



National Journal of Biological Sciences

Received: 29th January, 2023

Revised: 20th March, 2023

Accepted: 23rd June, 2023

Published: 25th June, 2023

DOI: <https://doi.org/10.37605/v4i1/3>

RESEARCH PAPER

TITLE

REGULAR USE OF ANTIBIOTICS AMONG THE STUDENTS OF LAHORE: A SURVEY BASED STUDY

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REGULAR USE OF ANTIBIOTICS AMONG THE STUDENTS OF LAHORE: A SURVEY BASED STUDY

Abstract:

This research investigates antibiotic usage patterns among university students in Lahore, Pakistan. The study, conducted through a cross-sectional design with a sample of 50 participants, reveals a high level of awareness about antibiotics among students. However, prevalent misconceptions persist, including the belief that antibiotics are effective against viral infections. Findings indicate that a significant proportion of students have used antibiotics in the past year, with common reasons including flu and cold. The study sheds light on the easy availability of antibiotics without prescriptions, contributing to self-medication practices. Despite awareness of antibiotic resistance, discussions with healthcare providers remain limited. The study suggests a pressing need for educational initiatives, stricter regulations on antibiotic sales, and enhanced awareness campaigns to address these issues among university students.

Key words: Antibiotics, Self-Medication, Antibiotics Resistance, Awareness, Infections

1. Introduction

An Antibiotic is an organic substance synthesized by microbes during the log phase. Microbes synthesize antibiotics to survive in a competitive environment to kill other bacteria. Being the most important antibacterial agent that microbes use against bacteria, antibiotics nowadays are used to treat a variety of bacterial infections [1].

Different Antibiotics work differently, for example, sulfonamides also known as sulfur drugs, interfere with the synthesis of nucleic acids. Folic acid is vital for the synthesis of nucleic acid. Synthesis of folic acid requires PABA. PABA is similar in structure to sulfamethoxazole. Sulfamethoxazole competes with PABA and inhibits the production of folic acid. Isoniazid another type of antibiotic interferes with the synthesis of bacterial cell walls. Quinolones are narrow-spectrum antibiotics and prevent nucleic acid synthesis [5].

The discovery of penicillin in 1928 by Alexander Fleming revolutionized the medical world. The accidental discovery of antibiotics kick-started a new era of medicine which later became a matter of high concern for the medical professionals. Mass antibiotic production started in the mid-1900s, also known as the golden era. Penicillin was the

first antibiotic to be mass-produced. Since then, numerous antibiotics have been introduced [1]. Long-term use of antibiotic resistance induces multiple types of changes in the bacteria that result in the resistance. Bacteria can make antibiotics harmless by following methods: Hydrolyzing the antibiotics, modifying the chemical structure of the antibiotics, modifying the structure of the target, altering the metabolism that the antibiotic targets, and by preventing drug entry. For example: Penicillin, an antibiotic with a beta-lactam ring, targets the peptidoglycan ring. Bacterial species resistant to penicillin produce beta-lactamases that destroy the beta-lactam ring by breaking it, hence converting it into harmless penicilloic acid. Tetracycline-resistant *E. Coli* contains pumps in cytosol and membrane that remove antibiotics from the bacteria before tetracycline can exhibit any effect. Streptomycin-resistant bacteria modify aminoglycoside so that it cannot bind to the ribosome. These bacteria have also shown resistance by altering the structure of their ribosomes so that streptomycin does not bind to them [5].

The resistance in the parent cell is easily transferred vertically into the next generation of bacteria. Along with this bacterium also transfer resistance horizontally. The mutant

gene is transferred to the other cell by transformation, transduction, and conjugation. Bacteria can also transfer genes via binary fission. Bacteria can become resistant to more than one antibiotic [5].

Antibiotic resistance increases pressure amongst scientists and pharmacists to produce new drugs to combat the ever-emerging species of newly resistant bacteria. Natural Penicillin, which is Penicillin V, has four derivatives which are Amoxicillin, Methicillin, Ampicillin, and Carbenicillin. These synthetic structures of Penicillin were synthesized because of bacterial resistance. Each of them has slight differences in their structure. Cephalosporins, another type of broad-spectrum antibiotic, have different beta-lactam rings. These antibiotics are used to treat gram –Ve bacteria for bacteria where penicillin resistance is observed. The drug penetrates the protein proteins present in the outer membrane and disrupts the structure of bacteria. Pharmacists have modified the chemical structure of cephalosporins to make different generations of cephalosporins to cope with bacterial resistance and to improve the treatments. Each successive drug is used for bacteria that were resistant to the previous generation's drug. Vancomycin is another drug that is used as a drug of last resort but even with restricted use resistance of this

drug has been reported [5].

Over the years, bacterial activity against bacteria has been observed and studied, resulting in bacterial resistance becoming a prominent cause of concern for scientists. Bacteria can develop defense mechanisms to reverse the effects of antibiotics and inactivate them. Not only can bacteria transfer the resistance to its new generations, but it can transfer to other types of bacteria as well, making it another serious concern for the medical community [1].

