



The Awareness of Beta-Lactam Antibiotics Prescription among Dental Students

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Authors' contributions

This work was carried out in collaboration among all authors. Author NSBS designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors DG and RD managed the analyses of the study. All authors read and approved the final manuscript.

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ABSTRACT

Beta-lactam antibiotic is the most common antibiotic prescribed by dental students. However, the actual knowledge on beta lactam is important as antimicrobial resistance is currently an alarming and growing phenomenon and in turn becoming a public health challenge. A survey was conducted to assess the knowledge and awareness of beta-lactam antibiotics prescriptions among dental students in their third years, final years and interns. A total of 145 responses were obtained and the results were analyzed using the SPSS statistical software. Based on their knowledge on beta-lactam antibiotics, 59.3% of the participants knew exactly the mechanisms of action of beta-lactam antibiotic which was by interfering with the synthesis of the bacterial cell wall. In the case of penicillin allergy, 40% of the participants chose erythromycin as the alternative for penicillin allergy. 84% of the participants were aware that the combination of amoxicillin with clavulanic acid may increase its effectiveness. Meanwhile, 98% of the participants were aware that amoxicillin is the drug of choice for bacterial endocarditis prophylaxis. 72% of the participants were aware that most

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beta-lactam antibiotics are considered safe for pregnant and lactating women which was statistically significant ($p < 0.05$). In conclusion, the students had quite a good knowledge and awareness regarding the prescription of beta-lactam antibiotics since they have been practicing under guidance from the practitioner in the college.

Keywords: Allergy; antimicrobial resistance; beta-lactam; penicillin.

1. INTRODUCTION

Beta-lactam antibiotic is the most common antibiotic prescribed by dental students. However, the actual knowledge on beta-lactam is important as antimicrobial resistance is currently an alarming and growing phenomenon and in turn becoming a public health challenge. Dental students were taught about Pharmacology in their second year. It includes various types of drugs, mechanisms of actions, indications, contraindications, adverse effects and resistance mechanisms. With the knowledge, they started to prescribe it in the third year of dental school onwards.

Penicillin was the first beta-lactam antibiotic introduced by Alexander Fleming in 1928 [1]. There are several classes of beta lactam antibiotics which include [2]:

- Natural penicillin – Penicillin V
- Penicillinase-resistant penicillin- Cloxacillin, Dicloxacillin
- Aminopenicillin – Amoxicillin, Ampicillin
- Beta-lactamase inhibitor – Amoxicillin-Clavulanate (Augmentin)
- Antipseudomonal penicillin - Carbenicillin
- Cephalosporin (1st to 4th generations)
- Monobactams - Aztreonam
- Carbapenems – Meropenem

The major concern in prescribing beta-lactam antibiotics is the antimicrobial resistance towards beta lactam antibiotics which is an alarming and growing phenomenon among the public healthcare system [3]. It tends to happen when the antibiotics are misused or overused by the patient which helps the bacteria to adapt to the antibiotics which intended to kill them [1].

Dental students and dental practitioners play an important role to ensure that the emergence of the antimicrobial resistance can be stopped. They should use their judgment correctly during prescribing antibiotics [1]. For example, in a clinical situation where extraction or endodontic therapy should be the first appropriate therapeutic intervention instead of prescribing antibiotics alone to treat bacterial infections.

However, the potential benefits and risks of antibiotics should be weighed first before prescribing it. Besides, it is important to assess the patient's medical history such as an allergy to drugs, pregnancy and history of organ transplants as it would affect antibiotic selection.

Several studies had reported on the knowledge of antibiotic prescription in the treatment of endodontics [4,5]. Another study reported on the knowledge in prescribing amoxicillin and clindamycin among dental students [6]. All of the study reported a lack of knowledge regarding antibiotic prescription. Previously our department has published extensive research on various aspects of prosthetic dentistry [7–17], this vast research experience has inspired us to research about the knowledge and awareness of beta lactam antibiotic prescription among dental students in a private dental hospital.

2. MATERIALS AND METHODS

2.1 Study Setting

This cross-sectional study was conducted in December 2019 among undergraduate students in their clinical year which includes third year, final years and interns of Saveetha Dental College and Hospitals. A total of 145 students participated in this study.

2.2 Study Subjects

A total of 145 students participated in this study out of which third year (24%), final year (34%) and interns (42%). A simple random sampling technique was followed and sample size calculated based on pilot sample of 30 participants.

