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Dental students' knowledge and practices regarding antibiotic prescribing guidelines in children in Abha, KSA: A cross-sectional study

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Objectives: **The use of antibiotics prophylactically and therapeutically in dentistry has become common practice. An inappropriate prescription may lead to adverse side effects and bacterial resistance. During clinical training, dental students in Saudi Arabia are authorized to prescribe antibiotics.** ***Aim:*** **To evaluate dental students' knowledge and attitudes regarding antibiotic prescription in Abha, Saudi Arabia.** ***Methods:*** **In this cross-sectional study, participants (n = 175) were selected based on simple random sampling method. Data were collected using a questionnaire regarding knowledge of antibiotics, attitudes and behavior towards antibiotic prescribing guidelines and clinical cases to assess knowledge of antimicrobial prescribing in children. Descriptive statistics were generated for all questions. The results were tabulated and expressed as both number and percentage.** ***Results:*** **Average percentage of fully correct answers (Yes) was higher than 70% of the all the statement proposed for knowledge about antibiotic. Attitude and behavior of statement about antibiotic are relatively less compared to knowledge questions, average correct answers (Yes) were ranges 31% to 59%. The compliance rate with prescribing guidelines in each of the clinical cases ranged from 28% to 53.2%.** ***Conclusions:*** **This study concludes that dental students have positive knowledge regarding antibiotics, but had low awareness and compliance with antibiotic prescribing guidelines to children. There is a clear need for the development of prescribing guidelines and educational initiatives to encourage the rational and appropriate use of the antibiotics in children by the dentist.**

INTRODUCTION

Antibiotics have been used for many years to manage infection and are commonly prescribed by general dental practitioners (GDPs) for certain orofacial infections.[1] However, the increasing rate of microbial resistance to antibiotics especially among the microorganisms in the oral cavity is a significant public health dilemma.[2] Penicillin and other antibiotics, which were initially viewed as miracle drugs for their ability to cure serious and often life-threatening diseases, were challenged by some defiant strains. Antibiotic resistance has become a serious public health concern. Reasons for the development of antimicrobial resistance could be due to over prescription by health care providers and improper use by patients.[3] The threat of antibiotic resistance has become a worldwide public health concern, with a substantial economic and clinical burden. The World Health Organization (WHO) estimated that this problem leads to an excess of mortality of 25,000 people every year in the European hospitals, with a cost of about 1.5 billion of Euro.[4] There are several indications for the use of antibiotics in dentistry including the treatment of periodontal disease, severe soft tissue lacerations and following the placement of dental implants. The two major reasons that antibiotics are used in children are 1) to treat oral infections and 2) to prevent bacteremia caused by dental treatment.[5] The goal of antibiotic treatment is to use the smallest amount of the drug that is most effective against the organism causing the infection.[6]

Clinicians treat children with antibiotics primarily to treat oral infections and to prevent bacteremia caused by dental treatment.[7] Antibiotic therapy for orofacial infections can achieve excellent results in selected clinical situations, but it should not be the primary treatment modality for orofacial infections. The most prescribed drugs in dentistry are the local anesthetics used during dental procedures, antibiotics, and NSAIDs. Because of the characteristics of these drugs, it is important to determine accurate doses and be aware of any adverse or toxic effects.[8] The improper and excessive use of antibiotics has resulted in the emergence of highly resistant bacteria. In developing countries including Saudi Arabia, antibiotics are excessively prescribed and can be obtained, in many instances, without a prescription.[9] Apart from patients' perceptions and expectations, knowledge held by healthcare professionals is a major determinant with regard to the prescription of antibiotics. A dental graduate student undergoes excessive training to be able to prescribe antibiotics. As per policy, during the clinical years, dental students in Saudi Arabia are authorized to prescribe antibiotics under the supervision of their instructors. Attitudes towards prescribing

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Table 1 Demographic characteristics of the participants in the study

VARIABLES	FREQUENCY	PERCENTAGE
GENDER		
Females	175	100
AGE (Years)		
21-23	65	37
24-26	57	32
27-30	53	31
EDUCATION (Dental Undergraduate)		
5th year	70	40
6th year	62	35
Internship	43	25

