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Original Article

The Battle against Antibiotic Resistance: Exploring Perceptions, Misconceptions, Attitudes, Practices, and Awareness Factors Influencing Antibiotic Resistance among General and Clinical Populations

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ABSTRACT

Antibiotic resistance is rapidly advancing and becoming a higher risk over time; previously manageable infections have turned untreatable. **Objective:** To assess the perceptions, misconceptions, attitudes, practices, and awareness factors influencing antibiotic resistance among general and clinical populations. **Methods:** A total of 348 participants from the general public and 523 junior and senior medical practitioners in Peshawar, Pakistan, were included in this comparative observational cross-sectional study. Data were collected using a standardized questionnaire, which was later assessed by Chi-square test through SPSS version 26.0. **Results:** The results revealed a lack of awareness and knowledge regarding antibiotic resistance among both groups. Only 32% of the general public correctly identified the definition of antibiotic resistance, while 76% of medical practitioners demonstrated a basic understanding of the concept. However, a significant number of participants from both groups recognized the problem of bacterial infections resistant to all antibiotics and the contribution of self-medication to antibiotic resistance. In terms of self-medication practices, approximately 60% of the general public reported self-medicating with antibiotics without consulting a healthcare professional. Among medical practitioners, the rate of self-medication was significantly lower, but a small proportion still admitted to prescribing antibiotics without appropriate diagnosis or indications. The majority of participants, however, did not intend to prescribe/suggest unnecessary antibiotics. **Conclusions:** The findings indicated that both groups were cognizant of the issue, yet certain misconceptions persisted within each group.

INTRODUCTION

The discovery and development of antibiotics certainly altered how serious bacterial diseases like meningitis and endocarditis are managed, though excessive antibiotic usage has serious repercussions, including antibiotic resistance [1, 2], which is considered a worldwide threat to public health that can have a negative impact on finances, mortality, and hospitalization rates [3-6]. Antibiotic resistance is rapidly advancing and becoming a higher risk over time; previously manageable infections have turned untreatable; hence becoming aware of the gravity and importance of antibiotic resistance is the first step that would slow its advancement [7-9]. In order to draw attention to the problem, the World Health Organization (WHO) established "Antibiotic Awareness Week" in 2015. This annual one-week event aims to increase public knowledge of antibiotic resistance and encourage the responsible and safe use of antimicrobials [10]. There is adequate evidence indicating that newly licensed doctors and prescribers are inadequately trained to safely prescribe antibiotics. By wisely prescribing antibiotics and

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encouraging patients understanding to stick to treatments and refrain from self-medication, young doctors—the field's future prescribers—can serve as the front-line defenders against antimicrobial resistance [4, 7, 11]. Studies have shown that China,[12] the United States,[13] Europe[14] and Pakistan[15] respectively, recorded 60%, 10%, 45%, and 50% of improper antibiotic use [5]. Self-medication, a lack of diagnostic tools, the marketing of antibiotics without a prescription, patient requests, and clinician likes and dislikes, and a lack of culture and sensitivity are just a few of the causes of antibiotic resistance [3]. A lack of proper training during undergraduate studies has been blamed by several authors for the knowledge and practice gaps among health practitioners. Antibiotic resistance and appropriate prescribing should be covered in greater detail during undergraduate medical education for aspiring doctors. Since it is difficult to modify the doctors' deeply ingrained beliefs and actions once they have obtained their credentials [5, 7, 16]. In spite of the abundance of foreign research, little is known about the knowledge and practices of medical practitioners in comparison to the general public [17]. This study is designed to assess the perceptions, misconceptions, attitudes, practices, and awareness factors influencing antibiotic resistance among general and clinical populations among both medical practitioners and the general public leading to antibiotic resistance.

