

KNOWLEDGE AND AWARENESS LEVEL OF EFFECT OF MOUTH RINSE (CHX) ON TOOTH-COLORED COMPOSITE RESTORATION

Samar Abuzinadah¹, Hadeel Alashram², Roaa Kalantan³, Hatoon Almaqboul⁴, Nour Nenri², Abeer Alqarni⁵, Khalid Almutairi⁶, Ola Khoja³, Hassan Nasser⁵, Abdulrahman Jafar Alhaddad⁷, Khames Alzahrani^{8*}

¹Department of Restorative Dentistry, Faculty of Dentistry, King Abdul-Aziz University, Jeddah, Saudi Arabia.

²Dental student, King Khalid University, Abha, Saudi Arabia.

³Dental student, King Abdulaziz University, Jeddah, Saudi Arabia.

⁴General dentist, Jeddah, Saudi Arabia.

⁵Dental Intern, King Khalid University, Abha, Saudi Arabia.

⁶General dentist, Zulfi, Saudi Arabia.

⁷Oral and Maxillofacial Prosthodontics Department, King Abdul-Aziz University, Faculty of Dentistry, Jeddah, Saudi Arabia.

⁸Saudi Board of Endodontic SR, King Faisal Specialist Hospital & Research Centre, Riyadh, Saudi Arabia. Dr.khames.alzahrani@gmail.com

ABSTRACT

Chlorhexidine (CHX) is the main chemical agent for treating and managing plaque and reducing gingivitis. It is a wide-spectrum antibacterial agent. Mouthwash used for oral hygiene can cause degradation of the resin composite surface because of its components, such as detergent, alcohol, emulsifier, and organic acid. Enhancing the baseline data and enhancing instructions, would improve dental student's understanding and awareness while protecting the integrity of composite restorations and patient's oral health. To evaluate the effect of chlorhexidine mouthwash on color stability and surface roughness of conventional nano-hybrid composite. A cross-sectional study was conducted. The survey was distributed among undergraduate dental students and interns in Saudi Arabia. Analyzes and entry methods were performed by using SPSS version 21 for the data gathered through surveys. The Statistical Package for Social Sciences was used to import the overall response rate and the percentage of responses for each question. One thousand and forty-one participants enrolled in this study, and the majority of respondents fall within the 21-25 age group accounting for 93.0% of the total sample. 48.4% were males and 51.6% were females. Findings showed a breakdown of the frequency and percentage distribution of individuals categorized by their level of knowledge. The parameter "High knowledge" is represented by 179 individuals, accounting for 17.2% of the total sample. The knowledge and awareness level of the effect of mouth rinse, specifically chlorhexidine, on tooth-colored composite restorations among dental students in KSA is acceptable based on the study results.

Key words: Chlorhexidine, Mouthwash, Composite, Dental material.

Introduction

Chlorhexidine (CHX) is now known as the main chemical agent for treating and controlling plaque and decrease gingivitis. It is a wide-spectrum antibacterial agent [1]. Mouthwash used for oral hygiene can cause degradation of the resin composite surface because of its components, such as detergent, alcohol, emulsifier, and organic acid [2]. Chlorhexidine (CHX) is well attached to teeth and surrounding soft tissues, and its progressive release can be maintained for up to 12 hours [3]. Many internal and external features may cause an alteration in the color of restorative materials. CHX mouthwash is one of the causative factors for discoloration [4]. The surface roughness and hardness of the composites are influenced by alcohol-containing mouth rinses, according to studies. On the other hand, some studies assert that alcohol mouth rinses have no negative impact on the composite material's hardness and that the material's microhardness value is more important than the rinsing solutions used [5]. The

discoloration, wear resistance and susceptibility of plaque retention are factors to be taken into account, Chlorhexidine (CHX), frequently used in dental medicine in the treatment of oral candidiasis, gingivitis, and periodontitis, among others is a cationic antiseptic with high potential for pigmentation of teeth and soft tissues. Several studies demonstrate the effects of chlorhexidine and its mechanisms on discoloration and surface changes of nano and micro-hybrid composite [6]. The aim is to evaluate the effect of chlorhexidine mouthwash on color stability and surface roughness of conventional nanohybrid composite [7]. Dental materials should be aesthetically pleasing, biocompatible, and beneficial. Due to the esthetic demands and developments in dental technology, it is now required to provide the desired look and durability in posterior teeth [8]. Teeth and restorations in the oral cavity tend to lose their color stability owing to internal and external influences. When aesthetics are valued as highly as dental hygiene, discoloration is unpleasant not just for the dentist but also for the patient [9]. Chlorhexidine (CHX) is now widely