Table 2 Questionnaire

Sl. No.	QUESTIONNAIRE	YES (n)	%
	Knowledge of students about antibiotics		
1	Antibiotics can cause secondary infections after killing good bacteria present in our organism	115	66.5
2	Penicillin and amoxicillin are antibiotics	168	96.6
3	antibiotics are useful for treating bacterial infections	162	93.1
4	Misuse of antibiotics can lead to antibiotic resistance	163	93.7
5	Antibiotics can kill good bacteria present in our organism	139	79.9
	Attitudes and behaviors of students about antibiotics		
1	Do you usually take antibiotics for cold or sore throat?	59	34.1
2	Do you usually take antibiotics for fever?	62	35.6
3	Do you have leftover antibiotics at home?	102	59
4	Do you use leftovers antibiotics when you have cold, sore throat or flu without consulting your doctor?	54	31.2
5	Do you buy antibiotics without medical prescription?	62	36

medications and experience with specific antibiotics usually develop during these early training years, and many carry their experiences with them into clinical practice. Their beliefs, attitudes and behaviors regarding the use of antibiotics have a tremendous impact on the consequences associated with such uses in Saudi Arabia. For this reason, it is important to evaluate the views knowledge regarding antibiotic prescribing for children by female undergraduates from 5th, 6th year and internship year of the BDS program (Students involving clinical courses) students in the College of Dentistry, King Khalid University, Abha.

MATERIALS AND METHODS

A cross-sectional survey was designed to determine the knowledge and attitude regarding antibiotic prescribing habits amongst female dental undergraduates from 5th, 6th year and internship year of the BDS program (Students involving clinical courses) in College of Dentistry King Khalid University, Abha, Saudi Arabia. Total 175 participants were selected by simple random sampling method [Table 1]. The study was approved by the ethical approval committee at the College of Dentistry King Khalid University (SRC/ETH/2017-18/088). Voluntary written informed consent was obtained from the dental students before the start of the survey. All individuals were requested to complete a comprehensive questionnaire in Arabic (local Language). Each respondent was made aware of the aims of the study and provided instructions on how to fill the questionnaire. The questionnaire was designed to evaluate the knowledge and attitude of dental students regarding prescribing antibiotics in children.

The questionnaires were obtained from different published articles, and it consists of 3 sections: knowledge of antibiotics, attitudes and behavior towards antibiotic prescribing guidelines [Table 2] and clinical cases to assess knowledge of antimicrobial prescribing [Table 3]. The questions were condensed to a total of 15 items covering the important aspects required. Experts reviewed the questionnaire to ensure content validity and face validity. The completed forms were compiled, and the data was entered into MS excel sheet (Microsoft Corp.), and percentages were calculated using SPSS 17. Descriptive statistics were generated for all questions. The results were tabulated and expressed as both number and percentage.

RESULTS

The questionnaire was distributed to female dental students in the college of dentistry, 175 physicians returned their reply with a response rate of 89.2%. The participants demonstrate a fair good knowledge about the antibiotic prescription in children. The average percentage of fully correct answers (Yes) was higher than 70% of all the statement proposed for knowledge about antibiotic [Table 2]. Attitude and behavior of statement about antibiotic are relatively less compared to knowledge questions, average correct answers (Yes) were ranges 31% to 59%. Regarding the knowledge about the misuse of antibiotics, 93.7% of the sample answered correctly. It was noticed that 79.9% of the sample answered correctly to the statement "Antibiotic can kill good bacteria present in our organism", "penicillin and amoxicillin are antibiotics" (96.6%), "antibiotic is useful for treating bacterial infections" (93.1%), "Antibiotics can cause secondary infections after killing good bacteria present in our organism" (66.5%).

In the matter of attitude of students regarding use of antibiotics, 34.1% and 35.6% of participants agreed that "antibiotic use for cold & sore throat" and "use of antibiotics for fever" respectively. Moreover,

Table 3 Clinical cases on antibiotic prescribing for dental infections in children