METHODS

This study employed a comparative observational cross-sectional design and was conducted in Peshawar, KPK, Pakistan. The study duration spanned six months, commencing from December 2022 to May 2023. The sample size was determined using the Open Epi Sample Size Calculator, resulting in a calculated size of 664 with a confidence level of 99%. However, to reduce the sampling error, a total of 1000 questionnaires were distributed among the participants, with 871 questionnaires ultimately being completed in their entirety. The sample consisted of 348 participants from the general public and 523 junior and senior medical practitioners collected using non-Probability convenient sampling technique. Prior to enrollment, participants were provided with comprehensive information regarding the study's objectives and were required to provide verbal consent. The study included individuals aged 18 years and older who willingly participated, gave verbal informed consent, and fully completed the questionnaire. On the other hand, it excluded individuals under 18, those who were not willing to participate, those who couldn't provide informed verbal consent, and those who didn't finish the questionnaire.

Data collection was carried out employing a standardized questionnaire. Ethical approval for the study design was obtained from the medical research board and ethical committee. The questionnaire used for data collection was meticulously designed, drawing upon an extensive review of the existing literature, and underwent validation by domain experts. Using in-person interviews, the questionnaires were distributed. The questionnaire consisted of two sections: Age, gender, institution, and educational level were among the demographic questions in the first section while perceptions, misconceptions, attitudes, practices, and awareness factors that contribute to antibiotic resistance were covered in the second section. Data analysis was performed utilizing SPSS version 26.0. Descriptive statistics, including means with standard deviation, frequencies, and percentages, were employed to analyze the variables. The relationship between the responses of the general population and medical practitioners was examined using the chi-square test, with a predetermined significance level of 0.05.

RESULTS

General population (348) and the Clinical participants (523) were involved in the study. Among which 47.5% of the general population and 52.4% of the clinical participants were males (Table 1).

Table 1: Gender-based distribution among the study participants

Variables	Males (%)	Females (%)
General Population	159 (47.5)	189 (54.3)
Clinical	274 (52.4)	249 (47.6)

The participants of the study had a mean age of 29.58 years ± 8.808 (18 – 67 years). Majority belonged to the 26 – 35 years age group, followed by the age group 18 – 25 (Table 2).

Table 2: Age-based distribution among the study participants

Age	General Population (%)	Clinical (%)	Total (%)
18 – 25 Years	234 (86.3)	37 (13.7)	271 (100)
26 – 35 Years	47 (11)	382 (89)	429 (100)
36 – 45 Years	34 (27.9)	88 (72.1)	122 (100)
46 – 67 Years	33 (67.3)	16 (32.7)	49 (100)

Among the general public, 64.4% (224/348) and 48.6% (254/348) of the clinical group agreed that there were bacterial infections resistant to all antibiotics, whereas 10.6% (37) and 8% (42) of the general public and clinical groups disagreed with the statement, respectively. Additionally, the participants considered antibiotic resistance to be a national and global public health concern. However, no significant difference was present when enquired about restricting the sale of non –prescribed antibiotics (p-value = 0.160) (Table 3).

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Table 3: Perception of antibiotics resistance among the general population and clinical participants

Variable	Completely Disagree (%)	Disagree (%)	Agree (%)	Completely Agree (%)	Total (%)	p – value	X^2 - Value
Bacterial infections are resistant to all antibiotics.							
General Population	37 (10.6)	45 (12.9)	224 (64.4)	42 (12.1)	348 (100)	0.000	33.046
Clinical	42 (8)	141 (27)	254 (48.6)	86 (16.4)	523 (100)		
Bacterial infections are resistant to all antibiotics.							
General Population	9 (2.6)	51 (14.7)	104 (29.9)	182 (52.9)	348 (100)	0.000	25.491
Clinical	20 (3.8)	37 (7.1)	228 (43.6)	238 (45.5)	523 (100)		
Antibiotic resistance is a national public health issue.							
General Population	16 (4.6)	22 (6.3)	167 (48)	143 (41.1)	348 (100)	0.001	16.891
Clinical	8 (1.5)	65 (12.4)	265 (50.5)	186 (35.6)	523 (100)		
The sale of non-prescribed antibiotics should be restricted.							
General Population	19 (5.5)	19 (5.5)	122 (35.1)	188 (54)	348 (100)	0.160	5.169
Clinical	21(4)	25 (4.8)	222 (42.4)	255 (48.8)	523 (100)		