2.3 Methodology

Questions about knowledge, attitude and practice regarding beta lactam antibiotic prescription were prepared and prevalidated. The survey was conducted through an online survey using Google Form application. Undergraduate students in their clinical year were included in the study. Postgraduates and incomplete surveys were excluded in the study. The responses of the

participants were recorded and analyzed. The variable knowledge included facts and information regarding beta lactam antibiotics and the variable attitude denotes the thinking pattern during prescription of beta lactam antibiotics.

2.4 Statistical Analysis

Data was entered in Excel and analyzed using SPSS software version 20.0. Descriptive analysis such as frequency distribution and Chi-square test were done and a significant level of less than 0.05 was set to be statistically significant.

3. RESULTS AND DISCUSSION

A total of 145 participants were willing to participate in the study out of which 64.8% were females and 35.2% were males as shown in Fig. 1. Predominantly, interns had participated in this study with 42%, followed by final years with 34% and third years students with 24% as shown in Fig. 2.

Several questions were prepared based on the knowledge of pharmacology. 59% of the participants knew exactly the mechanisms of action of beta lactam antibiotic which is by interfering with the synthesis of the bacterial cell wall as shown in Fig. 3. The pharmacology behind beta lactam antibiotic was by interfering

with the synthesis of the peptidoglycan in the bacterial cell wall [18]. Peptidoglycan is the vital component of the bacterial cell wall which provides mechanical stability to it [19]. Although it is theoretically, through practice and knowledge, the dentist will be able to avoid misuse and overuse of the antibiotics throughout their practice.

In case of penicillin allergy, 40% of the participants chose erythromycin as the alternative, followed by clindamycin with 38%, amoxicillin with 12% and ampicillin with 10% as shown in Fig. 4. Penicillin G is the most common drug implicated in drug allergy. However, it is most commonly seen during parenteral administration rather than oral administration [20]. There are several alternatives to penicillin allergy including clindamycin as the first drug of choice followed by macrolides like azithromycin, clarithromycin or erythromycin [4,21]. In this present study, 40% had chosen erythromycin as the drug of choice for penicillin allergy. Meanwhile, in the study done by Anitha Rao et al, clindamycin was the first choice for patients' allergy to penicillin among dental practitioners, postgraduate students and interns [22]. In a study done by Struzycka et al, in cases of aggressive periodontal disease in an individual allergy to penicillin, 58% of the students suggested using doxycycline and metronidazole as the alternatives [23].

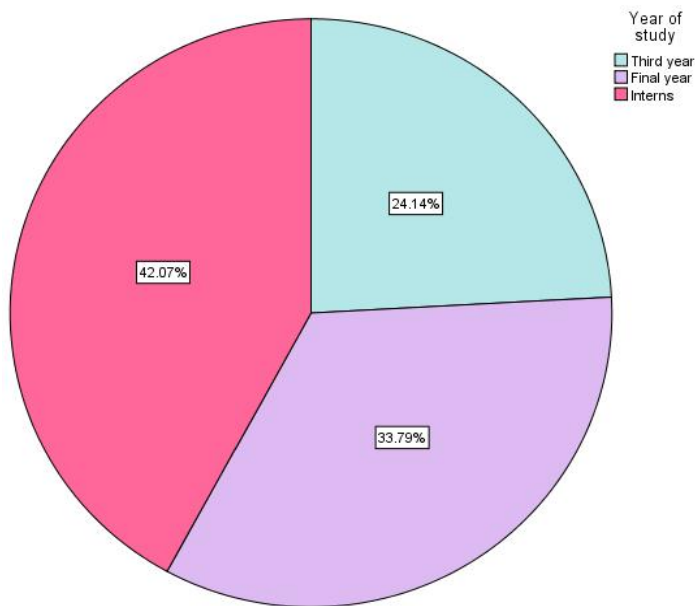


Fig. 1. Pie chart showing the responses to the question, "gender". Majority of the respondents were females (64.8%) followed by males (35.2%)

