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Effect of Dental Students' Education Level on Their Attitudes Towards Cross-Infection Control

Diş Hekimliği Öğrencilerinin Eğitim Seviyesinin Çapraz Enfeksiyon Kontrolü Tutumlarına Etkisi

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ABSTRACT

Objective: This study aimed to evaluate how the level of education influences dental students' knowledge and attitudes toward cross-infection control in prosthetic treatments, comparing fifth-year students with clinical experience and third-year students with only theoretical training.

Methods: A cross-sectional survey was conducted among 207 dental students at Zonguldak Bülent Ecevit University between May and October 2024. A 20-item questionnaire assessing vaccination status, infection control knowledge, and attitudes was administered via Google Forms. Data were analyzed using descriptive statistics and independent samples t-tests (P<.05).

Results: COVID-19 vaccination had the highest rate (83.1%), whereas hepatitis B vaccination remained low (42.9%). Fifth-year students demonstrated significantly greater knowledge of sterilization and disinfection procedures (P<.001), while third-year students were more likely to perceive infection control as a financial burden. In the event of sharp-instrument injury, 71.4% of fifth-year and 64.2% of third-year students reported adherence to post-exposure protocols. Awareness of disinfectant use for impression materials was insufficient in both groups.

Conclusion: Despite generally positive attitudes, gaps persist in students' vaccination awareness and adherence to infection control protocols. Continuous education, immunization monitoring, and reinforcement of infection control training are essential to ensure safer clinical practice.

Keywords: Cross Infection, infection control, dental students, education

ÖZ

Amaç: Bu araştırma, protetik tedavilerde çapraz enfeksiyon kontrolüne yönelik bilgi ve tutumların eğitim düzeyine göre nasıl değiştiğini değerlendirmeyi amaçlamaktadır. Çalışmada klinik deneyime sahip beşinci sınıf öğrencileri ile yalnızca teorik eğitim almış üçüncü sınıf öğrencileri karşılaştırılmıştır.

Yöntem: Kesitsel tipteki bu anket çalışması, Mayıs–Ekim 2024 tarihleri arasında Zonguldak Bülent Ecevit Üniversitesi Diş Hekimliği Fakültesi'nde öğrenim gören 207 öğrenciyle gerçekleştirilmiştir. Aşılama durumu, enfeksiyon kontrolü bilgisi ve tutumlarını değerlendiren 20 soruluk bir anket Google Forms aracılığıyla uygulanmıştır. Veriler tanımlayıcı istatistikler ve bağımsız örneklem t-testi ile analiz edilmiştir (P<,05).

Bulgular: En yüksek aşılanma oranı COVID-19 aşısında görülmüş (%83,1), buna karşın hepatit B aşılanma oranı düşük kalmıştır (%42,9). Beşinci sınıf öğrencileri, sterilizasyon ve dezenfeksiyon prosedürlerine ilişkin anlamlı derecede daha yüksek bilgi düzeyine sahiptir (P<,001). Üçüncü sınıf öğrencileri ise enfeksiyon kontrol önlemlerini daha çok finansal yük olarak görme eğilimindedir. Kesici-delici alet yaralanması durumunda, beşinci sınıf öğrencilerinin %71,4'ü ve üçüncü sınıf öğrencilerinin %64,2'si maruz kalma sonrası protokollere uyduklarını belirtmiştir. Ölçü maddelerinin dezenfeksiyonu konusundaki farkındalık her iki grupta da yetersiz bulunmuştur.

Sonuç: Genel olarak olumlu tutumlar gözlemlenmiş olsa da öğrencilerin aşılanma farkındalığında ve enfeksiyon kontrol protokollerine uyumlarında önemli eksiklikler mevcuttur. Daha güvenli klinik uygulamalar için sürekli eğitim, bağışıklama takibi ve enfeksiyon kontrol eğitimlerinin pekiştirilmesi gereklidir.