Considering the adverse effects of bacteria, many countries have formulated laws. With strict implementation of laws such as banning antibiotics to limiting the access of antibiotics to the public, the governments of developed nations have tried their best to prevent bacterial resistance in their population [2].

In underdeveloped nations, like Pakistan, where literacy rates are low and medical facilities are expensive people prefer self-medication to visiting the doctor. The availability of antibiotics without prescription makes it evident that the implementation of laws is poor. The use of antibiotics is prevalent in Pakistan not only among illiterate but also among students [2]. In recent years Pakistan has seen a drastic increase in new strains of bacterial infections

including typhoid fever. This can be attributed to the irregular and frequent use of antibiotics that comes with the lack of awareness about the graveness of the consequences. The common practices in the population that contribute to the rise of resistant bacterial species include the availability of antibiotics without physicians' prescription, discontinuing the use of antibiotics after the symptoms disappear, frequent use of antibiotics, use of broad-spectrum antibiotics, and self-medication [4].

We aim to find out the frequency of antibiotic use among university students. University students are educated, have access to information via the Internet, and are open to accepting new ideas. A survey conducted by the European Commission and World Health Organization concluded that there was an association between the knowledge of disease and antibiotic use.[3]

Studies conducted in Pakistan have also reported that antibiotics are often misused for symptoms, for example, they are often used when symptoms of upper respiratory tract infection appear which could be due to viral infections. In such cases the antibiotics are not effective and can lead to undesirable effects which can worsen the situation [4]. The Ministry of National Health Services is working with veterinary health professionals

and health development partners to address the issue. Pakistan has now completed a national action plan to educate the masses about antibiotic resistance and the threats it poses to the health of the public. This plan was completed with assistance from WHO. WHO and OIE help countries draft SOPs and standard practices to eradicate diseases [6]. Self-medication is the most critical reason that is driving antimicrobial resistance. People tend to use the leftover prescription antibiotics. People also tend to misuse the prescription to get antibiotics. Not only the misuse of antibiotics in humans but the misuse in livestock also causes resistive bacterial species to emerge. According to scientists, by 2050 there will be more than ten million deaths due to bacterial infection that would be the result of resistant strains. Developing countries will be the most strained due to these deaths. Bacterial resistance is emerging at an exponential rate whereas the antibiotic pipeline is dwindling [4].

University students have access to the latest information due to the internet and social media. 22 million of its population is young and Lahore is one of the most literate cities. We aim to find out the trend of antibiotic use among university students in Lahore.

2. Rationale

In today's era of medicine and health sciences,

the world has made significant progress, one such progress includes the production of antibiotics that have helped in controlling and treatment of many diseases. The use of antibiotics has become a regular behavior now. The main purpose of this research is to study and identify the factors that are responsible for the regular intake of antibiotics among students. The use of antibiotics is prevailing at a higher rate. The main focus of this study is to determine this prevalence among university students. This study also aims to determine whether the regular intake of antibiotics is associated with severe health problems or whether the students regularly use antibiotics for mild health issues such as flu, sore throat, stomachache, and headache. Another factor of focus in this study is to determine the uncontrolled and unprescribed use of antibiotics among students. Many students use unprescribed antibiotics and use them for diseases not treatable with antibiotics. This research aims to provide students with the knowledge of controlled and prescribed use of antibiotics. This study will show the average percentage of students using antibiotics daily. This study will provide data on factors responsible for increasing and unnecessary regular intake of antibiotics so that such factors can be further controlled and

reduced.

3. Objectives

The main objectives of this study will be to:

- Determine the prevalence of regular use of antibiotics among students.
- Identify the reasons for regular intake of antibiotics among students.
- Determine if the regular use of antibiotics is related to severe health problems or mild health issues.
- Identify ways by which unnecessary intake of antibiotics could be reduced

4. Literature Review

Antibiotics are a commonly prescribed class of medications for the treatment of bacterial infections. They have been lifesaving in the treatment of various infections, but their misuse has resulted in the emergence of antibiotic-resistant bacteria, making it difficult to treat infections. It is essential to understand the prevalence of regular use of antibiotics among students to address the issue of antibiotic resistance and take measures to deal with this threat to human health [5].

Studies around the world have been conducted to assess the knowledge, attitude, and practice of students towards antibiotic use. Studies have shown that students are frequent users of antibiotics, with the prevalence of self-medication and non-prescription use being high. Fadare et al. [5]

conducted a study in Nigeria and found that 53.7% of university students reported using antibiotics without a prescription. Jairoun et al. [7] study also showed high antibiotic self-medication among students with 38.3% of students using antibiotics without a prescription in the last 6 months of period, in Ajman University UAE. A survey conducted in a medical school in the United States found that 45% of students reported using antibiotics in the past year, and only 14% had a prescription for their most recent use of antibiotics. Another study in the United Kingdom found that 36% of university students had used antibiotics in the past year, and 28% had used antibiotics without a prescription. According to Virmani et al. [13] Indian university students showed antibiotic use as a frequent practice, 58% of students regularly used antibiotics while 30% of the student population acquired antibiotics without a prescription [13]. A study published in the Journal of Infection and Public Health in 2020 found that among university students in Saudi Arabia, 26.8% reported using antibiotics without a prescription in the past year. The study also found that students who had a higher level of knowledge about antibiotics were less likely to engage in self-medication. In a study published in the Journal of Global

Antimicrobial Resistance in 2019, researchers examined antibiotic use among undergraduate students in Ethiopia. The study found that 22.3% of the students reported using antibiotics without a prescription in the past year.