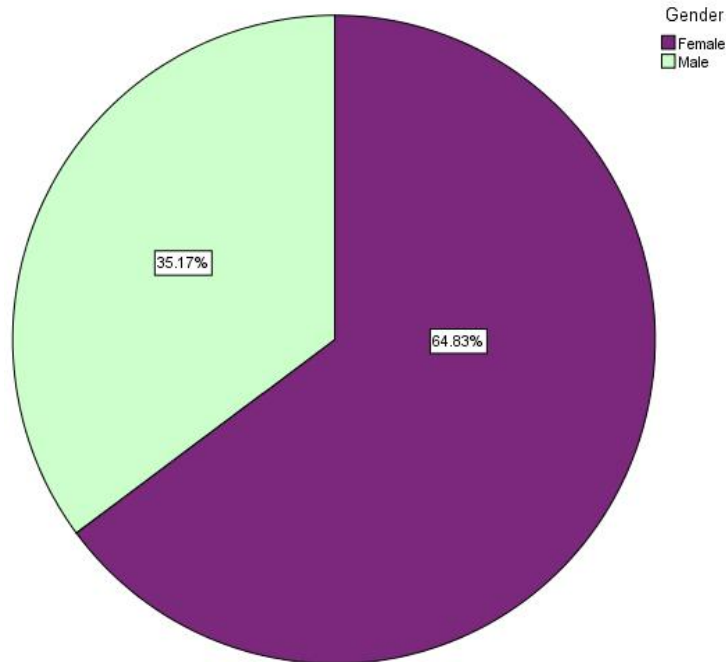


Fig. 2. Pie chart showing the responses to the question, “year of study”. Majority of respondents were interns (42.1%) followed by final year (33.8%) and third year (24.1%)

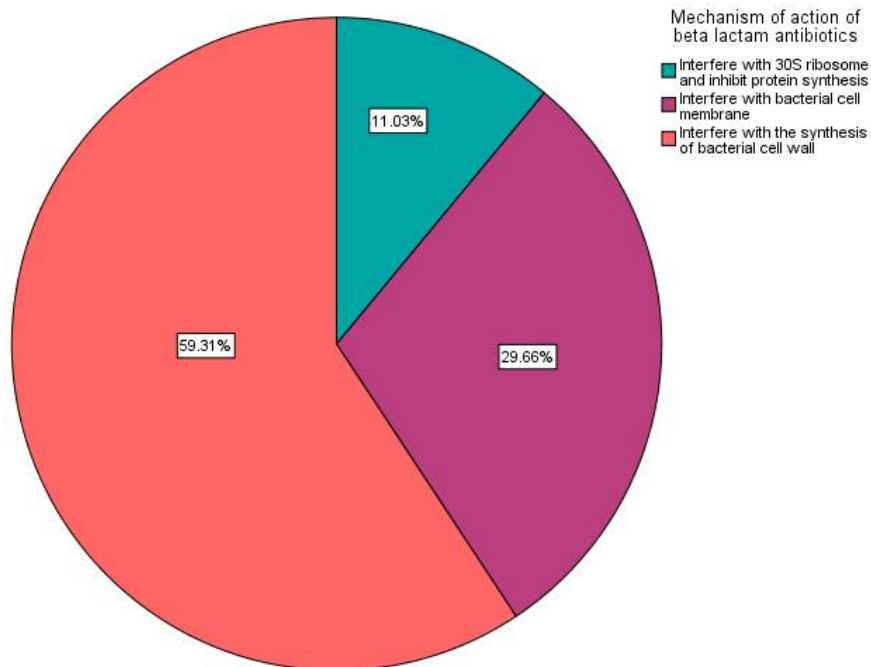


Fig. 3. Pie chart showing the responses to the question, “mechanism of action of beta lactam antibiotics”. Majority of the respondents answered that they interfere with the synthesis of bacterial cell walls (59.3%)

