance

Question	Responses	N=221	%
Can antibiotics destroy normal flora in the body?	Yes*	214	96.8%
	No	4	1.8%
	Not sure	3	1.4%
Can antibiotics cause allergic reactions?	Yes*	218	98.6%
	No	1	0.5%
	Not sure	2	0.9%
Do you know when to start antimicrobial treatment?	Yes*	154	69.7%
	No	10	4.5%
	Not sure	57	25.8%
Do you know how to choose the best antibiotic?	Yes*	94	42.5%
	No	26	11.8%
	Not sure	101	45.7%
Do you know the appropriate dosage of antibiotics to be given?	Yes*	57	25.8%
	No	60	27.1%
	Not sure	104	47.1%
Do you know when to switch from intravenous antibiotics to oral regimens?	Yes*	60	27.1%
	No	79	35.7%
	Not sure	82	37.1%
Inappropriate use of antibiotics causes antibiotic resistance.	Yes	220	99.5%
	No	0	0%
	Not sure	1	0.5%
Better use of antibiotics will not affect antimicrobial resistance?	Yes	21	9.5%
	No	179	81%
	Not sure	21	9.5%
Is it always better to prescribe broad-spectrum antibiotics even if more narrow-spectrum antibiotics are effective?	Yes	17	7.7%
	No	179	81%
	Not sure	25	11.3%
The mechanism of resistance to beta-lactams in K. pneumoniae is mainly enzymatic.	Yes	64	29%
	No	25	11.3%
	Not sure	132	59.7%
The resistance mechanism of methicillin-resistant S. aureus is efflux pumps.	Yes	66	29.9%
	No	25	11.3%
	Not sure	130	58.8%
The mechanism of resistance against vancomycin-resistant E. faecalis is by changing the region of binding.	Yes	54	24.4%
	No	13	5.9%
	Not sure	154	69.7%
Antibiotic use shorter than the standard duration provokes resistance.	Yes	180	81.4%
	No	17	7.7%
	Not sure	24	10.9%
Failure to debride the site of infection provokes resistance.	Yes	176	79.6%
	No	11	5%
	Not sure	34	15.4%
Does the use of antibiotics for self-limiting bacterial infections provoke resistance?	Yes	127	57.5%
	No	24	10.9%
	Not sure	70	31.7%
Overuse of antibiotics in livestock provokes resistance.	Yes	156	70.6%
	No	11	5%
	Not sure	54	24.4%

(*): Correct response

When antibiotic knowledge and resistance awareness and antibiotic knowledge and attitude scores of the intern doctors were evaluated separately, a significant but moderate positive correlation was found between antibiotic knowledge and resistance awareness (rs=0.247, p=0.003). Similarly, a significant but weakly positive correlation was found between antibiotic knowledge and attitude scores (rs=0.610, p<0.001), **(Figure 2)**.

Table 2: Antimicrobial resistance awareness

Question	Responses	N=221	%
How are antibiograms analyzed?	Do not know	54	24.4%
	Know partially	106	48%
	Know it well	45	20.4%
	Know it very well	16	7.2%
How to find authoritative data sources for treating infections?	Do not know	17	7.7%
	Know partially	130	58.8%
	Know it well	65	29.4%
	Know it very well	9	4.1%
How to deal with a patient who wants antimicrobials?	Do not know	27	12.2%
	Know partially	97	43.9%
	Know it well	79	35.7%
	Know it very well	18	8.1%
Identify the correct spectrum of different antimicrobial therapies?	Do not know	56	25.3%
	Know partially	124	56.1%
	Know it well	33	14.9%
	Know it very well	8	3.6%
How to choose the best antimicrobials for a specific infection?	Do not know	27	12.2%
	Know partially	129	58.4%
	Know it well	57	25.8%
	Know it very well	8	3.6%

4. Discussion

Physicians at the center of antibiotic stewardship have poor perceptions of antimicrobial therapy management and false perceptions about rational antibiotic usage [14, 15, 16]. The quality and adequacy of the education received by medical students directly impact their knowledge, perceptions, and attitudes toward the correct use of antibiotics. In one study, after infectious disease education, almost all the medical students who participated in the study thought that antimicrobial resistance is a public health problem today, and 98.4% of them thought that antimicrobial resistance should be prevented [17].

