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***Original Research Article***

# Assessment of Recent Knowledge, Attitude, and Practice Towards Antimicrobial Resistance and Their Consumption During COVID-19 in Balochistan

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**Abstract:** *Antimicrobial resistance is one of the biggest problems across the world. This condition threatens the effectiveness of treatments against infectious diseases. Most people are less aware of the causes of antimicrobial resistance. The irrational use of antibiotics during the COVID era has further aggravated the situation. In the current study, the recent knowledge, attitudes, and practices related to antibiotic resistance during the COVID-19 era were assessed among the people of Balochistan.* ***Methods:*** *The World Health Organization questionnaire on antimicrobial resistance, with certain modifications, was used in this study. The population was divided into two categories: the general population and healthcare professionals, including doctors, pharmacists, and medical students. The population of each category was sampled randomly among the different districts of Balochistan. The responses to each question were recorded and statistically analyzed to evaluate the significance of knowledge about antimicrobial resistance.* ***Results:*** *A total of 250 questionnaires' responses, consisting of males 103 (41.2%) and females 147 (58.8%), were analyzed in this study. Most of the participants (69.8%) were familiar with the term "antibiotic resistance. 57.6% of respondents agreed that improper use of antibiotics causes resistance in microbes. Only 33.2% of people expressed concern that antibiotic resistance was one of the major issues worldwide. The percentage of self-medication was found to be 26.6%. Our study also showed a correlation between education level and knowledge of antibiotic resistance. The overall mean knowledge score in our study was 3.67.* ***Conclusion:*** *Our findings suggest that the people of Balochistan lack knowledge about antimicrobial resistance. Their attitude and practices toward the usage of antibiotics were not promising. There is a need to raise awareness among the public about the responsible use of antibiotics and the issue of antibiotic resistance. Our study also indicated a danger-related increase in antibiotic resistance due to the overuse of antibiotics during the COVID period.*

**Keywords:** Antibiotics, Antimicrobial resistance, Microbes, Self-medication

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## Introduction

Antimicrobial agents have been used for treating serious infections, such as skin, dental, gastrointestinal, and kidney infections, for many years. They exist naturally and can also be synthesized chemically. The first antibiotic, "Penicillin," was discovered from Penicillium notatum by Alexander Fleming in 1928 (1). There are about 20 classes of commonly used antibiotics in the world, like cephalosporins, carbapenems, aminoglycosides, tetracyclines, sulphonamides, penicillins, macrolides, lincosamides, quinolones, glycopeptides, and others (2). The irrational use of antimicrobial agents has led to the development of antimicrobial resistance (AMR), which has been ranked among the top 10 global public health threats facing humanity. An antimicrobial-resistant microbe can duplicate or persist in the presence of an increased amount of an antimicrobial agent (3). The bacterial pathogens that exhibit the greatest resistance to antimicrobial agents are Staphylococcus aureus, Enterococcus faecium, Enterococcus faecalis, Streptococcus pneumoniae, Escherichia coli, Klebsiella pneumoniae, Pseudomonas aeruginosa, and Acinetobacter baumannii (4).

Antimicrobial resistance reduces the efficiency of treatment against infectious diseases. All around the world, drug overdose causes the death of about 0.7 million people yearly. This death rate is expected to reach 10 million by 2050 (5).

Many factors can cause resistance in microbes. Microorganisms, such as bacteria, possess mechanisms of antimicrobial resistance, including horizontal gene transfer, mutation, and efflux pumps. Antimicrobial-resistant bacteria spread resistance in the environment by releasing antimicrobial-resistant genes (ARG) through mobile genetic elements such as plasmids, integrons, gene cassettes, and/or transposons. (6, 7).

Another factor that plays a vital role in the development of antimicrobial resistance is the irrational use of antimicrobials. Various investigations worldwide have shown that many patients firmly believe that antibacterial agents would reduce viral infections, such as the common cold or influenza (8). Self-medication is another reason for the irrational use of antimicrobial agents and the development of resistance in microbes.