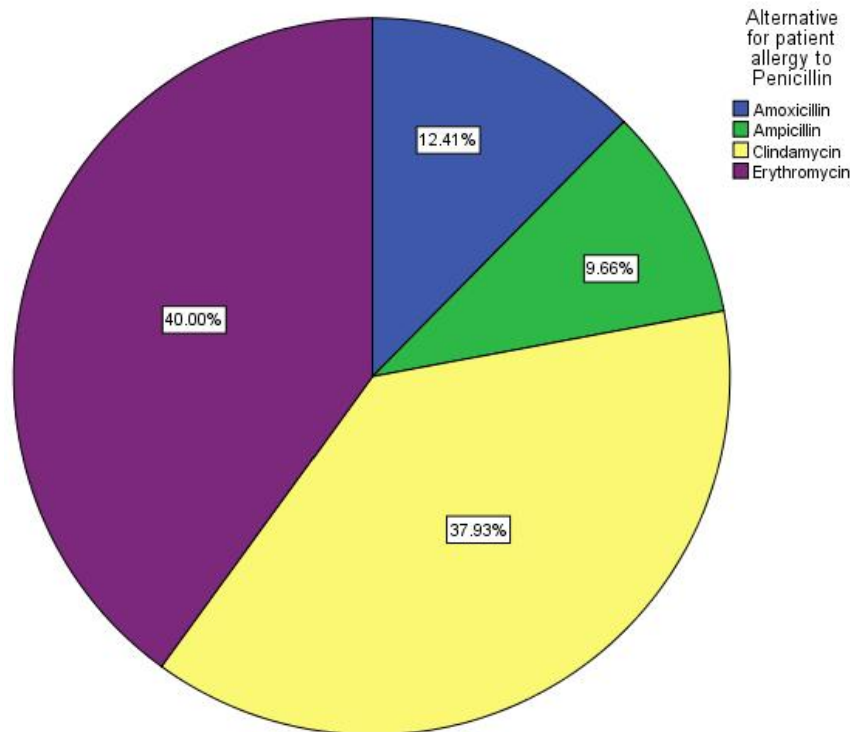


Fig. 4. Pie chart showing the responses to the question, “ alternative for patient allergy to Penicillin”. Majority of the respondents answered erythromycin as an alternative to penicillin allergy (40%)

Several questions were prepared based on their attitude toward beta lactam antibiotics. 84% of the participants were aware that the combination of amoxicillin with clavulanic acid may increase its effectiveness and 16% were not aware. Based on Fig. 5, a higher number of interns (38.6%) answered yes followed by final year (23.5%) and third year (22.1%). There is a significant difference in responses between the year of study ($p < 0.05$). Beta lactamase inhibitors like clavulanic acid when used alone may have weak intrinsic antibacterial activity. However, its effectiveness increases when combined with beta lactam antibiotic [18]. For example, a combination of amoxicillin and clavulanic acid (Augmentin). In this present study, 84% of the participants were aware that this combination may increase its effectiveness. In endodontic infections, amoxicillin is preferable as it has moderate-spectrum action but its effectiveness may be reduced if the same infections are sustained by beta lactamase producing bacteria [21,24]. Therefore, this combination is frequently administered which improves its bactericidal effect. Nonetheless, it may increase the risk of

Clostridium difficile infection and the risk of developing resistant bacteria [25,26].

Meanwhile, 98% of the participants were aware that amoxicillin is the drug of choice for bacterial endocarditis prophylaxis. Based on Fig. 6, a higher number of interns (42.1%) answered yes followed by final year (33.1%) and third year (22.8%). There is a significant difference in responses between the year of study. In dentistry, antibiotic prophylaxis mainly refers to patients with the risk of infective endocarditis [23]. It is usually done when the dental procedures involve the manipulation of gingival tissue, the periapical region of teeth or perforation of the oral mucosa in the patients with following conditions [27]. In 2017, the ADA reaffirmed that 2g of amoxicillin orally is the recommended regimen for infective endocarditis in adults and 50 mg/kg for children [28]. It should be administered 30-60 minutes before the dental procedure. In the study done by Elka Radeva et al, 61.6% of the respondents would prescribe amoxicillin 2g for standard prophylaxis in patients with systemic disease [29]. In a study done by

Oviya M et al, 95% of the participants were aware of the drugs used in antibiotic prophylaxis [30].

In the present study, 72% of the participants were aware that most beta lactam antibiotics are considered safe for pregnant and lactating women. Based on Fig. 7, a higher number of interns (50%) answered yes followed by final year (28.8%) and third year (21.2%). There is a significant difference in responses between the year of study. The administration of antibiotics in pregnant and lactating women should be considered to maintain both mother and fetus life. Some drugs may pass through the placenta and produce deleterious effects to the fetus such

as tetracycline. However, in pregnancy, beta lactam antibiotics including penicillin and cephalosporin are the most common drug prescribed. According to the Food and Drug Administration (FDA) classification, both drugs fall in category B which is safe for the pregnant mother [31,32]. In the study done by Struzycka et al, the students showed quite a good knowledge of antibiotic prescription in pregnant women [23]. Based on the research done, the first-trimester exposure to drugs is critical for the fetus [32]. Both the general physician and the mother should be aware of the potential risks of certain antibiotics towards the developing fetus while prescribing it.