In the general public group, 35.9% agreed, 39.1% completely agreed and in the clinical group 51.2% agreed and 25.4% completely agreed that the use of antibiotics in self-limiting infections contributed to antibiotic resistance. (p-value = 0.000) A statistically significant difference was found to be present among the participants believing antibiotics for longer duration (p-value = 0.007), Empirical therapy (p-value = 0.002), and over-the-counter distribution of antibiotics (p-value = 0.009) contributed to antibiotic resistance (Table 4). In contrast to this, there was no statistical difference among participants who believed that antibiotics for a duration shorter than indicated contributed to antibiotic resistance (p-value = 0.172) (Table 4).

Table 4: Factors Contributing to Antibiotic Resistance According to the Study Participants

Variable	Completely Disagree (%)	Disagree (%)	Agree (%)	Completely Agree (%)	Total (%)	p – value	X^2 - Value
Antibiotics taken for a shorter period of time than recommended add to antibiotic resistance.							
General Population	29 (8.3)	130 (37.4)	123 (35.3)	66 (19)	348 (100)	0.172	5.001
Clinical	43 (8.2)	159 (30.4)	203 (38.8)	118 (22.6)	523 (100)		
Taking antibiotics for a longer period than advised leads to antibiotic resistance.							
General Population	36 (10.3)	29 (8.3)	226 (64.9)	57 (16.4)	348 (100)	0.007	12.036
Clinical	37 (7.1)	82 (15.7)	319 (61)	85 (16.3)	523 (100)		
Antibiotic resistance is aided by empiric antibiotic therapy.							
General Population	29 (8.3)	93 (26.7)	183 (52.6)	43 (12.4)	348 (100)	0.002	14.838
Clinical	49 (9.4)	201 (38.4)	225 (43)	48 (9.2)	523 (100)		
The lack of regulation over the trade-in of medications in pharmacies encourages antibiotic resistance.							
General Population	24 (6.9)	22 (6.3)	210 (60.3)	92 (26.4)	348 (100)	0.009	11.668
Clinical	21 (4)	64 (12.2)	292 (55.8)	146 (27.9)	523 (100)		
Self-medication is a major contributor to antibiotic resistance.							
General Population	6 (1.7)	54 (15.5)	170 (48.9)	119 (33.9)	348 (100)	0.031	8.906
Clinical	10 (1.9)	76 (14.5)	209 (40)	228 (43.6)	523 (100)		

Among the general public participants, 62/348 and 104/523 of clinical participants considered antibiotics effective for the treatment of viral infections (p-value = 0.094). Also there was a statistical significance among the participants who considered antibiotics as first-line treatment for cough and sore throat (p-value = 0.004) and who taught antibiotics help them recover faster, when they had a fever (p-value = 0.008) (Table 5).

Table 5: Misconceptions about antibiotic use among the study participants

Variable	Completely Disagree (%)	Disagree (%)	Agree (%)	Completely Agree (%)	Total (%)	p – value	X^2 - Value
Antibiotics are safe and should be widely utilized.							
General Population	84 (24.1)	148 (42.5)	86 (24.7)	30 (8.6)	348 (100)	0.437	2.720
Clinical	140 (26.8)	230 (44)	121 (23.1)	32 (6.1)	523 (100)		
Antibiotics can be used to treat viral infections.							
General Population	178 (51.1)	108 (31)	34 (9.8)	28 (8)	348 (100)	0.094	6.388
Clinical	239 (45.7)	180 (34.4)	73 (14)	31 (5.9)	523 (100)		
Antibiotics are the first-line treatment for coughs and sore throats.							
General Population	47 (13.5)	176 (50.6)	80 (23)	45 (12.9)	348 (100)	0.004	13.192
Clinical	75 (14.3)	220 (42.1)	176 (33.7)	52 (9.9)	523 (100)		

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Antibiotics help me recover faster when I have a fever.							
General Population	17 (4.9)	87 (25)	177 (50.9)	67 (19.3)	348 (100)	0.008	11.846
Clinical	38 (7.3)	175 (33.5)	237 (45.3)	73 (14)	523 (100)		

Most of the participants of both the general public and clinical participants did not intend to prescribe/suggest unnecessary antibiotics. (P-value = 0.000) also there was a statistical difference among participants contributing to antibiotic resistance research (p-value = 0.000) (Table 6).