The irrational use of antibiotics also contributes to the development of bacterial resistance. In many emerging nations, administration of antibiotics is part of medication due to a lack of appropriate diagnostic methods (9). Additionally, antibacterial obstruction can be created by medical practitioners who recommend excessive courses of the antimicrobial agent (10). The environmental microbes also develop resistance due to the use of antibiotics in agriculture. There is a growing understanding that the use of antimicrobial agents in farming and hydroponics is contributing to the spread of antimicrobial resistance in the environment (11).

Studies have indicated that antibiotics are being prescribed inappropriately, even in minor illnesses, as well as viral infections. People are also using anti-infection agents without a physician's advice, which contributes to the development of microbial resistance (12, 13). Thus, there is a need to create awareness among the people about the irrational use of antibiotics. The current study aims to evaluate the recent knowledge, attitudes, and practices regarding antibiotic consumption among the Balochistan community, particularly during the COVID-19 era.

**Methodology**

Pakistan comprises five provinces, which are further subdivided into divisions, districts, tehsils, and union councils. This study was conducted in the province of Balochistan, which consists of six divisions. The major districts based on population (Quetta, Sibi, Khuzdar, Zohb, Gawader, and Jaferabad) were selected from each division for sampling. The sample size was maintained at 250, comprising the general population, pharmacists, medical staff, doctors, and students.

A cross-sectional survey was conducted from December 2020 to February 2021 by using a questionnaire on antimicrobial resistance. The questionnaire was adapted from the WHO questionnaire with certain modifications. The questionnaire was divided into three sections. The first section contains personal/demographic questions, including gender, occupation, age, education level, and others. The second contains knowledge and practice questions related to antibiotics, microbes, and antibiotic resistance. Knowledge questions were assessed using "Yes", "No", and "Not sure" responses. The last section contains questions about attitudes towards the antibiotic resistance problem. A five-point Scale (i.e., strongly disagree, disagree, not sure, agree, strongly agree) was used as a response to questions on drug resistance. Educated individuals who could understand English and agreed to participate in the study were given questionnaires. In comparison, interviews were conducted among less educated individuals. The questions were also asked in their local languages (Pashto and Balochi) in addition to Urdu, among the less educated population. Two hundred fifty participants were included in the survey, all of whom responded to all questions.

Descriptive statistics were performed to summarize demographic characteristics and responses to the knowledge, attitude, and practice (KAP) questions, with results presented as percentages. Additionally, statistical significance was assessed using p-values computed through SPSS software.

**Results**

Two hundred and fifty (250) questionnaires were analyzed. Among 250 participants, the majority were females (58.8%) as compared to males (41.2%). The highest proportion of all respondents was between the ages of 15 and 24 years (45.6%). The data demonstrated a significant interaction between the age and gender of respondents ($\chi^2 = 47.775$; $p < 0.001$). Most participants belonged to the non-medical field (58%), and only 20% were related to the medical field. Most participants held a Bachelor's degree (32.8%) or a Master's/Professional degree (32%), while a small number had no formal schooling (2.4%). The socio-demographic characteristics of the participants are presented in Table 1.

The majority of participants were familiar with the terms "antibiotic resistance" (69.8%) and "drug resistance" (59.1%). Only a few were unfamiliar with either term (7.2%). Respondent's familiarity with terms used for drug resistance is shown in (Figure 1A). Their primary source of information on antimicrobial resistance was health practitioners, specifically doctors and Nurses (34.8%), followed by family members and friends (33.9%), as shown in Figure 1 B.

Most respondents consumed Amoxicillin and Azithromycin as antibiotics, while some (7.2%) also took Metronidazole (Figure 2A). Mostly, respondents consumed antibiotics during infection(48.8%) while others consumed them even in pain(11.6%), as shown in Figure 2B. Most respondents had consumed antibiotics within the last 1 to 6 months of the survey, as shown in Figure 3.

Figure 4 indicates the participants' responses toward self-medication. Sixty-seven % of the respondents consumed antibiotics when prescribed, while 26.6% of them consumed them without a prescription.