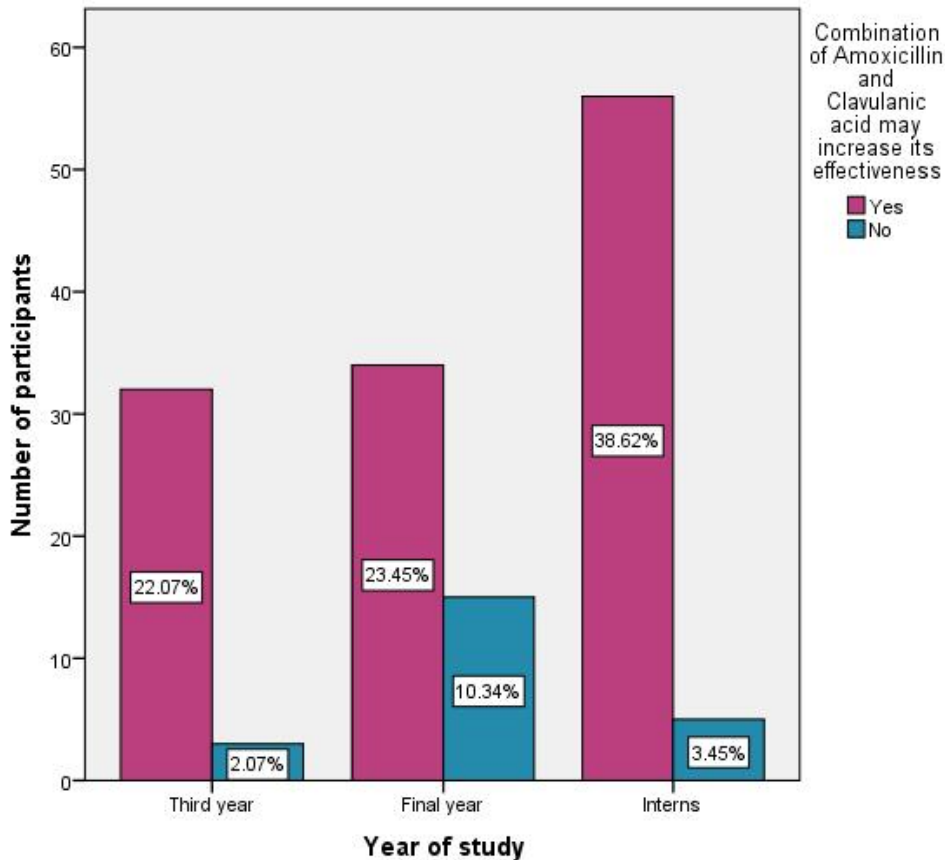


Fig. 5. Bar chart showing comparison of response based on year of study to the question, “combination of amoxicillin with clavulanic acid may increase its effectiveness”. X-axis represents the year of study and Y-axis represents the number of participants with their responses (purple-yes and blue-no). Higher number of interns (38.6%) answered yes followed by final year (23.5%) and third year (22.1%). There is a significant difference in responses between third year, final year and interns. (Chi-square test value: 12.068^a, p-value: 0.002 (p<0.05)). Hence it is statistically significant