1	***Case 1:*** Imagine you are working in a private dental clinic. A healthy 9-year-old child, who is a patient of the clinic, visits during normal working hours with tooth pain in the lower right quadrant. On clinical examination, you notice a deep carious lesion on the mandibular right primary second molar. Would you prescribe antibiotics for the following: • Pain only? • Pain and local swelling with no radiographic evidence of pathology? • Pain and local swelling with radiographic evidence of pathology? • Pain and facial swelling with radiographic evidence of pathology?
2	***Case 2:*** Imagine you are working in a private dental clinic. A healthy 9-year-old child, who is a patient of the clinic, visits during normal working hours with tooth pain in the lower right quadrant and a fever of 38.3°C. On clinical examination, you notice a deep carious lesion on mandibular right primary second molar. Would you prescribe antibiotics for the following: • Pain and fever? • Pain, local swelling with no radiographic evidence of pathology? • Pain, local swelling with radiographic evidence of pathology? • Pain, facial swelling with radiographic evidence of pathology?
3	***Case 3:*** Imagine you are working in a private dental clinic. A healthy 9-year-old child, who is a patient of the clinic, visits during normal working hours with tooth pain in the lower right quadrant. The child has no fever. On clinical examination, you notice a deep carious lesion on the mandibular right primary second molar along with a draining fistula. Would you prescribe antibiotics for the following: • Pain only? • Pain and local swelling with no radiographic evidence of pathology? • Pain and local swelling with radiographic evidence of pathology? • Pain facial swelling with radiographic evidence of pathology?
4	***Case 4:*** Imagine you are working in a private dental clinic. The parent of a healthy 9-year-old child, who is a patient of the clinic, telephones you on a public holiday because the child has a chief complaint of tooth pain in the lower right quadrant. Would you prescribe antibiotics for the following symptoms, if the parent can collect the prescription: • Pain only? • Pain and local swelling? • Pain and facial swelling? • I would see the child before prescribing antibiotics.
5	***Case 5:*** Imagine you are working in a private dental clinic. The parent of a healthy 9-year-old child, who is a patient of the clinic, telephones you on a public holiday and reports that the child has pain on the lower right quadrant with some warmness of the skin and some swelling that she noticed that morning. Would you prescribe antibiotics for the following symptoms, if the parent can collect the prescription: • Pain only? • Pain, warmness of the skin? • Pain, warmness of the skin and localized swelling? • Pain, warmness of the skin and facial swelling? • I would see the child before prescribing antibiotics.

* Source: American Society of Anesthesiologists.[10] ASA: American Society of Anesthesiologists.

Table 4 Compliance rates to antibiotic guidelines for each of the clinical cases

Case No.	Compliance with clinical guidelines	Non-compliance with clinical guidelines
	n (%)	n (%)
Case 1	72	28
Case 2	58.8	41.2
Case 3	58.3	41.7
Case 4	46.8	53.2
Case 5	53.7	46.3

36% of the students agreed to buy the antibiotics without medical prescription, but a majority 64% disagreed with this.

The compliance rate with prescribing guidelines in each of the clinical cases ranged from 28% to 53.2% [Table 4]. According to the AAPD professional guidelines, dentists should consider prescribing antibiotics when a patient has facial swelling with or without pain, radiographic evidence of pathology or a combination of the preceding [Table 5]. For case 1, 28% would prescribe antibiotics only for pain and facial swelling with radiographic evidence of pathology, which is consistent with the AAPD guidelines.[11] For case 2, when the fever was added to the scenario, the compliance rate was 41.2%. For case 3, when the fever was absent, but draining fistula was added to the signs and symptoms, the compliance was 41.7%. For cases 4 and 5, which were nonworking day cases, the compliance rates were 53.2% and 46.3%, respectively. Dentists' adherence to the professional guidelines decreased for the weekend cases. The ADA guidelines state that to prescribe antibacterial drugs, the dentist must "make an accurate diagnosis".[12] In other words, he or she should see the patient before prescribing antibiotics.

Table 5 Professional guidelines for antibiotic use in children according to the American Academy of Pediatric Dentistry[11]

• ***Oral wound management:*** Antibiotic therapy should be considered with oral wounds that are at an increased risk of bacterial contamination; examples are soft-tissue lacerations, complicated crown fractures, severe tooth displacement, extensive gingivectomy and severe ulcerations
• ***Pulpitis/apical periodontitis/draining sinus tract/localized intraoral swelling:*** If a child has acute symptoms of pulpitis and the infection is contained within the pulpal tissue or the immediate surrounding tissue, treatment should be performed and an antibiotic should not be prescribed
• ***Acute facial swelling of dental origin:*** Facial swelling secondary to a dental infection should receive immediate dental attention; depending on clinical findings, treatment may consist of treating or extracting the tooth or teeth in question with antibiotic coverage or prescribing antibiotics for several days to contain the spread of infection and then treating the involved tooth or teeth
• ***Dental trauma:*** Application of an antibiotic to the root surface of an avulsed tooth is recommended to prevent resorption and increase rate of pulpal revascularization; the need for systemic antibiotics with avulsed teeth is unclear.
• ***Pediatric periodontal diseases:*** In pediatric periodontal diseases associated with systemic diseases such as neutropenia, Papillon-Lefevre syndrome and leukocyte adhesion deficiency, antibiotic therapy is indicated.