According to Fadare et al. [5] study the most common reasons reported for the use of antibiotics among students were upper respiratory tract infections, sore throats, coughs, and colds with cough (57.5%), followed by sore throat (40.6%) and fever (23.5%) [5]. Jairoun et al. [7] showed that in United States university students, upper respiratory tract infections were the most common reason reported for antibiotic use (81%), followed by sinusitis (23%) and urinary tract infections (17%). According to Hassan et al. [7] the most commonly used antibiotics among students were amoxicillin and cephalosporins, with 43.6% of students using amoxicillin and 32.9% of students using cephalosporins, this finding is also consistent with other studies [7]. Amoxicillin belongs to the penicillin-like antibiotic group and it stops the growth of bacteria, students have reported using amoxicillin for treating chest infections. On the other hand, cephalosporins belong to the beta-lactam group of antibiotics which works by killing the bacteria to treat the infection, students have reported using

cephalosporins mostly for treating skin infections and strep throat [14].

The knowledge about antibiotics has been found poor among students. The majority of the student population believed that antibiotics could treat viral infections. Jairoun et al. [7] showed that 48% of students believed that antibiotics can be used for infections caused by viruses [7]. Sunusi et al. [8] study showed that 42% of university students in Sudan believe antibiotics can be used for fungi and viral infections [8]. Sakeena et al. [9] found a little different pattern of antibiotic use, knowledge, and practice among students of developed and developing countries in a study conducted jointly in universities of Australia and Sri Lanka. The study found that overall practice and attitude towards antibiotic usage was found good among students of universities of Australia, a developed country but found less among students of universities of Sri Lanka, a developing country [9]. The regular use of antibiotics can result in the development of antibiotic-resistant bacteria, which can be difficult to treat and pose a threat to human health. Giacomo et al. [10] assessed the knowledge about antibiotic resistance and it was found to be good among medical studies but poor among non-medical students as found in a study conducted among medical

university students in Italy and medical university students of Sudan [8] [10]. The study also found that students who had a higher level of knowledge about antibiotics were less likely to engage in self-medication. Yin X et al. [11] examined the prevalence and determinants of antibiotic use among college students in China. The study found that 43.6% of the students had used antibiotics in the past year, and 6.3% of those students had used antibiotics without a prescription. The study also found that students who had a higher level of antibiotic knowledge were less likely to misuse antibiotics [11]. Another prevalent issue regarding antibiotic misuse is the availability of antibiotics over the counter without prescription, studies show that most students from developing countries have easier access to antibiotics over the counter. Some studies have also enlightened the issue of storing the antibiotics at home and students refer to them when they feel the need, this causal self-medication is a serious threat to antibiotic misuse.

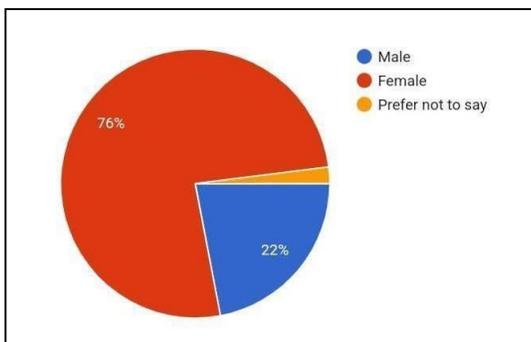
Additionally, the overuse of antibiotics can lead to the development of adverse drug reactions and disruption of the normal flora, leading to opportunistic infections. The misuse of antibiotics can also result in unnecessary healthcare expenditures and contribute to the rising costs of healthcare [7]. Overall, the

knowledge about antibiotic use was found to be fair among students but the practice and attitude were found to be relatively poor. Even with knowledge, students showed poor practice towards controlled and prescribed use of antibiotics. We aim to find out the frequency of antibiotic use among university students. University students are educated, have access to information via the Internet, and are open to accepting new ideas. A survey conducted by the European Commission and World Health Organization concluded that there was an association between the knowledge of disease and antibiotic use [3]. Nepal et al. [12] in the WHO South-East Asia Journal of Public Health examined the prevalence and predictors of self-medication with antibiotics among university students in Bangladesh. The study found that 65.5% of the students had self-medicated with antibiotics in the past year, and the most common reasons for self-medication were cough, sore throat, and fever. The study also found that students who had a higher level of knowledge about antibiotics were less likely to self-medicate with antibiotics [12].

Regular use of antibiotics among students is a prevalent problem, and it is essential to understand the reasons for their use to develop appropriate interventions to address this issue. It is necessary to educate students about the appropriate use of antibiotics and the

consequences of their misuse. It is also crucial to take measures for the prescribed selling of antibiotics and to increase access to healthcare services to promote the appropriate use of antibiotics and prevent the development of antibiotic-resistant bacteria [6]. Workshops and symposiums can be carried out in universities to deliver knowledge of safe antibiotic practices and awareness about antibiotic resistance and to address the need to prevent the irrational use and misuse of antibiotics.