Anahtar Kelimeler: Çapraz enfeksiyon, enfeksiyon kontrolü, diş hekimliği öğrencileri, eğitim

INTRODUCTION

The oral cavity provides a favorable environment for the proliferation and transmission of various infectious agents.[1] Everyone may harbor microorganisms that are harmless to the host but may exhibit pathogenic effects in other individuals. Blood and saliva serve as ideal vehicles for the transmission of such agents.[2] Dental clinics are considered potential high-risk environments for infection spread due to the use

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of aerosol- and droplet-producing equipment, the high number of personnel and instruments, the need to select disinfectants appropriate for each instrument, and frequent contact with blood and oral fluids.[3] Cross-infection is defined as the transmission of infection from patients to healthcare personnel or vice versa, caused by insufficient cleaning, disinfection, and/or sterilization of instruments contaminated with pathogenic microorganisms.[4] All healthcare workers and patients are at risk of cross-infection.[5]

Infections can be transmissed through direct or indirect contact with blood, saliva, or organic debris, or through inhalation.[4] Healthcare professionals and patients may be exposed to many pathogens, including cytomegalovirus (CMV), hepatitis B virus (HBV), hepatitis C virus (HCV), herpes simplex virus types 1 and 2 (HSV), human immunodeficiency virus (HIV), Mycobacterium tuberculosis, staphylococci, streptococci, and other viruses.[6] Contact with these pathogens poses a potential risk of infection, although not every exposure results in clinical disease. The development of infectious diseases requires a sufficient inoculum with adequate virulence, a reservoir, a route of transmission, a portal of entry, and a susceptible host.[7] Failure to adhere to sterilization and disinfection protocols leaves both patients and dentists vulnerable to pathogenic microorganisms.[8]

A review of the literature[9-18] reveals studies in Türkiye and worldwide evaluating dental students' knowledge of infection control measures, use of personal protective equipment, and cross-infection control. It has been reported that the risk of cross-infection is increased in prosthetic treatments due to the variety of devices, materials, and the large number of personnel involved in clinical and laboratory processes.[3] However, few survey studies focusing on students undertaking internships in prosthetic dentistry clinics.

The aim of this study was to investigate the effect of education level on the attitudes of fifth-year dental students, who are actively involved in patient treatment during clinical internships, and third-year students, who have only received theoretical training without clinical experience, regarding the prevention of cross-infection in prosthetic treatments. The findings obtained from this study are expected to contribute to the improvement of educational programs and raise awareness of infection control practices.

METHODS

This cross-sectional study investigated the knowledge and attitudes of third- and fifth-year dental students at Zonguldak Bülent Ecevit University Faculty of Dentistry regarding the risk of cross-infection in prosthetic treatments. Ethical approval was granted by the Non-Interventional Clinical Research Ethics Committee of Zonguldak Bülent Ecevit University (Date: 17.04.2024, Decision No.: 2024/09). Students were included after providing voluntary informed consent; the questionnaire was administered via Google Forms between May and October 2024 (six months). Sample size calculation using G*Power 3.1.9.4 indicated that a minimum of 150 students were required at 95% confidence. The study included 207 participants. A 20-item questionnaire, prepared based on a literature review[9-18], assessed demographic characteristics, vaccination status, health screenings, and knowledge levels regarding cross-infection. Exclusion criteria were incomplete responses or not being a third- or fifth-year dental student. Inclusion criteria were voluntary participation, complete questionnaire submission, and enrollment as a third- or fifth-year student.

Statistical analysis was performed using IBM SPSS 25.0 (IBM SPSS Corp., Armonk, NY, USA). Descriptive statistics were reported as frequencies (n), percentages (%), means, and standard deviations. An independent samples t-test was used to compare variables between third- and fifth-year students. Statistical significance was set at $P<.05$. For items using a 5-point Likert scale, response options ranged from 1 = Never to 5 = Always.

RESULTS

The study included 132 female (63.8%) and 75 male (36.2%) students; 140 were fifth-year (67.6%) and 67 were third-year students (32.4%). Of all participants, 52.7% reported receiving education on cross-infection, 42% had not, and 5.3% were uncertain. COVID-19 had the highest vaccination rate (83.1%), followed by tetanus (70.5%), measles-mumps-rubella (52.7%), hepatitis B (42.9%), and influenza (30.4%). Frequencies and percentages of students' responses regarding their socio-demographic characteristics are presented in Table 1.