Source: Adapted with permission of the American Academy of Pediatric Dentistry from the American Academy of Pediatric Dentistry Council on Clinical Affairs.[11]

DISCUSSION

This study investigated the prevalence dental students training in antibiotic prescribing, clinical experience in treating child patients, awareness of antibiotic prescribing guidelines for dental infections in children, and preparedness in antibiotic prescribing, and their association with compliance with existing guidelines. The WHO, antimicrobial resistance: global report on surveillance 2014[13] makes a clear case that resistance to common bacteria has reached alarming levels in many parts of the world. Another important finding of the report is that surveillance of antibacterial resistance is neither coordinated nor harmonized and there are many gaps in the information on bacteria of major public health concern. Fortification of the global antimicrobial resistance surveillance is critical as it is the basis for forming global strategies, monitoring the effectiveness of public health interventions, and detecting new trends and threats (WHO, 2014).[13] Hence, this study is an attempt toward contribution to the existing literature, related to antibiotic use and abuse, especially while treating children located in Saudi Arabia.

The current study was conducted to evaluate the views of knowledge and attitude regarding antibiotic prescribing for children by female undergraduates from 5th, 6th year and internship year of the BDS program. During this period, books, teachers, internet sources, and educational programs conducted at the college level are the only readily available sources of knowledge. This provides a limited amount of time duration to master the proper prescription of antibiotics for dental graduates who directly go into private practice. On the other hand, specialized dentists who have had some extra years in getting trained in a particular specialization may enable them to practice their prescribing skills or may limit them if training is not provided in this important aspect of prescribing drugs. Although private practitioners have ample opportunities to broaden their knowledge, their lack of initiative, inability to attend educational programs may limit their knowledge and awareness regarding antibiotic prescription.[14]

Most human orofacial infections originate from odontogenic infections. The prescribing of antibiotics by dental practitioners has become an important aspect of dental practice. Dentists were benefited greatly from the discovery of penicillin because it is a broad-spectrum antibiotic and covers most of the odontogenic infections.[15] On the other hand, antibiotic use is the key driver of resistance. This is mainly due to its overuse in many parts of the world, particularly for minor infections, misuse due to lack of access to appropriate treatment, and underuse due to lack of financial support and awareness to complete full treatment courses.[16] Hence, a critical approach to the use of antibiotics in the treatment of odontogenic infections dictates precisely defined criteria for the indication of antibiotic therapy.

In this study, the vast majority of the self-administered questionnaire to dental students had a medium level of knowledge in prescribing antibiotics to children. Al-Huwayrini *et al.*,[17] showed by self-survey that 70% of dentists working in private clinics in Riyadh area had a good information level about prescribing antibiotics, while Baadani *et al.*,[18] concluded that by self-administered questionnaire, both the dentists in public and private practices in western region of Saudi Arabia had good antimicrobial prescribing knowledge. In Saudi Arabia, a 2015 study undertaken in the Northern region concluded that amoxicillin clavulanate was the most commonly prescribed antibiotic to treat endodontic infections.[19] Furthermore, two nationwide studies were carried out in 2016 and 2017 which found that dentists' knowledge of antibiotic prescription guidelines and indications was roughly gauged to be intermediate. These studies indicated that there was a frequent prescription of antibiotics in situations where they are not necessary or indicated .[20, 21] Moreover, a survey that was distributed amongst Riyadh's non-medical female university students investigating their knowledge and attitudes regarding the medical and dental use of antibiotics revealed that there are misconceptions and a negative attitude towards antibiotics usage in treating dentistry-related problems.[22]

Compliance with antibiotic guidelines in the case scenarios presented in the present study was low ie., from 28 to 53.2 percent. Compliance did not appear to be associated with training in antibiotic prescribing, clinical experience, and awareness of guidelines or preparedness for practice. Similar lack of concordance between guidelines and the antibiotic prescribing practices of dentists has been reported.[23] The findings observed in this study are supported by a study done by Hammad[24] where it was observed that the majority of the dental practitioners did not follow the proper guidelines for antibiotic

prophylaxis. A cross-sectional survey by Jayadev *et al*.,[25] was carried out to assess the knowledge and pattern of antibiotic prescription for pulpal/periapical pathologies among dentists which concluded that there was lack of uniformity among the dental practitioners regarding the antibiotic prescription. Al-Huwayrini *et al*.,[17] in a questionnaire-based survey among dentists in private clinics, observed an acceptable level of knowledge regarding antibiotics but advocated improvements in training and updating knowledge regarding antibiotic prophylaxis and its pertinent use. Peedikayil and Narayan,[26] reported the overuse of antibiotic by dentists in many conditions which did not require an antibiotic prescription. Inappropriate antibiotic prescriptions have important costs. Unnecessary antibiotic use contributes to the selection of multidrug resistant organisms, wastes healthcare resources and likely leads to a significant number of adverse patient events annually.[27]