An overview of responses to knowledge questions is given in Table 2. Out of 250 participants, 222 understood the concept of antibiotics, while 28 were unaware of antibiotics. 68.4% of respondents recognized that using antibiotics frequently was not beneficial for their health, whereas 15.6% considered it beneficial. Fifty % of them agreed that antibiotics are widely used in agriculture (including in food-producing animals), while 8% disagreed. 48% of the respondents considered that hospitals/diagnostic labs had some role in promoting antimicrobial resistance, while 8.8% of them disagreed with this fact.

Regarding their knowledge of microbes, 170 participants were well-informed, while 80 did not know anything about them. 58.8% of the respondents considered bacteria to be microbes, whereas 7.6% of them were not in favor of this view.

82% of them responded that bacteria could cause disease, whereas 3.6% disagreed. 57.6% of respondents believed that the improper use of antibiotics could lead to microbes becoming resistant to antibiotics, while 9.6% disagreed.

Regarding the antibiotic resistance problem, Majority of respondents (70%) were strongly agreed that doctors should prescribe antibiotics when needed while (2.8%) of them were strongly disagreed. 33.2% of respondents agreed strongly that antibiotic resistance was one of the biggest problems worldwide, while 4.4% of participants disagreed strongly. 38%of respondents strongly agreed that medical experts would solve the problem of antibiotic resistance before it became too serious, while only 1.2% strongly disagreed. 46% of participants also strongly agreed that they were not at risk of getting an antibiotic-resistant infection, as long as they took antibiotics properly; on the other hand, 1.6% disagreed with this. Our data also show a significant correlation between respondents' awareness of antibiotics, health impact, and their gender ($x^2 = 19.015$; $p < 0.001$). The level of education also has a significant interaction with the knowledge of respondents. Overall, the Mean knowledge score is (3.67). The overall response toward the solution of antibiotic resistance is given in Figure 5.

**Table 1: Socio-demographic characteristics of participants.**

| Characteristics | n (%) |
|---|---|
| Gender | |
| Male | 103 (41.2) |
| Female | 147 (58.8) |
| Age group | |
| 15-24 | 114 (45.6) |
| 25-34 | 92 (36.8) |
| 35-44 | 20 (8) |
| 45-54 | 15 (6) |
| 55-64 | 6 (2.4) |
| 65+ | 3 (1.2) |
| Education level | |
| No formal education | 6 (2.4) |
| 12th grade or less qualification | 52 (20.8) |
| Vocational education | 10 (4.0) |
| Bachelor's degree | 82 (32.8) |
| Master's/Professional degree | 80 (32) |
| Doctorate | 20 (8) |
| Occupation | |
| Medical fields | 50 (20) |
| Non-medical fields | 145 (58) |
| Students | 40 (16) |
| Housewife's | 15(6) |

**n is the number of participants, and (%) is the percentage.*

**Table 2. Overview of Responses to Knowledge Questions.**

| Knowledge related to antibiotics | Good | Poor | Doubtful | *p- values* |
|---|---|---|---|---|
| Awareness of antibiotics | 222 (88.8) | 28 (11.2) | - | 0.315 |
| Danger-related antibiotics | 79 (31.6) | 64 (25.6) | 107 (42.8) | 0.093 |
| Excessive usage of antibiotics | 39 (15.6) | 171 (68.4) | 40 (16) | 0.787 |
| Usage of antibiotics in agriculture | 125 (50) | 20 (8) | 105 (42) | 0.265 |
| Hospitals/diagnostic labs spread antimicrobial resistance | 120 (48) | 22 (8.8) | 108 (43.2) | 0.312 |
| Knowledge related to microbes | | | | |
| Awareness about microorganisms | 170 (68) | 80 (32) | - | 0.165 |
| Familiar with microbial forms | 118 (47.2) | 132 (52.8) | - | 0.006 |
| Bacteria are a microbe | 147 (58.8) | 19 (7.6) | 84 (33.6) | 0.316 |
| Awareness about Pathogenic bacteria | 205 (82) | 9 (3.6) | 36 (14.4) | 0.038 |
| Awareness about Beneficial bacteria | 201 (80.4) | 17 (6.8) | 32 (12.8) | 0.001 |
| Indiscriminate use of antibiotics and resistance development | 144 (57.6) | 24 (9.6) | 82(32.8) | 0.335 |