Table 1. Distribution of Students According to Socio-Demographic Characteristics (n=207)

		n	%
Gender	Male	75	36.2
	Female	132	63.8
Year of Study	3rd Year	67	32.4
	5rd Year	140	67.6
Have you received training on cross-infection?	Undecided	11	5.3
	Yes	109	52.7
	No	87	42.0
Vaccination Status	COVİD-19	172	83.1
	Tetanus	146	70.5
	Measles-Mumps-Rubella (MMR)	109	52.7
	İnfluenza	63	30.4
	Hepatitis B	89	42.9
	Meningococcal	12	5.8
	Hepatitis A	68	32.9
Do you have any bloodborne infectious diseases?	No	207	100.0

Knowledge regarding sterilization and disinfection of prosthetic materials was significantly higher in fifth-year students than in third-year students ($P<.001$). More third-year students reported changes in contamination control measures following the COVID-19 pandemic than fifth-year students ($P=.033$). Students' perceptions of the financial burden posed by infection control measures on clinics differed significantly ($P=.036$), with third-years more frequently perceiving these measures as a financial burden. Both groups concurred that antiseptic mouth rinses, rubber dams, and surgical aspirators effectively reduce the risk of cross-infection ($P=.941$). There were no significant differences between groups regarding the belief that patients disclose infectious diseases during anamnesis ($P=.846$) or that immersion in disinfectant causes material deformation ($P=.172$). Similar results were found for the belief that digital impression techniques reduce cross-contamination ($P=.818$) (Tables 2, 3).

Regarding sharp-instrument injuries, 79.1% of third-year and 67.1% of fifth-year students would report to a clinical supervisor, 50.7% and 47.9% would visit a hospital, 38.8% and 42.9% would request hepatitis markers from the patient, 64.2% and 71.4% would comply with protocols (vaccination, immunoglobulin), while 1.5% and 3.6% would take no action, respectively. Most students were unaware of the active ingredients of the disinfectants used for impression materials, with sodium hypochlorite, glutaraldehyde, and phenolic compounds being the most frequently mentioned by those who were knowledgeable (Tables 4, 5).

Table 2. Assessment of Behavior and Attitudes Regarding Cross-Infection

	3rd Year n=67	5rd Year n=140	Test	
	Mean±SD	Mean±SD	t	*P*
Do you have sufficient knowledge about which materials require sterilization and which require disinfection only?	3.09±1.15	4.24±0.86	-8.081	.000
Do you think the use of antiseptic mouthwash, rubber dam, and surgical aspirator reduces cross-infection risk?	4.07±0.96	4.09±1.02	-0.075	.941
Do you think patients clearly declare infectious diseases (HBV, HCV, HIV, Tuberculosis, etc.) during anamnesis?	2.48±1.01	2.46±1.08	0.131	.896
Do you think soaking auxiliary materials (impression materials, acrylics, waxes, burs, etc.) in disinfectant solution causes deformation?	3.16±1.18	3.26±1.03	-0.581	.562
Do you think it is the dentist's responsibility to disinfect materials before sending them to the laboratory?	3.51±1.16	3.76±1.26	-1.37	.172
Do you think the widespread use of digital impression techniques reduces cross-contamination risk?	4.09±0.88	4.12±0.96	-0.23	.818
Do you think there has been a significant change in contamination control measures before and after COVID-19?	3.70±0.94	3.36±1.11	2.15	.033
Do you think cross-infection control measures increase the financial burden on the clinic?	2.96±1.20	2.55±1.33	2.113	.036

Table 3. Percentage Distribution of Attitudes and Behaviors Regarding Cross-Infection