Oral antibiotics that are effective against odontogenic infections in children comprise of penicillin, clindamycin, erythromycin, cefadroxil, metronidazole, and the tetracyclines.[28] These antibiotics are effective against Streptococci and oral anaerobes. Penicillin V is the penicillin of choice in cases of odontogenic Infection. Amoxicillin with clavulanic acid (clavulanate) can be used in certain cases, as it offers the advantage of preserving activity against the betalactamases commonly produced by microorganisms associated with odontogenic infections.[29] Clindamycin is an alternative in the case of patients who are allergic to penicillins. The latest generation macrolides, clarithromycin, and azithromycin can also be used if a child is allergic to penicillin. Cephalosporin and cefadroxil are additional options when a broader spectrum of action is required. Metronidazole is usually used against anaerobes, and is characteristically reserved for situations in which only anaerobe bacteria are suspected. Tetracyclines are of very limited use in dental practice, as these drugs can cause alterations in tooth color, they must not be administered to children under eight years of age, or pregnant or nursing women.[30]

A number of factors affect the choice of antibiotic prescription. In this study, UG/PG training, scientific material, Continuing Dental Education (CDE) programs, and cost of drug-affected antibiotic prescription whereas patient's preference and availability of drugs at the pharmacy influenced to a smaller extent. CDE program is an important source of knowledge for dental health-care professionals, to refresh or upgrade their clinical skills regarding the appropriate use of antibiotics which in turn will affect prescribing practices.[31] Whilst some surveys have emphasized that dental prescriptions do not follow clinical guidelines,[32] other authors have concluded that there is a lack of scientific information about the appropriate and efficient prescription of a proper antibiotic.[33] Moreover, changes in the dental pharmacotherapeutic field have been so rapid in recent years that necessitate the constant updating of dental practitioners' knowledge about new drugs, drug interactions, and useful therapeutic trends are necessary.[34] To achieve these needs, it is only possible with the help of continuing education programs, attending conferences, and reading various dental journals and dental magazines to gain appropriate knowledge on the use of drugs and their pharmacokinetics. Thus, lifelong learning in the subject following graduation is highly recommended. Additional studies are required to better evaluate antibiotic prescribing behavior among dental students and practicing dentists in Saudi Arabia. Specific areas for further investigation include longitudinal prescribing trend analyses, evaluations of indeterminate antibiotic treatment durations (e.g., 2-4 days' supply) and prolonged treatment durations (e.g., beyond 10 days), better insights into prescriber behavior rationale.[27,35] Ultimately, improved antibiotic prescribing may likely require a combination of clear treatment guidelines by the ADA and/or the CDC along with comprehensive antimicrobial stewardship efforts targeted to dental prescribers.

The limitations of the present study are sample size was small, which could limit its possibility to the generalization of other population. One of the major limitation of our study that we included only female dental students, future research is indicated to include both the gender for the comparison of knowledge. Reinforcement of knowledge in the form of repeated intervention would be desirable, and possible directions for future research were indicated considering these limitations. In addition, since there are no Saudi guidelines for antibiotics, different schools may be teaching different guidelines. Thus there may be a baseline difference in these student's education. Finally, the administration of a cross-sectional questionnaire may have introduced bias whereby student's practices may reflect those of their mentors, which may or may not be truly evidence-based. Consequently, further studies comparing the attitudes of the mentors, clinical instructors and dental students towards antibiotic prescription may shed some light regarding this possible confounding element.

CONCLUSION

This study concludes that dental students have good knowledge regarding antibiotics, but had low awareness and compliance with antibiotic prescribing guidelines to children. This may be due to a very low sample size selected and included only female dental students in this study. Further studies are necessary to evaluate the appropriateness of these antibiotic prescribing patterns. There is a clear need for the development of prescribing guidelines and educational initiatives to encourage the rational and appropriate use of the antibiotics in children by a dentist. This study supported the need for continuous education to contribute to the wise use of antibiotics such as establishing standard guidelines and are needed to educate dental students in judicious antibiotic prescribing and to better prepare them for their practice as future dentists.

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