***In brackets, percentages are given for each question with the response***

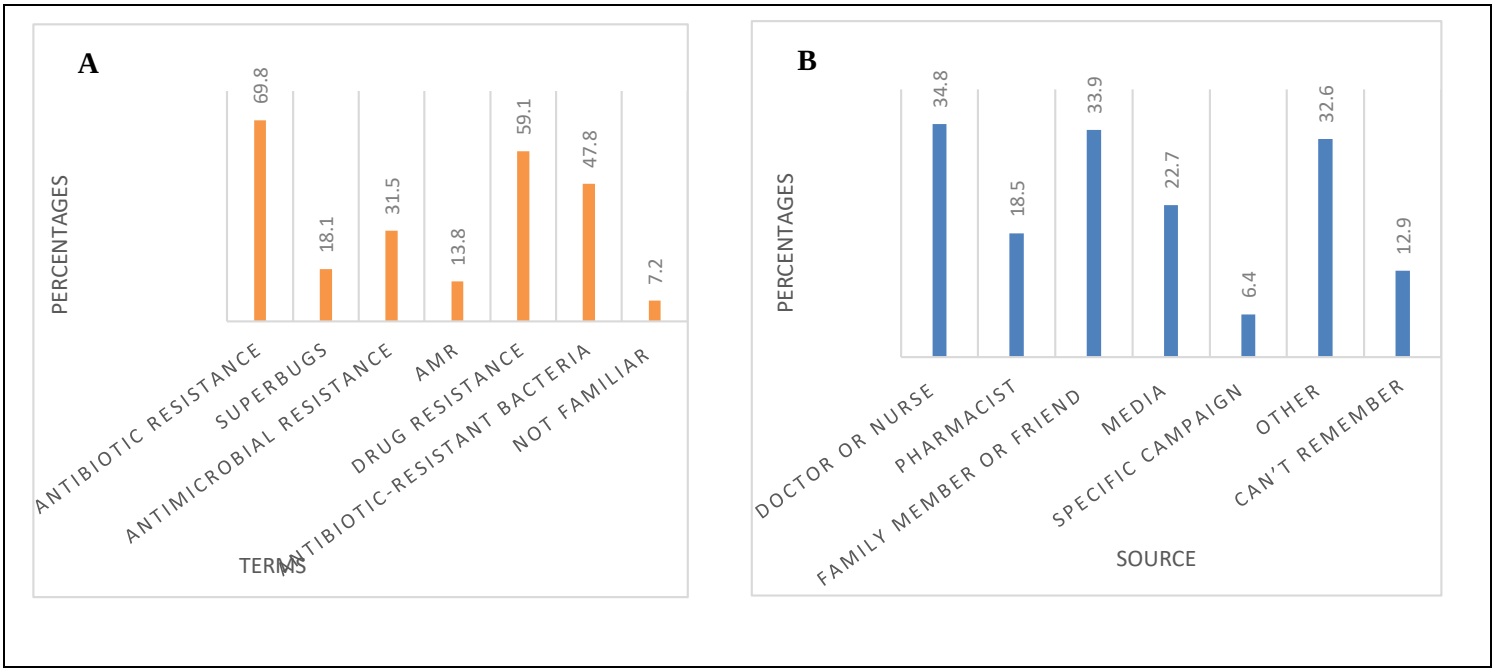


**Figure 1. Respondents' familiarity with terms used for drug resistance (A) and source of information on drug resistance (B).**