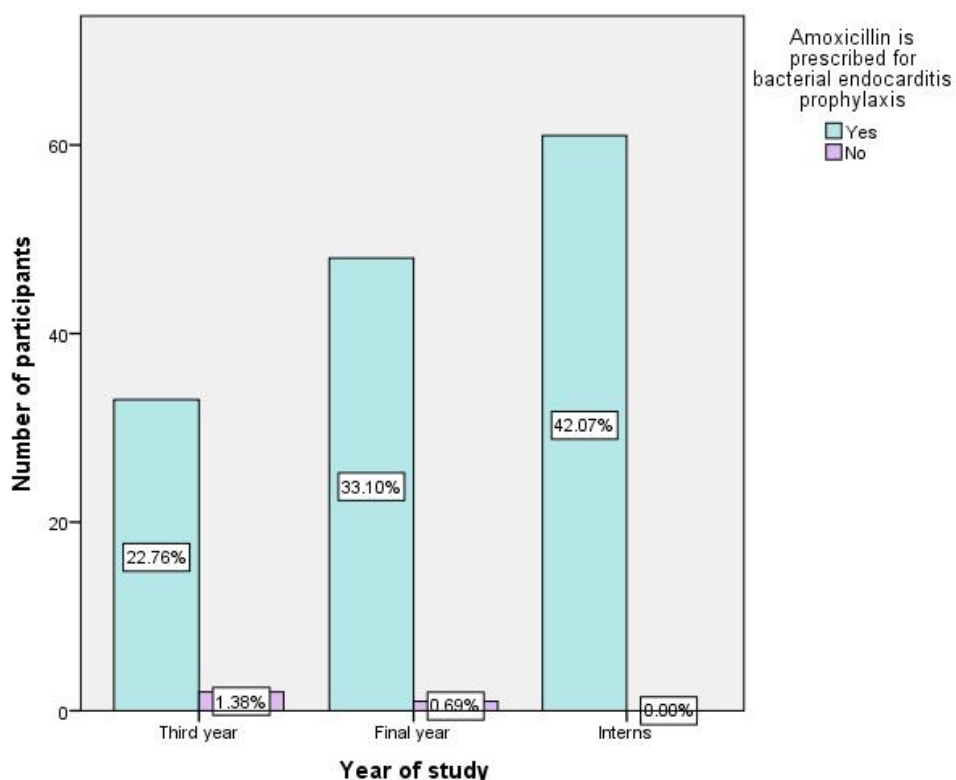


Fig. 6. Bar chart showing the comparison of response based on the question, “amoxicillin is prescribed for bacterial endocarditis prophylaxis”. X-axis represents the year of study and Y-axis represents the number of participants with their responses (light blue-yes and light purple-no). Higher number of interns (42.1%) answered yes followed by final year (33.1%) and third year (22.8%). There is a significant difference in responses between third year, final year and interns. (Chi-square test value: 9.520^a, p-value: 0.009 (p<0.05)). Hence it is statistically significant

Since all the participants in this study are in their clinical year, 97% of the participants had prescribed and 3% had not prescribed beta lactam antibiotics to their patients as shown in Fig. 8. Based on Fig. 9, the most common type of beta lactam antibiotic prescribed by the participants was amoxicillin (74.48%), followed by amoxicillin and amoxicillin + clavulanic acid (18.6%), amoxicillin and penicillin (4.1%), penicillin alone (1.38%) and amoxicillin + clavulanic acid alone (1.38%). The most common condition where antibiotics will be prescribed was dental extraction and root canal treatment (47.6%), followed by dental extraction, pericoronitis, root canal treatment and periodontal diseases (31%), dental extraction alone (18.6%) and dental extraction with pericoronitis (2.8%) as shown in Fig. 10. Antibiotics are usually prescribed by the dentist to treat bacterial infections. However, a study

reported that 30% to 50% of prescribed antibiotics are either not necessary or not optimally prescribed [33]. In this study, the participants had prescribed antibiotics in certain conditions such as post-dental extraction, endodontic infections, pericoronitis, periodontal diseases and dentoalveolar abscess. A study suggests that antibiotics usually are not prescribed in cases when the root canal treatment is successful where the infections are completely removed from the root canals [29]. In case when cleaning and shaping of the root canal are not done, prescribing antibiotics will not eliminate the microorganisms [34]. Besides, an antibiotic prescription is not necessary for conditions like irreversible pulpitis, necrotic pulp, symptomatic apical periodontitis and localized acute apical abscess and in cases where adequate local debridement, medication, incision and drainage is achieved [34].