Most studies conducted cross-sectional studies among university students from multiple study backgrounds using self-administered questionnaires for data collection and followed random sampling. The strong determinants in knowledge, attitude, and practice towards antibiotic use were found to be major, gender, age, and study year of students. Our study follows up on the existing knowledge on antibiotic use among students and contributes the



knowledge about attitudes and practices towards antibiotic use of students in universities of Pakistan as currently many

studies have not been conducted covering students belonging to different study backgrounds and female students in universities of Pakistan.

CHAPTER III METHODOLOGY

- **Study design:**

The present study falls in the category of Applied research of qualitative type, cross-sectional studies.

- **Study location & sample size:**

The study was carried out in Lahore and 50 participants were taken from the different Universities of Lahore.

- **Data Collection Method:**

The data was collected in the form of a questionnaire through Google Forms.

- **Questionnaire:**

The demographic variables included in the questionnaire were age, gender, area of residence, and socioeconomic status.

5. Results

In the present study, random data collection of 50 participants was done. Responses were taken through a Google form comprising 14 questions.

- **Gender Distribution:**

The demographic finding of this study revealed that out of 50 subjects, 76 % were females, 22 % were males, and 1 % preferred not to say belonging to the age group from 15-25 years.

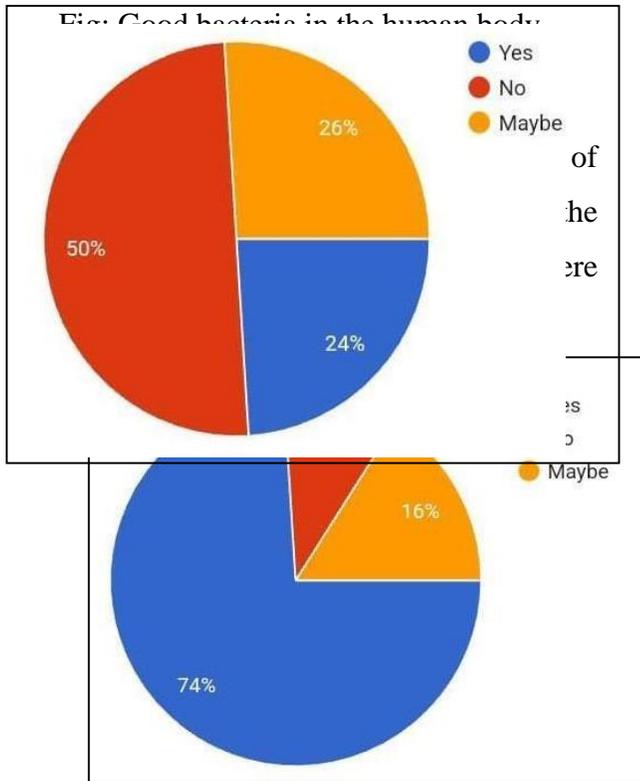
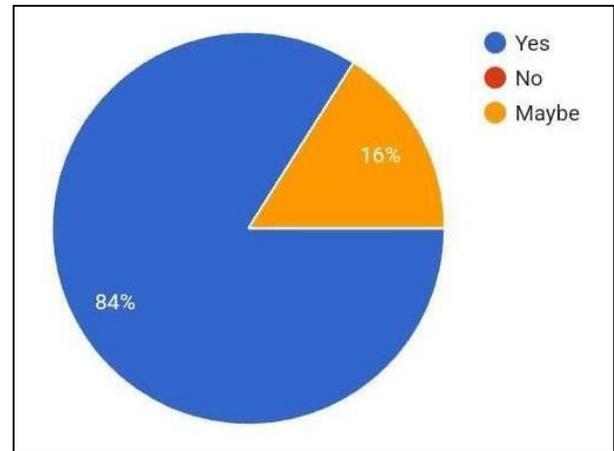


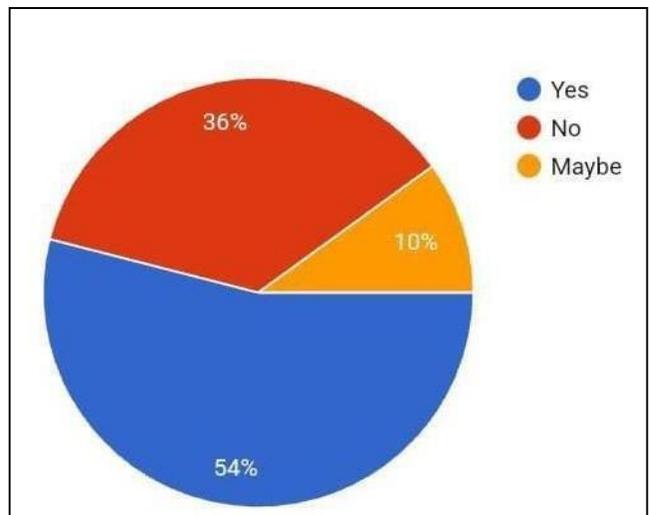
Fig: Antibiotic Information

• **Usage of Antibiotics:**

It was found that 84% of students possessed knowledge about the usage of antibiotics for bacterial infections, whereas 24 % of students believed that antibiotics could be used for viral infections. The study also revealed that 54 % of the students have been using antibiotics for cold and flu.