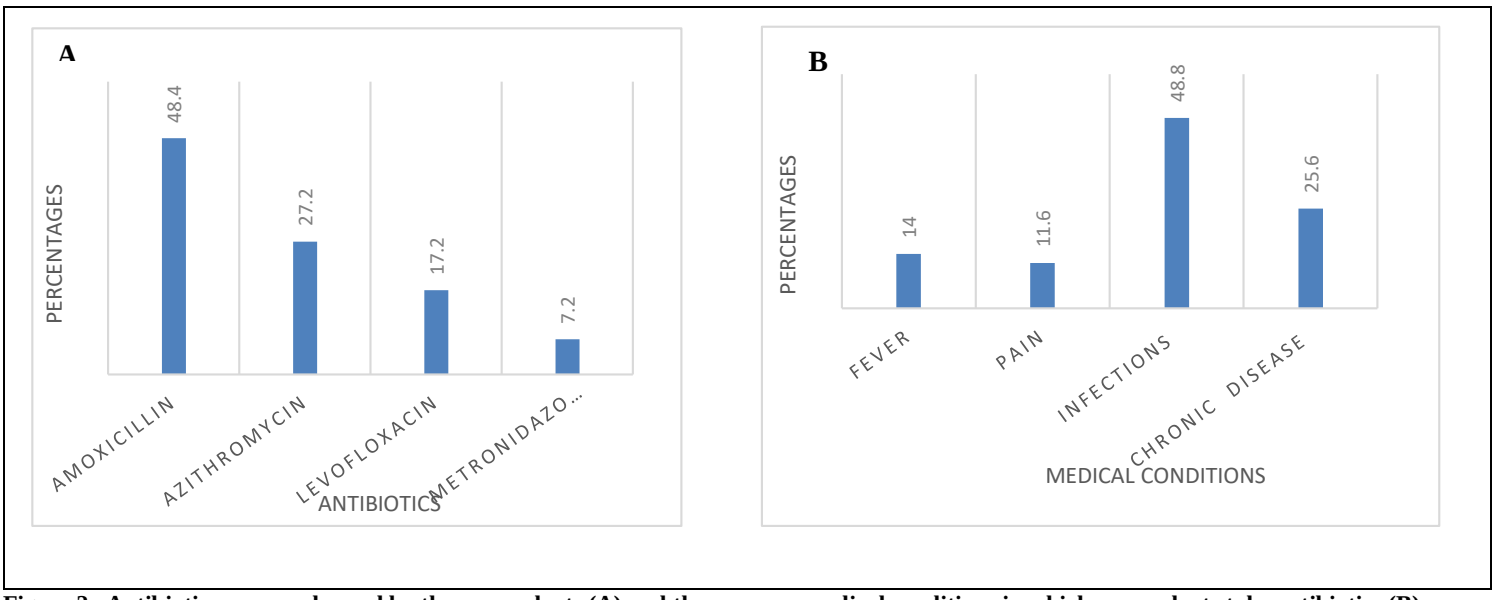


**Figure 2. Antibiotics commonly used by the respondents (A) and the common medical conditions in which respondents take antibiotics (B)**