	Always	Often	Sometimes	Rarely	Never
Do you have sufficient knowledge about which materials require sterilization and which only require disinfection?					
3rd year	14.9%	16.5%	40.3%	19.4%	8.9%
5rd year	47.1%	34.3%	14.3%	4.3%	0%
Do you think cross-infection control measures increase the financial burden on the clinic?					
3rd year	10.5%	20.8%	38.8%	13.5%	16.4%
5rd year	9.3%	17.1%	23.5%	19.3%	30.8%
Do you think it is the dentist's responsibility to disinfect materials before sending them to the laboratory?					
3rd year	23.8%	26.9%	31.4%	12%	5.9%
5rd year	37.8%	25%	18.6%	12.1%	6.5%
Do you think the widespread use of digital impression techniques reduces the risk of cross-contamination?					
3rd year	32.9%	38.9%	19.4%	2.9%	5.9%
5rd year	42.1%	37.1%	13.5%	6.5%	0.8%
Do you think there has been a significant change in contamination control measures before and after the COVID-19 pandemic?					
3rd year	20.9%	37.3%	34.3%	7.5%	0%
5rd year	17.8%	27.9%	35%	13.5%	5.8%
Do you think soaking auxiliary materials used in prosthetic treatments (impression materials, acrylics, waxes, burs, etc.) in disinfectant solution causes deformation?					
3rd year	15%	20.8%	41.8%	10.4%	12%
5rd year	11.5%	27.2%	41.4%	15%	5%
Do you think the use of antiseptic mouthwash, rubber dam, and surgical aspirator reduces the risk of cross-infection?					
3rd year	44.9%	29.9%	20.8%	2.9%	1.5%
5rd year	42.8%	34.2%	17.2%	2.9%	2.9%
Do you think patients clearly disclose their infectious diseases (HBV, HCV, HIV, Tuberculosis, etc.) during anamnesis?					
3rd year	5.9%	4.5%	37.3%	37.3%	15%
5rd year	7.1%	6.5%	28.6%	40%	17.8%

DISCUSSION

Healthcare workers are in constant contact with sources of infection, and a thorough understanding of transmission routes is essential for the prevention of infections.[19] Dental education requires graduates to be highly competent in medical training, clinical skills, and infection control. The General Dental Council (GDC) in the United Kingdom states that dental graduates must be able to "implement infection control and prevent physical, chemical, or microbiological contamination in dental practice.[20] The fundamental principle of cross-infection control is to take standard precautions to minimize the risk of transmission, regardless of the health status of the patient or healthcare worker.[21]

Table 4. Students' Attitudes Toward Sharp-Instrument Injuries

	3rd year (n=67)		5rd year (n=140)	
What would you do in the event of a sharp-instrument injury?	**n**	**%**	**n**	**%**
Reporting to the clinical supervisor	53	79.1	94	67.1
Visiting the hospital	34	50.7	67	47.9
Requesting hepatitis markers from the patient	26	38.8	60	42.9
Complying with the protocol to be applied for yourself (vaccination, immunoglobulin, etc.)	43	64.2	100	71.4
Taking no action	1	1.5	5	3.6

Table 5. Students' Preferred Disinfection Methods for impression materials in prosthetic treatments.

	Zinc Oxide Eugenol		Alginate		Polyvinyl Siloxane	
	3rd Year	5rd Year	3rd Year	5rd Year	3rd Year	5rd Year
I don't know the content	61.2%	67.9%	65.7%	67.9%	62.7%	65.7%
NaOCl	13.4%	5.0%	13.4%	5.7%	16.4%	9.3%
Glutaraldehyde	10.4%	5.0%	6.0%	5.7%	6.0%	7.1%
Phenolic compounds	4.5%	5.9%	6.0%	12.9%	4.5%	12.1%
Ozone	1.5%	0%	3.0%	0.7%	4.5%	0.7%
Iodophor	4.5%	5.0%	1.5%	%5.7	1.5%	8.6%
Ultraviolet	6.0%	1.4%	4.5%	0%	7.5%	0%
Microwave	0%	0%	0%	2.1%	0%	0%
I don't use any	20.9%	17.1%	17.9%	14.3%	17.9%	15.7%
Other	0%	1.4%	0%	1.4%	0%	2.9%