acknowledged as the primary chemical agent for managing and preventing biofilm and suppressing gingivitis [10]. However, continuous usage of mouth rinses may be harmful to oral and dental tissues [11]. Recent research in Riyadh, Saudi Arabia has suggested that about 51% of dental students in Riyadh city want to prescribe chlorhexidine mouth rinses for tooth-colored restoration patients [12]. Chlorhexidine mouth rinse was observed to cause staining on restorative materials [13]. Thus, the correlation between chlorhexidine and tooth-colored composite restoration demands to be clarified more directly during dental schooling. That would contribute to the knowledge and awareness of dental students by enriching the baseline data and improving education, consequently, preserving the integrity of composite restoration and patient oral health. However, due to a lack of research on our topic, none of the studies provide a true estimate of the knowledge and awareness of the effect of chlorhexidine among dental students in Saudi Arabia. This study aimed to assess the knowledge and awareness level of dental students about the impact of chlorhexidine mouthwash on tooth-colored composite restoration in Saudi Arabia.

Materials and Methods

Study design

This is a cross-sectional questionnaire survey at Dental schools in Saudi Arabia.

Study setting

Participants, recruitment, and sampling procedure

The study's population consisted of undergraduate students from dental college plus the internship. Participants were recruited during 2023. All students from dental college plus the internship were invited to participate in the study.

Inclusion and exclusion criteria

The inclusion criteria included undergraduate dental students and dental interns who agreed to participate in our study in Saudi Arabia. Dental students, dental interns outside Saudi Arabia, and graduate dentists were in the exclusion criteria.

Sample size

The sample size was estimated by using the Qualtrics calculator with a confidence level of 95%; the minimum sample size was 384. The sample size was calculated by (Raosoft, Inc., Seattle, WA, USA) (22) at 384 individuals using the following formula and applying means and standard deviation. Considering standard deviation (=1.96) for a 95% Confidence interval and the maximum acceptable marginal error (=0.05). Therefore, the calculated minimum sample size required for this study is $n = (1.96)^2 \times 0.50 \times 0.50 / (0.05)^2 = 384$ participants.

$$n = \frac{z^2 p(1-p)}{d^2} \quad (1)$$

By using the Qualtrics calculator and a 95% degree of confidence, the size of the sample was estimated, So the minimum sample size was 384. The Sample size was estimated by using this formula: $n = P(1-P) * Z^2 / d^2$ with a confidence level of 95%.

n: Calculated sample size.

Z: The z-value for the selected level of confidence (1- α) = 1.96.

P: Estimated knowledge.

Q: (1 - 0.50) = 50%, i.e., 0.50

D: The maximum acceptable error = 0.05.

So, the calculated minimum sample size was $n = (1.96)^2 \times 0.50 \times 0.50 / (0.05)^2 = 384$.

Method for data collection and instrument (Data collection Technique and tools)

A structured questionnaire was used as the study tool [14], and 13 statements were used to assess the knowledge and awareness level of the effect of mouthwash rinse (CHX) on tooth-colored composite restoration.

Scoring system

Overall, 13 statements were used to assess the knowledge and awareness level of the effect of mouthwash rinse (CHX) on tooth-colored composite restoration. For each correct answer, a score of 1 was considered. A score of 0 was provided for an incorrect response, then the total score was calculated. The scoring system was divided as follows: low knowledge (0-7), average knowledge (8-9), and high knowledge (10-13).

Analyzes and entry method

utilizing SPSS version 21, data gathered through surveys. From this database, the Statistical Package for Social Sciences was used to import the overall response rate and the percentage of responses for each question.

Results and Discussion

Table 1 showed that in terms of age distribution, the majority of respondents fall within the 21-25 age group, accounting for 93.0% of the total sample. This is followed by the 18-20 age group at 4.3%, 26-30 at 2.4%, and those above 30 years at 0.3%. Gender-wise, the data reflects a relatively balanced distribution, with 48.4% male respondents and 51.6% female respondents. The highest representation comes from Riyadh at 36.8%, followed by Asir at 19.7% and Makkah at 7.8%. The GPA range distribution provides a clear picture of the academic performance of the respondents. The majority fall within the 4.25-4.50 GPA range, constituting 37.1% of the sample, followed by the 3.74-3.50 range at 16.8%.