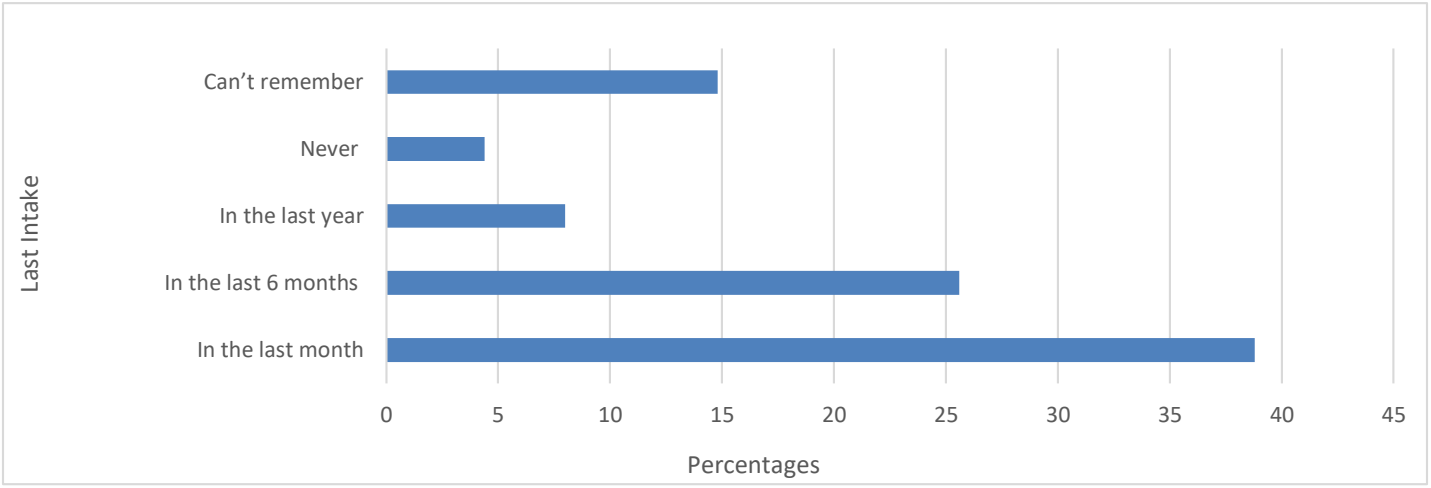


**Figure 3. Consumption of antibiotics by respondents**

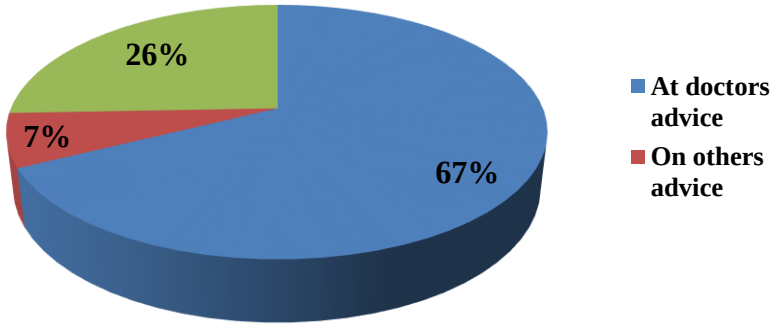


**Figure 4. Assessment of self-medication in participants**

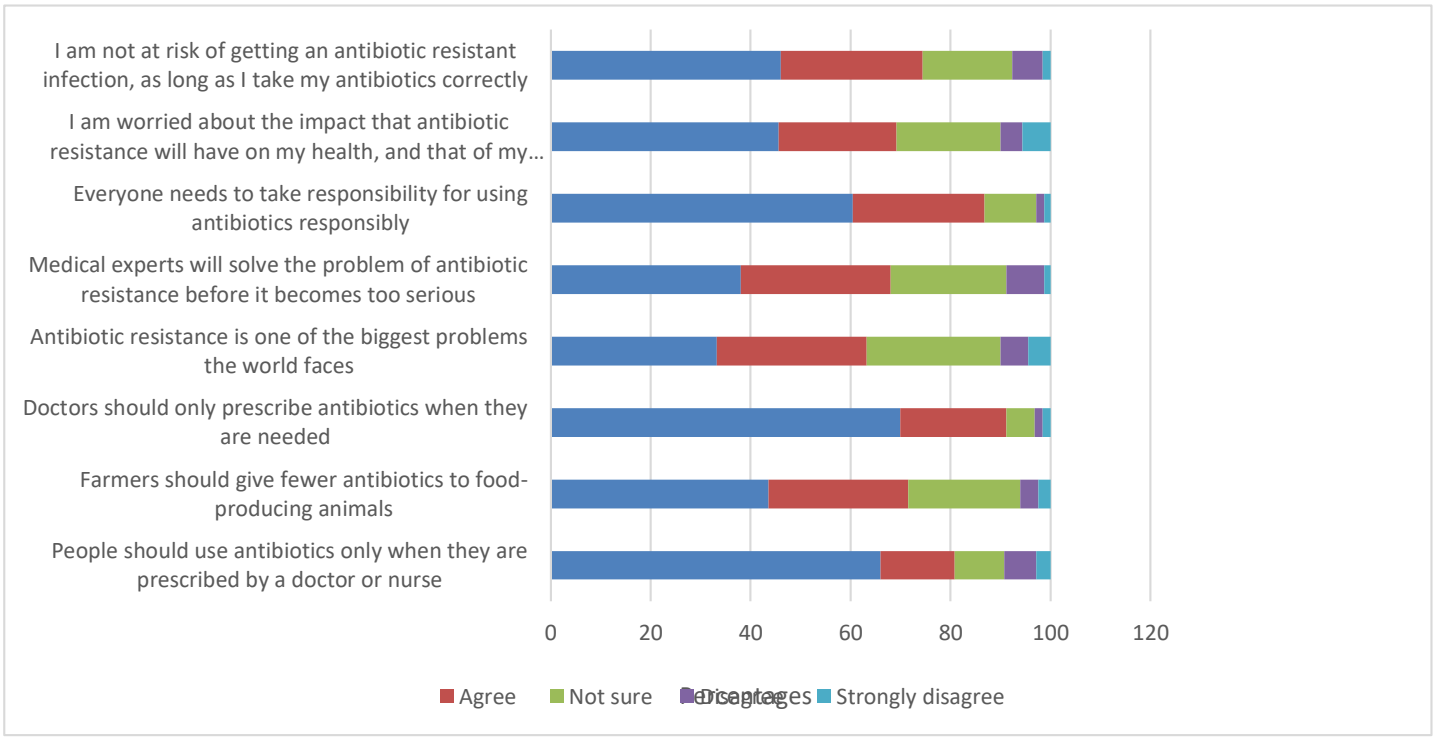


**Figure 5: **In brackets, percentages are given for each question with response***

**Discussion**

Antibiotic resistance is one of the major problems worldwide, reducing the effectiveness of treatment. It has become a serious issue in developing countries, including Pakistan, as they use antibiotics extensively in clinical treatments, agriculture, and livestock. Several factors contribute to the development of microbes resistant to antimicrobial agents, including inadequate public awareness and the improper use of antibiotics. In the present study, we utilized a customized version of the WHO questionnaire on antibiotic resistance, designed to assess the knowledge, attitudes, and practices (KAPs) of the Balochistan community.

Overall, our study revealed that the community had moderate knowledge about antibiotic resistance and its health implications. The highly educated individuals had better knowledge of antibiotics compared to those with less education. These findings were similar to those of earlier reports/ surveys conducted among the public of Cyprus and Lebanon (14, 15). The majority of participants were familiar with the terms used for antimicrobial resistance, antibiotic resistance, and drug resistance. Their sources of information were doctors, nurses, pharmacists, family, and friends. These findings were similar to those of studies conducted in Nigeria, Pakistan, and Cyprus (14, 16-18). Self-medication