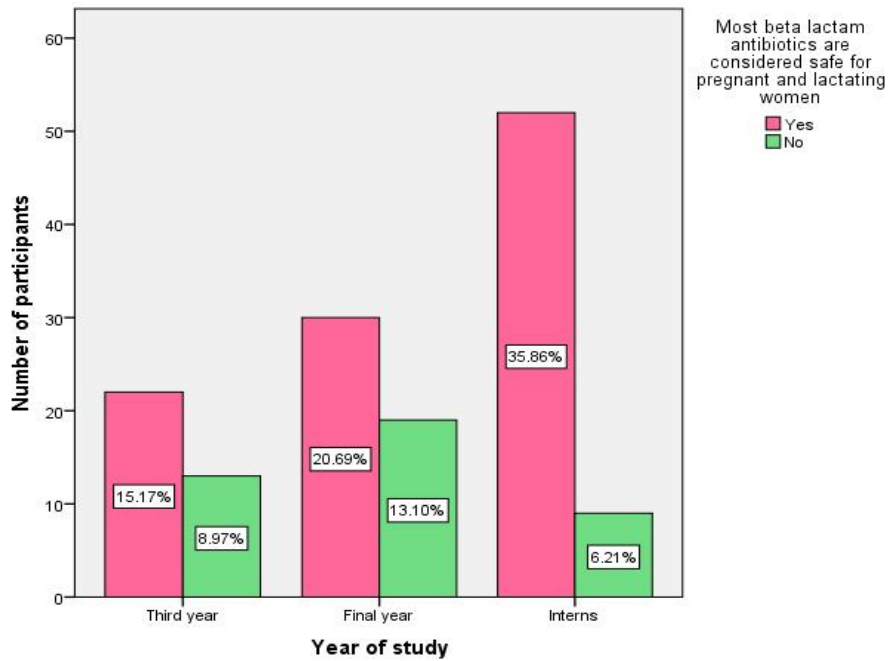


Fig. 7. Bar chart showing the comparison of response based on the question, “most beta lactam antibiotics are considered safe for pregnant and lactating women”. X-axis represents the year of study and Y-axis represents the number of participants (pink-yes and green-no). Higher number of interns (35.8%) answered yes followed by final year (20.7%) and third year (15.2%). There is a significant difference in responses between third year, final year and interns. (Chi-square test value: 12.928^a, p-value: 0.002 (p<0.05)). Hence it is statistically significant

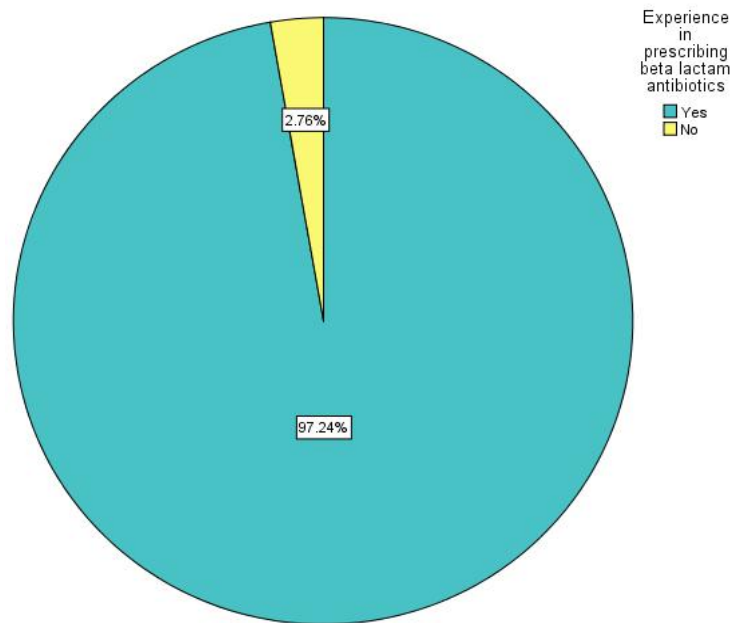


Fig. 8. Pie chart showing the responses to the question, “experience in prescribing beta lactam antibiotics”. Majority of the respondents had prescribed beta lactam antibiotics (97.2%)