A



B

Fig A, B: Student’s knowledge about antibiotics for bacterial infections and Viral Infections

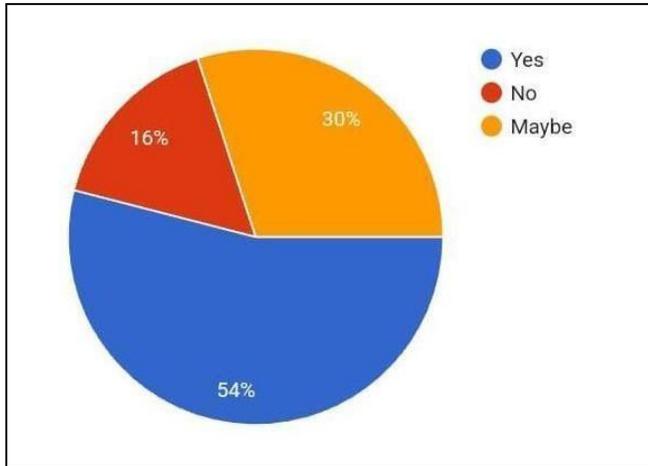


Fig: Antibiotic use for Cold/Flu

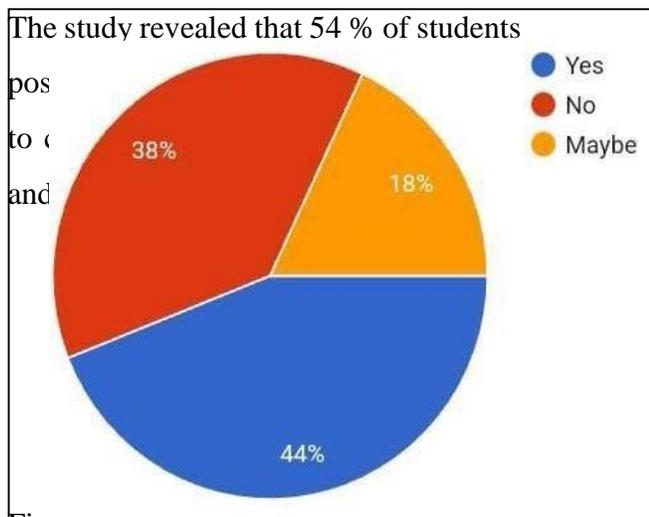
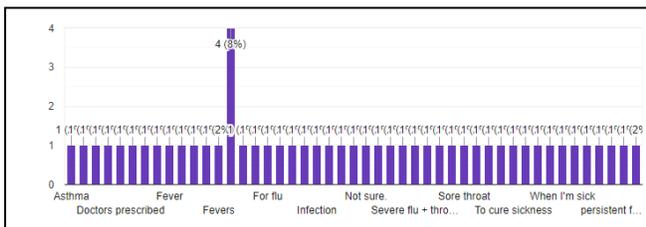


Fig: Antibiotic use for illness

• Reason for Antibiotic Usage

There were varied responses from students about the most common reason they take antibiotics. The majority of the responses



were about the usage of antibiotics for fever. Some of the responses were related to Asthma and throat infection.

Fig: Use of antibiotics by the participants

• Availability of Antibiotics

90 % of the responses showed that antibiotics are available at pharmacies without a prescription and 44 % of participants responded that they had taken antibiotics without a prescription.

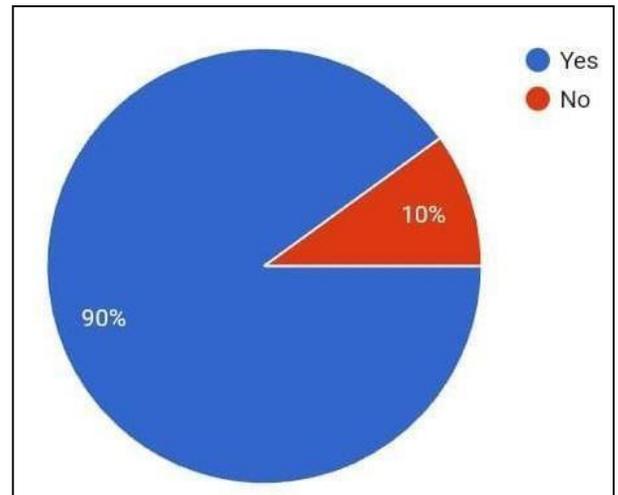


Fig: Availability of antibiotics at pharmacies

Fig: Usage of antibiotics without prescription

- **Effect of Antibiotics**

The study revealed that 46 % of the people have never faced any side effects from antibiotics, 26 % have not experienced and 26 % were unsure about any side effects.