This study aimed to draw attention to the deficiencies, false attitudes, and perceptions of semester V students who will be interns for one month and intern doctors in antibiotic stewardship. We have once again identified the importance of general antibiotic knowledge and resistance awareness in rational antibiotic usage. These parameters directly relate to eliminating false perceptions and attitudes among intern doctors. There are many reasons for the irrational use of antibiotics. Antibiotic administration for nonbacterial infections, antibiotic administration for longer than necessary, treatment of colonization and contamination, lack of correct differentiation of other causes that increase acute phase reactants, and high fever are some of them [18, 19]. Unlike in the above study, most volunteer doctors who participated were still unaware of the importance of antimicrobial resistance. However, among European countries, Turkey has a high rate of antibiotic usage [20]. One-third of the participants still did not know or were unsure about the correct choice of antibiotic, and three-quarters did not know or were unsure about the appropriate dosage and the timing of antibiotic switching. A very small proportion had misconceptions, such as taking antibiotics for every fever and repeatedly taking too many antibiotics. Furthermore, about 90 percent of participants did not know or were not sure about the positive impact of antibiotics on resistance when used with better stewardship, and the fact that they believe that antibiotics can be discontinued

Table 3: Attitude and Perception

Question	Responses	N=221	%
Strong antimicrobial knowledge is important for my career.	Agree Disagree	213 8	96.4% 3.6%
Antimicrobials are overused in our country.	Agree Disagree	218 3	98.6% 1.4%
The antimicrobials I will prescribe/distribute will contribute to the problem of resistance.	Agree Disagree	177 44	80.1% 19.9%
I would like more training on the appropriate use of antimicrobials.	Agree Disagree	197 24	89.1% 10.9%
Efficacy is better if antimicrobials are newer and more expensive.	Agree Disagree	23 198	10.4% 89.6%
Antimicrobial resistance is not a major problem.	Agree Disagree	14 207	6.3% 93.7%
Antibiotics must be given when there is a fever.	Agree Disagree	9 212	4.1% 95.9%
Stop the antibiotics immediately when the patient feels better.	Agree Disagree	15 206	6.8% 93.2%
Leftover antibiotics should be saved for future use.	Agree Disagree	49 172	22.2% 77.8%
I should know the correct and relevant specimen to collect for an infection.	Agree Disagree	209 12	94.6% 5.4%
I can distinguish between normal flora and a true pathogen from a microbiology report.	Agree Disagree	200 21	90.5% 9.5%
I can understand the mechanisms of resistance based on a microbiology report.	Agree Disagree	206 15	93.2% 6.8%

without waiting for adequate treatment time proves that the medical faculty education in our center should be reconsidered. Partial re-teaching of microbiology courses in semester V, making the infectious diseases compulsory, and extending their duration will seriously contribute to solving the problems we have identified in this study. The high number of students in academic institutions negatively affects the quality of education. In addition, the supply of adequate and effective equipment for the quality of education in hospitals and health institutions is another problem that needs to be addressed by politicians and government authorities. Seminars can be organized from time to time so that academicians can update their knowledge of effective teaching techniques. In addition, the potential integration of mobile learning applications, case-based discussions, or simulation-based training that will contribute to the development of students can contribute positively to the quality of education.