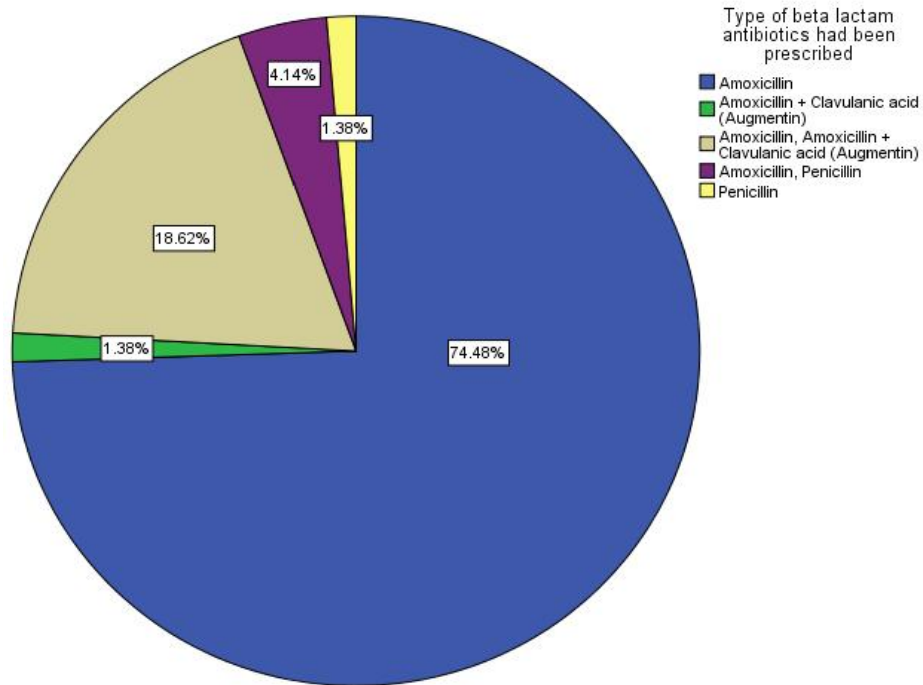


Fig. 9. Pie chart showing the responses to the question, “type of beta lactam antibiotics had been prescribed”. Majority of the respondents had prescribed amoxicillin (74.48%)

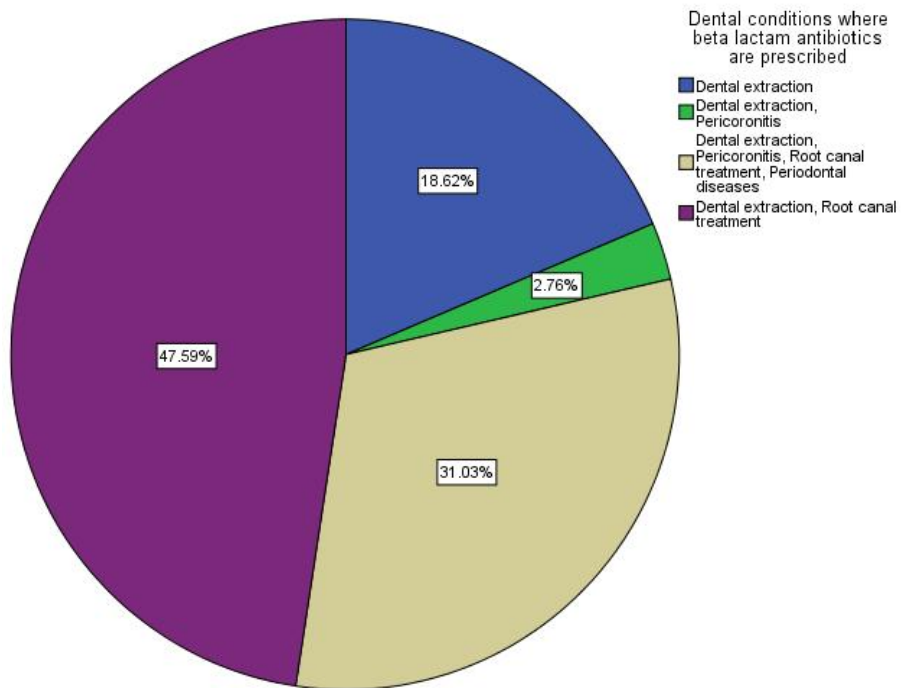


Fig. 10. Pie chart showing the responses to the question, “dental conditions where beta lactam antibiotics were prescribed”. Majority of the respondents prescribed beta lactam antibiotics during dental extraction and root canal treatment (47.6%)

Our study was done based on the responses from only one private dental hospital in Chennai. Thus, the number of responses were low. However, since online survey was done, the responder's bias might be present as their information was anonymous. A study with a larger number of respondents including different types of dental hospitals can be conducted in the future.

4. CONCLUSION

In conclusion, the interns showed quite a good knowledge and awareness regarding the prescription of beta lactam antibiotics which were statistically significant since they have been practicing under guidance from the practitioner in the college. Nonetheless, the guidelines and clinical tips for antibiotic prescribing should be followed and referred to as the inappropriate prescription of beta lactam antibiotics might create antimicrobial resistance.

CONSENT AND ETHICAL APPROVAL

The study was approved by the Institutional ethical committee and informed consent was obtained from all the participants.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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