is a common practice in both developed and developing countries, with rates ranging from 3 to 75% (19, 20). The Misuse of antibiotics as self-medication is very common in our society. The prevalence of self-medication recorded in this study is 25.6%, which differs from previous regional studies conducted within Pakistan. Our results are slightly higher than those of the study performed in Karachi, and in contrast to the study conducted in Islamabad, they show a higher percentage (77.03%) of self-medication (13, 21). The factors contributing to self-medication in Pakistan are the lack of healthcare knowledge, ease of access to medicines, poor accessibility to healthcare providers, and lack of public healthcare facilities (22-24).

The use of broad-spectrum antibiotics for minor infections can also contribute to the development of bacterial resistance.

Amoxicillin (broad spectrum) is the frequently used antibiotic reported by participants in our survey. Likewise, the finding was also reported by Javed in his study. The most probable reason for using a drug is the prior experience of participants, based on the assumption that the same or similar symptoms of a disease or infection can be treated with the same drug used earlier (21).

Almost all respondents have taken antibiotics for infections, regardless of whether they were bacterial or viral in origin. Consuming antibiotics for viral infections can also cause bacterial resistance. Even some consume antibiotics for pain. These practices indicate a lack of proper knowledge and misconceptions about antibiotics among the public. The study of Khan et al also focuses on the same point (25).