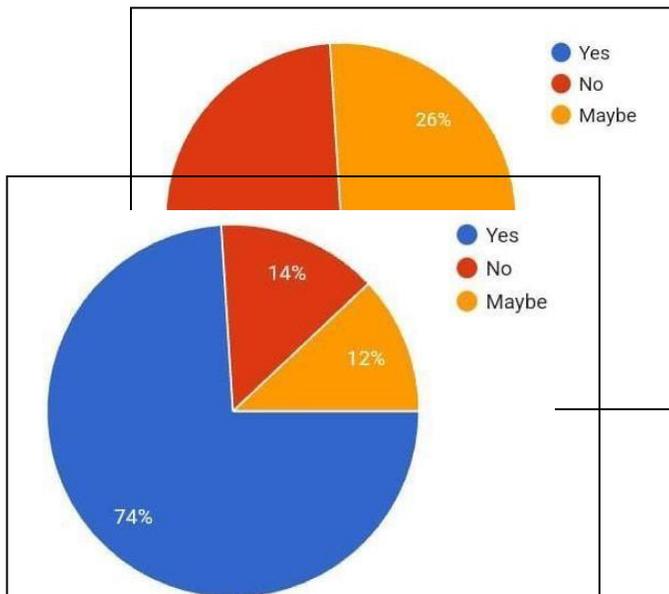


Fig: Usage of antibiotics without prescription

- **Antibiotic Resistance**

The study revealed that 60 % of the participants were aware of risks, such as antibiotic resistance, associated with regular use of antibiotics.

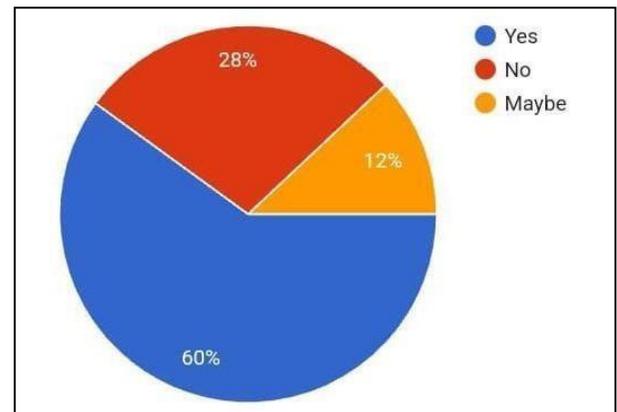


Fig: Awareness of antibiotic resistance

- **Abuse of Antibiotics**

The statistics from the participants showed that 74 % agreed with the abuse of antibiotics, 14 % disagreed and 12% were unsure.

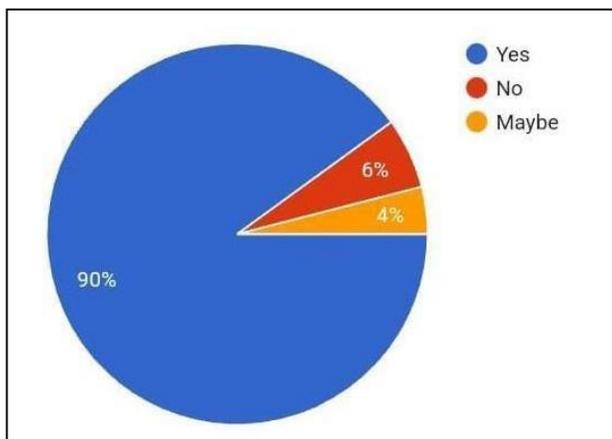


Fig: Abuse of antibiotics

- **Educate People**

90 % of the participants possessed concern that it is important to educate people about the appropriate use of antibiotics, while 10 % were not interested in education regarding the use of antibiotics.

Fig: Viewpoint of participants regarding antibiotic education and use

6. Discussion

This discussion aims to analyze the findings of a recent study on the regular use of antibiotics among university undergraduates and explore their implications in light of similar research in the field.

The study revealed that a substantial majority (88%) of university undergraduates were aware of antibiotics. This finding aligns with previous studies conducted among college students. For example, a study by Sakr et al. [17] among students in Lebanon found that the majority of participants were familiar with antibiotics. This high level of awareness highlights the importance of targeting educational involvement towards this demographic.

The study also reported that 74% of the students had taken antibiotics within the past year. This prevalence of antibiotic use is concerning, as it may indicate inappropriate prescribing practices or self-medication. Similar findings were observed in a study by Wang et al. [18] among Chinese university students, where 23.0% of students had used

antibiotics as prophylaxis, 63.1% kept a personal stock of antibiotics and 56.0% had bought antibiotics at a drugstore (two-thirds without a prescription). These results highlight the need for interventions to promote responsible antibiotic use and discourage unnecessary consumption.

A notable finding was that 24% of students believed antibiotics could be used to treat viral infections. This misconception aligns with findings from other studies. For instance, a study by Gary et al. [16] among medical and nonmedical university students in Jordan reported that 44% of nonmedical students and 28% of medical students believed antibiotics were effective against viral infections. Such misconceptions contribute to antibiotic misuse and highlight the necessity of educational efforts to address knowledge gaps.