Table 6: Participants Attitude contributing to Antibiotic Resistance

Variable	Completely Disagree (%)	Disagree (%)	Agree (%)	Completely Agree (%)	Total (%)	p – value	X^2 - Value
I would prescribe/suggest antibiotics if someone requests them.							
General Population	201 (57.8)	89 (25.6)	48 (13.8)	10 (2.9)	348 (100)	0.000	24.614
Clinical	236 (45.1)	218 (41.7)	61 (11.7)	8 (1.5)	523 (100)		
I quit taking antibiotics as soon as the symptoms go away.							
General Population	67 (19.3)	87 (25)	144 (41.4)	50 (14.4)	348 (100)	0.001	16.761
Clinical	102 (19.5)	195 (37.3)	172 (32.9)	54 (10.3)	523 (100)		
I usually skip one or two antibiotic doses.							
General Population	60 (17.2)	56 (16.1)	133 (38.2)	99 (28.4)	348 (100)	0.003	14.027
Clinical	86 (16.4)	123 (23.5)	214 (40.9)	100 (19.1)	523 (100)		
I shall use broad-spectrum antibiotics to ensure that my patient has recovered.							
General Population	39 (11.2)	107 (30.7)	161 (46.3)	41 (11.8)	348 (100)	0.036	8.554
Clinical	48 (9.2)	183 (35)	257 (49.1)	35 (6.7)	523 (100)		

Majority of the participants have taken steps to avoid antibiotic resistance in themselves (p-value= 0.000) and their family and friends (p-value = 0.000). Also, a statistical difference was found among the general population and clinical participants trying to persuade people not to self-medicate (p-value = 0.046) (Table 7).

Table 7: Practices followed by study participants to reduce antibiotics resistance

Variable	Completely Disagree (%)	Disagree (%)	Agree (%)	Completely Agree (%)	Total (%)	p – value	X^2 - Value
I've taken steps to avoid antibiotic resistance.							
General Population	19 (5.5)	34 (9.8)	170 (48.9)	125 (35.9)	348 (100)	0.000	23.951
Clinical	18 (3.4)	112 (21.4)	250 (47.8)	143 (27.4)	523 (100)		
I have taken steps for protecting my family and friends from antibiotic resistance.							
General Population	3 (0.9)	4 (1.1)	80 (23)	261 (75)	348 (100)	0.000	29.050
Clinical	9 (1.7)	12 (2.3)	203 (38.8)	299 (57.2)	523 (100)		
I try to persuade people not to self-medicate with antibiotics.							
General Population	17 (4.9)	22 (6.3)	179 (51.4)	130 (37.4)	348 (100)	0.046	7.979
Clinical	17 (3.3)	57 (10.9)	280 (53.5)	169 (32.3)	523 (100)		

DISCUSSION

This study emphasizes the urgent need for focused educational programs and evidence-based recommendations to address these problems and encourage safe antibiotic use by synthesizing the data [18, 19]. In the current study among the general public, 64.4% and 48.6% of the clinical group agreed that there are bacterial infections resistant to all antibiotics. A study conducted on the general population in Italy concluded that 94% of their participants were well aware of antibiotic resistance [20]. A study enrolling junior doctors in Sweden concluded that only 31% and 26% of the doctors knew the correct prevalence of antibiotic misuse and resistance [21]. Another study by Konde *et al.*, concluded that doctors should prescribe antibiotics according to the guidelines to control antibiotic resistance [22]. The analysis reveals a sizable knowledge gap about antibiotics and their proper usage among the general public as well as healthcare professionals. There are still misconceptions, such as the notion that antibiotics are beneficial against viral illnesses or that it is appropriate to cease taking antibiotics once symptoms subside, which can also be seen in this study among 55.7% and 10.6% of the general population and medical practitioners respectively [23, 24]. These misconceptions aid in improper intake behaviors, such as self-medication, disregard for recommended regimens, and sharing of antibiotics. Furthermore, the situation is made worse by the sharing of antibiotics, which is frequently done without the correct knowledge or direction. Due to the selection and spread of drug-resistant strains resulting from these practices, antibiotics are less efficient at treating illnesses. This study also showed that 16.6% of the general population and 13.1% of the medical population were of the view to always suggest or prescribe medication whenever someone requires them [25]. The surprising finding, however, is that the healthcare workers