In the present study, the HBV vaccination rate among students was found to be 42.9%. Kechagia et al.[16] reported a rate of 91.5%, Ahmad et al.[22] 80%, Arıkan et al.[12] 88.5%, Tomruk et al.[9] 79.3%, Halboub et al.[14] 54.2% in fourth-year students and 89% in fifth-year students, and Al-Maweri et al.[10] 90% of dental students being vaccinated against HBV. Singh et al.[15] reported a vaccination rate of 38.4% among students, which is consistent with the results of our study. The low vaccination rate in this study is thought to be due to the absence of a mandatory vaccination requirement before internship and insufficient awareness of the subject. Considering the critical role of dental students in healthcare services, it is recommended that their immunization status be reviewed regularly and that they be vaccinated in appropriate healthcare facilities before commencing clinical training.

In our study, the tetanus vaccination rate was determined to be 70.5%, which is significantly higher than the 11.8% reported by Singh et al.[15] and indicates a positive trend in this area. Kechagia et al.[16] reported a tetanus vaccination rate of 80.2%, which is similar to the findings of the present study. Our students demonstrated an informed attitude regarding the risk of tetanus following sharp and penetrating instrument injuries. In addition, Arıkan et al.[12] reported a measles vaccination rate of 58.6% among dental students, which is consistent with the present study's finding of 52.7%. The highest vaccination rate in this research was for COVID-19 at 83.1%. This result is thought to reflect the fear and panic caused globally by the COVID-19 pandemic and the perceived threats to public health.

In the present study, 74.8% of third-year and 77% of fifth-year students found the use of a rubber dam, antiseptic mouth rinse, and surgical aspirator beneficial for infection control, indicating a generally positive attitude toward preventive measures. Similarly, Yıldırım et al.[18] reported comparable rates for rubber dam (73%) and antiseptic mouth

rinse (84.3%) use. Kechagia et al.[16] and Singh et al.[15] also emphasized that the use of mouth rinses and rubber dams, though variable among academic years, remains an essential component of infection control practices. The use of a rubber dam plays a key role in preventing cross-infection by markedly reducing the bacterial load in aerosols generated during dental procedures. Similarly, the pre-procedural use of antiseptic mouth rinses or high-volume aspirators effectively limits bacterial aerosol formation.[23] Among antiseptic agents, chlorhexidine has been identified as the most potent and long-acting option for minimizing microbial contamination.[24]

In our study, 47.1% of fifth-year and 14.9% of third-year students reported having complete knowledge about which dental instruments require sterilization versus disinfection. The higher accuracy among senior students suggests that increased clinical exposure enhances awareness of infection control. Similarly, Yıldırım et al.[18] found that 79.7% of students questioned the apropriate sterilization method, while Altındiş et al.[17] reported that 84% recognized the need for sterilizing aerators and 60% considered disinfection alone insufficient. Akbulut et al.[11] observed that only 24% of students consistently checked sterilization indicators, and Singh et al.[15] and Halboub et al.[14] reported high autoclave use rates (94–100%) among senior students. Overall, these findings highlight that while sterilization awareness improves with clinical experience, variability across countries and education levels remains evident.

Impression materials frequently used in prosthetic treatments are an important risk factor for cross-infection. The American Dental Association (ADA) recommends the use of at least an intermediate-level disinfectant for the disinfection of impressions.[25] In our study, when alginate disinfection was evaluated, 67.9% of fifth-year students and 65.7% of third-year students stated that they did not know the content of the disinfectant; 14.3% of fifth-year students and 17.9% of third-year students reported not using a disinfectant. The rate of non-use of disinfectants was higher among third-year students, while the rate of those unaware of the content was similar between the two groups. Similar results were obtained for polyvinyl siloxane and zinc oxide eugenol impression materials. Contrary to expectations, the knowledge level of fifth-year students was not significantly higher than that of third-year students. This may be explained by individual differences in experience, the delivery of the curriculum, or the forgetting of theoretical knowledge given in the third year by the time students reach the fifth year. It is recommended that educational programs include repeated reinforcement on infection control issues. A review published in Brazil reported that 70% of students did not disinfect impressions.[2] Compared with these data, the knowledge and practice levels of the students in our study appear to be higher. Tomruk et al.[9] reported that 91.6% of students stated that prostheses and impressions should be disinfected before being sent to the laboratory, while Ahmad et al.[22] reported that 87% of students disinfected impressions before sending them to the laboratory and 74% disinfected incoming trials and prostheses before placing them in the patient's mouth. In our study, the majority of students also stated that it is the dentist's responsibility to disinfect materials before sending them to the laboratory. These findings show that students' awareness of impression disinfection is at an acceptable level. The ADA recommends that impressions be disinfected immediately after they are taken, before being sent to the laboratory.[26]