Results of the present study revealed that 54% of students had used antibiotics for cold and flu. Buke et al. [20] conducted a similar study in which it was revealed that 83.1% of students believed that antibiotics are used to treat cold and flu symptoms. A similar study by Sobierajski et al. [26] found that 36% of students believe that antibiotics are effective in the treatment of the common cold and flu. This study revealed that fever was the most common reason found among students to

take antibiotics. A recent study by Alsayed et al [19] among university students in UAE reported that around half of students think that antibiotics are used to treat fever.

About 90% of students reported that antibiotics are easily available at pharmacies without any prescription. It was found in a study by Saleem et al. [24] that about 96.9% of pharmacies and medical stores in Pakistan gave antibiotics without demanding a prescription. A similar study in China indicated the percentage to be 78.3%. [25]. A cross-sectional study by Ndaki et al [12] in Tanzania found that only 1.5% of pharmacy salesmen asked for a prescription.

This study uncovered that a significant proportion of students (44%) reported taking antibiotics without a prescription or medical advice. This behavior is consistent with findings from other studies, such as a study by Ghaieth et al. [22] on Libyan university students in which it was reported that about 43% of medical and 46% of nonmedical students were antibiotics self-medicated. A much higher percentage was found in Iranian students (about 53%) [23]. The easy availability of antibiotics without prescription reported by a large number of students further reinforces the need for regulatory measures and public awareness campaigns to combat inappropriate self-

medication practices.

The study found that 50% of students reported always finishing the full course of antibiotics prescribed to them. This finding is consistent with studies that have highlighted poor adherence rates among young adults. For instance, a study by Tiong and Chua [21] also reported similar findings in which the majority of the students (more than 75%) took antibiotics according to proper instructions and finished the whole course. This emphasizes the importance of promoting appropriate antibiotic use and educating students on the potential consequences of incomplete treatments.

The majority of students in the present study were aware of the risks associated with regular antibiotic use, including antibiotic resistance. However, the finding that 56% of students never discussed the risks and benefits of taking antibiotics with their healthcare provider is concerning. This lack of communication has been observed in other studies as well, suggesting a need for improved patient-provider discussions regarding appropriate antibiotic use [24].

7. Conclusion

As a whole, it was observed that students do not have sufficient information about antibiotics and their mode of action. Even though many of them knew about antibiotic

resistance many have taken antibiotics for colds and flu. Proper campaigns must be organized by the government to educate the youth about the significance of the proper use of antibiotics. Along with this ban should be imposed on selling medications without prescription. The sample size of the study was low due to limited time.

Throughout the study, the extent of knowledge of the participant could not be accessed which could have impacted the reliability of the answers collected. The survey was conducted online, which was solved either on mobile phones or laptops. Poor palm Rejection in mobile phones could have affected the reliability of the answers Universities must organize seminars and workshops about the importance of using antibiotics as suggested by the doctor. Many students have mentioned that they take antibiotics for flu and cold which indicates that they are unaware of the pathogen antibiotic targets. Chapters about antibiotic resistance must be added to the compulsory English curriculum at the intermediate and matric levels. The government must take the help of social media influencers to run campaigns on awareness about antibiotic resistance. Along with this advertisement on national television about the use of antibiotics. Furthermore, the government

must take action against pharmacies that sell antibiotics without a prescription.

REFERENCES

1. Huang Y, Gu J, Zhang M, Ren Z, Yang W, Chen Y, et al. Knowledge, attitude, and practice of antibiotics: a questionnaire study among 2500 Chinese students. *BMC Med Educ*, volume 13, page 163, 2013.
2. Sarahroodi, S., Maleki-Jamshid, A., Sawalha, A. F., Mikaili, P., & Safaeian, L. (2012). The pattern of self-medication with analgesics among Iranian University students in central Iran. *Journal of Family & Community Medicine*, volume 19 (issue 2), pages 125–129, 2012.
3. Saleem Z, Saeed H, Hassali MA, Godman B, Asif U, Yousaf M, Ahmed Z, Riaz H, Raza SA. The pattern of inappropriate antibiotic use among hospitalized patients in Pakistan: longitudinal surveillance and implications. *Antimicrobial Resistance & Infection Control*, volume 3, 2019.
4. Cassini A, Högberg LD, Plachouras D, Quattrocchi A, Hoxha A, Simonsen GS, Colomb-Cotinat M, Kretzschmar ME,