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contribute to the problem's persistence. Inappropriate prescribing practices may result from a combination of many external variables and healthcare practitioners' inadequate expertise. The overuse of antibiotics, their usage for viral diseases, and a lack of adherence to evidence-based recommendations all contribute to their improper use. The general public's lack of understanding about effective antibiotic use is partly exacerbated by the little patient education provided by healthcare professionals. In the general public group, 35.9% agreed, 39.1% completely agreed and in the clinical group, 51.2% agreed and 25.4% completely agreed that the use of antibiotics in self-limiting infections contributes to antibiotic resistance. Additionally, the participants considered antibiotic resistance to be a worldwide public health concern. Among the general public participants 62/348 and 104/523 clinical considered antibiotics effective for the treatment of viral infections. These findings are supported by literature identifying concerning knowledge gaps leading to antibiotic misuse [26-29]. Alarming in this regard is the knowledge gap noted even among the medical professionals aside from general public which further points towards the dire need of identifying the knowledge gaps and working towards a solution. As can be seen in this study conducted in Peshawar, Pakistan. The requirement for thorough healthcare professional education and training programs is equally crucial. The most recent evidence-based recommendations and recommended practices for prescribing antibiotics can be kept up to date for medical professionals through ongoing professional development. Patients can be empowered to take an active role in the fight against antibiotic resistance through improved patient communication and education regarding the proper use of antibiotics, particularly the significance of following prescribed regimens. Also, future prescribers in the industry should also be properly taught and educated, as discussed in a study held in Rwanda [30]. The study has several limitations that should be acknowledged. First, the study was conducted in a specific geographical location (Peshawar, KPK, Pakistan) and may not be representative of other regions or countries. Second, the study employed a non-random convenient sampling technique, which may introduce selection bias. Third, the study relied on self-reported data, which is subject to recall and response biases. Finally, the study focused on knowledge and practices related to antibiotic resistance and did not assess actual prescribing behavior or patient outcomes. While both groups acknowledge the role of inappropriate antibiotic use in resistance, beliefs vary on specific practices. Participants express an intention to avoid unnecessary antibiotic prescriptions, but translating this intention into action is crucial. Comprehensive education on antibiotic resistance and prescribing practices should be integrated into medical education. Targeted initiatives and stricter regulation of antibiotic sales and prescriptions are necessary to combat resistance effectively. Increasing awareness and restricting inappropriate antibiotic use is vital for reducing antibiotic-resistant infections and safeguarding public health. Addressing the knowledge gap, promoting responsible prescribing, and implementing targeted education and regulations are crucial steps in tackling antibiotic resistance.

CONCLUSIONS

The study reveals that a significant portion of both the general public and clinical group recognize antibiotic resistance as a public health concern. There's strong agreement that antibiotics are effective against bacterial infections, but significant variations in beliefs about what contributes to antibiotic resistance. Most participants are committed to avoiding unnecessary antibiotics and educating others, emphasizing the need for comprehensive awareness campaigns and education in this regard.

Authors Contribution

Conceptualization: SZ, SJ, KK
Methodology: SZ, SJ, KK, HUJ, ZAK, ZA, MI, AA
Formal analysis: SZ, SJ, KK
Writing-review and editing: SZ, SJ, KK, HUJ, ZAK, ZA, MI, AA

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Conflicts of Interest

The authors declare no conflict of interest.

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