More than half of the total participants (64.4%) reported taking antibiotics in the six months preceding the survey. It has been observed that antibiotic use has increased during the COVID-19 pandemic. Doctors have prescribed broad-spectrum antibiotics to COVID-19 patients, and people have also taken antibiotics on their own as a precautionary measure. The consumption of antibiotics during the COVID-19 pandemic was investigated in a study conducted at an Italian university hospital (26).

Healthcare professionals have a vital role in contributing to bacterial resistance. Some doctors prescribe medicines even for minor illnesses, as well as for viral infections, which is not a healthy practice. Seventy % of respondents in our study agree that doctors only prescribe antibiotics when necessary. Doctors' prescriptions are based on their knowledge or incorrect information about the patient's indications for antibiotic use. Some of them are easily influenced by the pharmaceutical industry, which engages in various immoral practices, and patients demand quick relief in the form of antibiotics (27, 28).

Microbes that are present in the environment become resistant due to the use of antibiotics in agriculture and livestock. 50% of participants agree that antibiotics are widely used in agriculture and livestock in our country. 43.6% of respondents believe that farmers should administer fewer, but highly necessary, antibiotics to food-producing animals and plants for their growth.

Proper handling and proper disposal of laboratory waste also play a role in antimicrobial resistance. 48% of people agree that hospitals/diagnostic labs have a significant role in promoting antimicrobial resistance. Multiple studies have been conducted to evaluate standardized laboratory practices within Pakistan. Studies indicated that 21% of respondents who worked in laboratories did not maintain standard operating procedures (SOPs). Additionally, reported rates of awareness regarding the role of waste removal, sterilization, and hand washing in restricting the spread of antimicrobial resistance were 75%, 42%, and 81%, respectively (29).

45.6% of the public is concerned and worried about the impact that antibiotic resistance will have on their health and that of their family, whereas 46% agree that they are not at risk of getting an antibiotic-resistant infection, as long as they take antibiotics correctly.

Overall, our results suggest that there is a need to educate people, including physicians, farmers, pharmacists, and the general public, about the appropriate use of antibiotics. Awareness campaigns (seminars, workshops, programs, public discussions) should be arranged for the public. In Pakistan, the media has a significant influence, allowing it to play a crucial role in raising awareness about antibiotic resistance among the public. The media should promote the campaign against the inappropriate use of antibiotics.

Strict laws should be enforced for selling antibiotics and drugs without a prescription. The consumption level of antibiotics should be monitored in humans, animals, and plants at the Federal and Provincial levels. Physicians should discourage the excessive use of antibiotics and prescribe them as a last resort. The Federal Government and an Advisory Body might be established to develop National Infection Prevention and Control Guidelines and to establish a system and instruments for their implementation and monitoring by relevant specialists.

**Conclusion**

This study presents data on antimicrobial resistance awareness among the community of Balochistan. It concludes that the public has moderate knowledge related to antibiotics and antibiotic resistance. Their attitude towards antibiotic consumption and practices is not very promising. The education/awareness of people regarding the safe and proper use of antibiotics and the threats related to antibiotic resistance are quite necessary. The government should make policies regarding antibiotic misuse not only on a national level, but also on a provincial level in Pakistan. Our study also highlights the risk associated with an increase in antibiotic resistance resulting from the irrational use of antibiotics during the COVID period.

**Declarations**

**Data Availability statement**

All data generated or analysed during the study are included in the manuscript.

**Ethics approval and consent to participate**

Approved by the department concerned. (IRBEC-24)

**Consent for publication**

Approved

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**Conflict of interest**

The authors declared the absence of a conflict of interest.

**Author Contribution**

**FM** (Scientific Officer)

*Manuscript drafting, Study Design,*
**MGS** (WMO)
*Review of Literature, Data entry, Data analysis, and drafting an article.*
**AK** (Technical Manager)
*Conception of Study, Development of Research Methodology Design,*
**AA** (Associate Professor)
*Study Design, manuscript review, and critical input.*
**GS** (Director)
*Manuscript drafting, Study Design,*

*All authors reviewed the results and approved the final version of the manuscript. They are also accountable for the integrity of the study.*

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