- Devleesschauwer B, Cecchini M, Ouakrim DA. Attributable deaths and disability-adjusted life-years caused by infections with antibiotic-resistant bacteria in the EU and the European Economic Area in 2015: a population-level modeling analysis. *The Lancet Infectious Diseases*, 2019.
5. Fadare J, Tamuno I. Antibiotic self-medication among university medical undergraduates in northern Nigeria. *J Public Health Epidemiol*. 2011.
 6. Pan H, Cui B, Zhang D, Farrar J, Law F, Ba-Thein W. Prior knowledge, older age, and higher allowance are risk factors for self-medication with antibiotics among university students in southern China. *PLoS One*. 2012.
 7. Jairoun A, Hassan N, Ali A, Jairoun O, Shahwan M, Hassali M. University students' knowledge, attitudes, and practice regarding antibiotic use and associated factors: a cross-sectional study in the United Arab Emirates. *Int J Gen Med*. 2019.
 8. Sunusi LS, Mousnad Mohamed Awad, Njelekela Makinga Hassan, Assessment of Knowledge and Attitude toward Antibiotic Use and Resistance among Students of the International University of Africa, Medical complex, Sudan. *Glob Drugs Therapeutics*, 2019.
 9. M. H. F. Sakeena, Alexandra A. Bennett, Stephen J. Carter, Andrew J. McLachlan, A comparative study regarding antibiotic consumption and knowledge of antimicrobial resistance among pharmacy students in Australia and Sri Lanka, *Journal Plos One*, 2019.
 10. Giacomo Scaioli, Maria R. Gualano, Renata Gili, Simona Masucci, Fabrizio Bert, Roberta Siliquini, Antibiotic Use: A Cross-Sectional Survey Assessing the Knowledge, Attitudes, and Practices amongst Students of a School of Medicine in Italy, *Journal Plos One*, 2015.
 11. Yin X, Gong Y, Sun N, Li D, Wu J, Wang J, Qiu L, Li H. Prevalence of inappropriate use behaviors of antibiotics and related factors among Chinese antibiotic users: an online cross-sectional survey. *BMC Infectious Diseases*, 2022.

12. Nepal, G., & Bhatta, S. Self-medication with Antibiotics in WHO Southeast Asian Region; A Systematic Review. *Cureus*. 2018.
13. Samarth Virmani, Manideep Nandigam, Bahar Kapoor, Purva Makhija, Suma Nair, Antibiotic use among health science students in an Indian university: A cross-sectional study, *Clinical Epidemiology and Global Health*, Volume 5, 2017.
14. M. Núñez, M. Tresierra-Ayala, F. Gil-Olivares, Antibiotic self-medication in university students from Trujillo, Peru, *Journal Medicina Universitaria*, volume 18, 2016.
15. Huang Y, Gu J, Zhang M, Ren Z, Yang W, Chen Y, et al. Knowledge, attitude, and practice of antibiotics: a questionnaire study among 2500 Chinese students. *BMC Med Educ*, volume 13, page 163, 2013.
16. Gary S, Shehadeh M, Darwish DA, et al. A cross-sectional study on knowledge, attitude, and behavior related to antibiotic use and resistance among medical and non-medical university students in Jordan. *Afr J Pharm Pharmacol*, volume 6 issue 10, pages 763–70, 2012.
17. Sakr, S., Ghaddar, A., Hamam B. *et al.* Antibiotic use and resistance: an unprecedented assessment of university students' knowledge, attitude and practices (KAP) in Lebanon. *BMC Public Health*, volume 20, page 535, 2020.
18. Wang, X., Peng, D., Wang, W., Xu, Y., Zhou, X., & Hesketh, T. (2017) Massive misuse of antibiotics by university students in all regions of China: implications for national policy. *International journal of antimicrobial agents*, volume 3, pages 441–446, 2017.
19. Alsayed, A. R., Darwish El Hajji, F., Al-Najjar, M. A. A., Abazid, H., & Al-Dulaimi, A. (2022). Patterns of antibiotic use, knowledge, and perceptions among different population categories: A comprehensive study based on Arabic countries. *Saudi Pharmaceutical Journal: SPJ: the official publication of the Saudi Pharmaceutical*

- Society*, volume 30, 317–328, 2022.
20. Buke, C., Hosgor-Limoncu, M., Ermertcan, S., Ciceklioglu, M., Tuncel, M., Köse, T., & Eren, S. Irrational use of antibiotics among university students. *The Journal of infection*, volume 2), pages 135–139, 2005.
 21. T Fong, T. W., & S.Chua,S Knowledge and Attitude of University Students on Antibiotics: A Cross-sectional Study in Malaysia. *Drug, healthcare and patient safety*, volume 12, pages 135–144, 2020.
 22. Ghaieth, M. F., Elhag, S. R., Hussien, M. E., & Konozy, E. H. Antibiotics self-medication among medical and nonmedical students at two prominent Universities in Benghazi City, Libya. *Journal of Pharmacy & allied sciences*, volume 7 (issue 2), pages 109–115, 2015.
 23. Sarahroodi, S., Maleki-Jamshid, A., Sawalha, A. F., Mikaili, P., & Safaeian, L. (2012). The pattern of self-medication with analgesics among Iranian University students in central Iran. *Journal of Family & community medicine*, volume 19 (issue 2), pages 125–129, 2012.
 24. Saleem, Z., Hassali, M.A., Godman, B. *et al.* Sale of WHO AWaRe groups antibiotics without a prescription in Pakistan: a simulated client study. *J of Pharm Policy and Pract*, volume 13, pages 21-26, 2020.
 25. Chen J, Xie Y, Sun Y, Zang R, Sun Y, Dan L, Wang X, Hesketh T. Sales of antibiotics without a prescription in pharmacies, 2017 and 2021, China. *Bull World Health Organ*, volume 5, pages 317-325, 2023.