One of the main themes of antibiotic management is the problem of developing resistance. Knowing the resistance mechanisms of some gram-negative and gram-positive agents and choosing appropriate antibiotics accordingly will contribute to the prevention of resistance development [21]. In our study, it was shown that the general antibiotic knowledge of the intern doctors was good. They reported that they were aware of antibiotic resistance at a high rate. However, there is a serious lack of awareness of resistance methods and resistance awareness. Although there was no correlation between gender and resistance awareness, there was a poor correlation between age and resistance awareness. There was no significant correlation between age and attitudes or perceptions toward antibiotics. This may be explained by the fact that the education received by the interns about infectious diseases was forgotten at that time. We think that the fact that the intern doctors, who were older than the Term V students, did not take any internship or course related to antibiotic knowledge in the last year was effective in this. Similar studies have found results that support this thesis [22, 23]. In addition, it may be thought that they are unaware that they have serious deficiencies in resistance. To overcome this deficiency, up-to-date guidelines can be prepared according to the resistance frequency of each center. Antibiotic resistance rates and the type and frequency of resistant pathogens may vary according to country, center, and region [24]. Alternatively, practical telephone applications adapted to international guidelines can be created. In addition, banning the usage of prescriptions without antibiotics as a policy in our country has been a wise decision that will contribute to the reduction of unconscious antibiotic usage and resistance development. Studies have shown that factors such as having more clinical experience and experience and seniority affect the correct attitude about antibiotics, whereas gender was shown to be an effective factor in our study [25]. In addition, it was determined that antibiotic stewardship program training led to significant improvements in knowledge and attitudes after the deficiencies of healthcare professionals on this subject were identified [26].

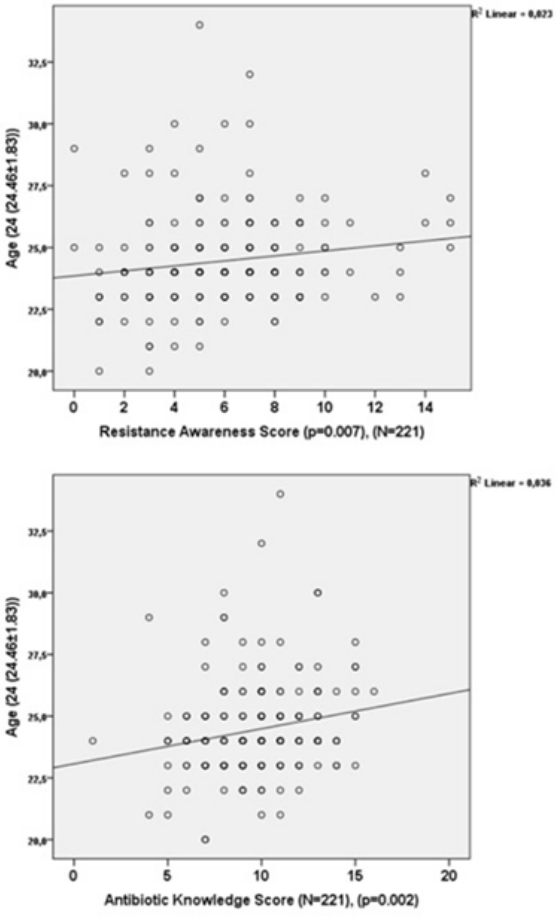

Figure 1: (A) Relationship between Resistance Awareness (rs=0.152) by Age, (B)Relationship between Antibiotic Knowledge (rs=0.190) by Age. rs: Spearman's rank correlation coefficient.

Table 4: Analyzing the Scoring According to Gender

Scores	Gender	Mean	SD	p-values	95% CI Lower	95% CI Upper
Resistance Awareness Score	Male Female	5.91 6.06	2.612 2.950	0.686	-0.889	0.586
Antibiotic Knowledge Score	Male Female	9.55 10.00	2.574 2.292	0.175	-1.099	0.201
Attitude Score	Male Female	10.69 11.20	1.495 1.123	0.004	-0.872	-0.163