In the event of a sharp-instrument injury, 67.1% of fifth-year students and 79.1% of third-year students stated that they would report it to a clinical supervisor. The lower sensitivity observed among fifth-year students is thought to be due to a heavier workload and higher stress levels. The literature contains studies reporting that 80% of contaminated instrument injuries are not reported to supervisors.[25] In our study, 71.4% of fifth-year students and 64.2% of third-year students stated that they would comply with the procedure (vaccination, immunoglobulin) to be applied to themselves in the event of injury. This indicates that students' behaviors and attitudes toward infection control measures can be improved and that fifth-year students provided responses consistent with their clinical experience. All published protocols recommend obtaining a blood sample from both the injured healthcare worker and the patient, followed by vaccination and immunoglobulin support according to immunity status.[26] In a survey study on sharp-instrument injuries by Yıldırım et al.[18] 84.3% of students stated that they would comply with the protocol after injury, and 73% stated that they would request blood tests from the patient. Kechagia et al.[16] reported that, in response to the question "Would you go to the hospital in the event of injury?" 70.6% of students answered "never" and 9.2% answered "always." In their study, the percentage of third- and fourth-year students who stated that they would not go to the hospital was 72%, while this rate was 55.6% among fifth-year students. In our study, one in two students stated that they would go to the hospital. Compared to the study by Kechagia et al.[16] our research found a higher level of knowledge regarding post-injury prophylaxis and observed that fifth-year students were more knowledgeable in this respect. The risk of infection after percutaneous injury has been determined as 3% for hepatitis C, 30% for hepatitis B, and 0.3% for HIV.[27] Many studies have shown that healthcare workers do not have sufficient knowledge of what to do in the event of exposure. Although almost all healthcare facilities have some form of protocol regarding exposure, some healthcare workers are unaware of them. The fact that 40% of HBV and HCV cases and 2.5% of HIV cases among healthcare workers worldwide result from accidental occupational exposures clearly highlights the importance of this issue.[26]

Finally, when evaluating the role of digital impression techniques in reducing the risk of cross-infection, 71.8% (32.9% always, 38.9% often) of third-year students and 79.2% (42.1% always, 37.1% often) of fifth-year students stated that digital impressions were effective in this regard. This finding indicates that the advantages of digital technologies in terms of infection control are recognized by students and that awareness is high in both years.

The literature shows that simply having knowledge about infection control does not guarantee a positive influence on attitudes and behaviors in practice.[11] The main limitation of this study is that the results were based on subjective responses rather than direct observation of students' knowledge levels. Furthermore, whether students' knowledge levels are high or low may not always influence their behaviors in the same direction.

CONCLUSION

According to the results of this study, the responses of third- and fifth-year dental students were largely similar. Fifth-year students showed higher knowledge regarding sterilization and disinfection of prosthetic materials. The relatively low hepatitis B vaccination rate (42.9%) compared with the high COVID-19 vaccination rate (83.1%) highlights an important gap in awareness of blood-borne infections. Although most students reported compliance with post-exposure protocols, the rate remains suboptimal, indicating the need to strengthen education on infection control and management of occupational injuries. Continuous training, regular monitoring of immunization status, and reinforcement of infection control infrastructure are essential to ensure safer clinical practice among dental students.

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