CI, Confidence Interval of the Difference; SD, Standard deviation

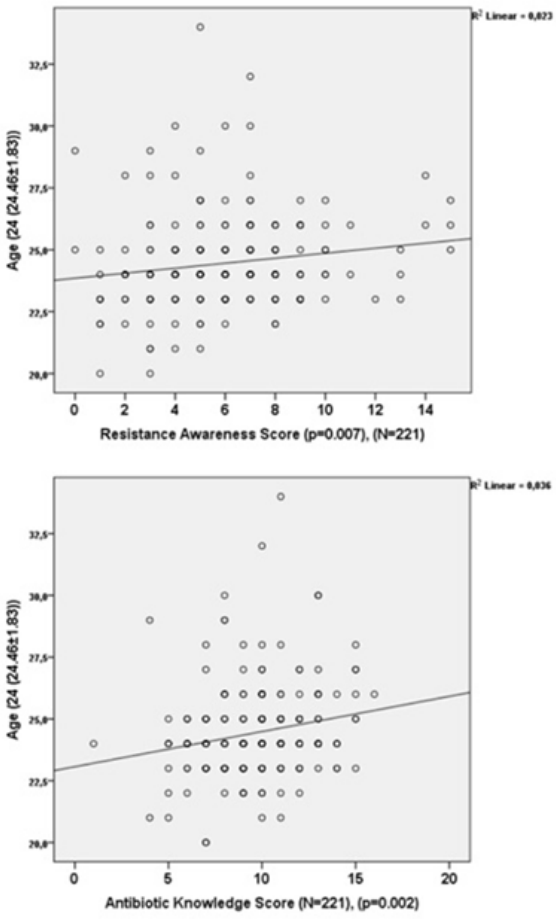

Figure 2: (A) Relationships between Antibiotic Knowledge (rs=0.247) and Attitudes, (B) Resistance Awareness (rs=0.610) and Attitudes. rs: Spearman's rank correlation coefficient.

This study has several limitations. This study was conducted in a single center. The sample size was determined by calculating the minimum required number of participants based on the total number of semester V students and intern doctors in our center. Because of this, it cannot be generalized to the whole of our country. Factors such as the quality of training in other centers and differences in training programs may change the statistical significance and comprehensiveness. In addition, the accuracy of the results is related to the honesty of the participants in answering. Subjective responses were minimized as much as possible by not asking for any identity information that would reveal the participants. It may be possible to reach more reliable responses in large-scale surveys where participants can easily give objective responses. In addition, the inclusion of semester five students with a very short internship period may have partially affected the homogeneity. Other limitations include the fact that a generally accepted validity scale could not be used for the study, and the questions were prepared only for this study by using similar studies in the literature.

5. Conclusions

As a result, despite serious resistance problems due to the mismanagement of antimicrobials, intern doctors still have serious knowledge deficiencies and perception-attitude inaccuracies, especially regarding antimicrobial resistance. The age of the intern doctor is partially associated with antibiotic knowledge and resistance awareness. General antibiotic knowledge was directly associated with correct perceptions and attitudes toward antibiotic treatment. Gender was also directly associated with attitude and perception, but not with antibiotic knowledge or resistance awareness. In conclusion, our education system should be revised or facilitated to train medical doctors governed by knowledge rather than obsession, and awareness practices should be implemented

Conflicts of Interest

None

Funding Source

None

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Institutional Review Board (IRB)

The study was approved by the Abant Izzet Baysal University Non-interventional Clinical Research Ethics Committee Unit. Ethical permission was received at the meeting on February 20, 2024, numbered 2024/28 (Approval no: BAIBU-28).

Large Language Model

None

Authors Contribution

Conceptualization was equally contributed by, AD, AS, BD and HŞÇ; methodology, AD, CR, EBN, ZA; software, LM; validation,

AD, AS, BD, HŞÇ, CR, EBN, ZA, MTA, RÖ; formal analysis, AD; investigation, AD, AS, BD, HŞÇ, CR, EBN, ZA, MTA, RÖ; resources, AD, AS, BD; writing—original draft preparation, AD; writing—review and editing, AD; visualization, AD; supervision, AD; project administration, AD. All authors have read and agreed to the published version of the manuscript.

Data Availability

The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request. The datasets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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