Table 1. Sociodemographic characteristics of participants (n=1041)

	Parameter	No.	%
Age	18_20	45	4.3
	21_25	968	93.0
	26_30	25	2.4
	more than 30	3	.3
Gender	Male	504	48.4
	Female	537	51.6
Province of Residency	Asir	205	19.7
	Baha	40	3.8
	Eastern Province	121	11.6
	Hail	76	7.3
	Jazan	31	3.0
	Jouf	1	.1
	Madinah	32	3.1
	Makkah	81	7.8
	Najran	32	3.1
	Qassim	39	3.7
	Riyadh	383	36.8
University	Al Baha University	40	3.8
	Al Qussaim University	40	3.8
	Al-Jouf University	36	3.5
	Bisha University	38	3.7
	Ha'il University	42	4.0
	Imam Abdul Rahman bin Faisal University	115	11.0
	Jazan University	31	3.0
	King Abdulaziz university	4	.4
	King Faisal University	40	3.8
	King Khalid University	171	16.4
	King Saud bin Abdulaziz University for Health Sciences	31	3.0
	King Saud University	151	14.5
	Majmaah University	91	8.7
	Najran university	32	3.1
	Prince Sattam bin Abdulaziz University	34	3.3
	Princess Nora bint Abdulrahman University	37	3.6
	Taibah University	31	3.0
	Taif University	37	3.6
	Umm Al Qura University	34	3.3
	Vision college	6	.6
GPA if out of 5	(3.24 - 3)	2	.2
	(3.74 - 3.5)	175	16.8
	(3.99 - 3.75)	74	7.1

	(4.24 - 4)	117	11.2
	(4.49 - 4.25)	386	37.1
	(4.74 - 4.5)	215	20.7
	(5-4.75)	24	2.3
	The GPA used in my university is out of 3	1	.1
	The GPA used in my university is out of 4	47	4.5
GPA if out of 4	(2.99 - 2.75)	1	2.1
	(3.49 - 3.25)	46	95.8
	(4 - 3.75)	1	2.1

It is evident from the data presented in **Table 2** that a significant proportion of respondents have experience with composite restorations, with a vast majority (99.0%) indicating they have performed such procedures. Additionally, the utilization of mouth rinse, specifically chlorhexidine (CHX), is prevalent, as 97.3% of respondents reported its use. When it comes to the primary reasons for prescribing mouthwash to patients, the most common causes cited were gingivitis (87.7%) and periodontitis (6.6%), emphasizing the focus on periodontal health and disease prevention. In the scenario of a patient presenting with a high-risk caries profile, the preferred type of mouthwash for prescription was found to be fluoride-containing, with 54.6% of respondents opting for this type. Furthermore, the frequency of mouthwash usage among respondents predominantly leaned towards twice daily application (88.6%), reflecting a consistent and regular incorporation of mouthwash into oral hygiene routines. The impact of mouthwashes on esthetic restorations was a notable area of inquiry. A majority of respondents (56.9%) acknowledged that mouthwashes can increase the surface roughness of esthetic restorations, while a significant portion (51.0%)

believed that these products can affect the color of restorations. Moreover, when considering the potential discoloration and surface roughness of different restorative materials, composite materials were identified as the most susceptible to both discoloration (55.1%) and surface roughness (35.1%). In the context of prescribing mouthwash to patients with esthetic restorations, the responses were diverse. While a substantial portion of respondents were inclined to prescribe chlorhexidine-containing mouthwash (70.6%), there were notable reservations regarding the prescription of betadine-containing (44.8%) and alcohol-containing (52.9%) mouthwashes. Conversely, a larger proportion of respondents were hesitant to prescribe fluoride-containing mouthwash (60.7%) to patients with esthetic restorations, indicating a degree of caution regarding its potential impact on restorative materials. The influence of toothbrushes on restorations was also explored, with a significant majority (79.6%) acknowledging their effect. Notably, the overwhelming preference for soft toothbrushes (94.0%) among respondents underscores the emphasis on minimizing potential abrasive effects on esthetic restorations.

Table 2. Knowledge of participants of the effect of mouth rinse (CHX) on tooth-colored composite restoration (n=1041).

Parameter	No.	%	
Done composite restoration before	Yes	1031	99.0
	No	10	1.0
Use of mouth rinse (CHX) before	Yes	1013	97.3
	No	28	2.7
The main cause for prescribing mouthwash to the patient	Gingivitis	913	87.7
	Halitosis	51	4.9
	High caries risk	8	.8
	Periodontitis	69	6.6
Patient comes to your clinic suffering from high-risk caries, you are going to prescribe a mouthwash, what is its type?	Alcohol containing	69	6.6
	Betadine containing	49	4.7
	Chlorhexidine containing	355	34.1
	Fluoride containing	568	54.6
Frequency of using mouthwash	1 time daily	36	3.5

	2 times daily	922	88.6
	3 times daily	66	6.3
	I am not using	17	1.6
Mouthwashes increase the surface roughness of esthetic restorations	Yes	592	56.9
	No	332	31.9
	I do not know	117	11.2
Mouthwash affects the color of restorations	Yes	531	51.0
	No	183	17.6
	I do not know	327	31.4
Materials that have a higher discoloration rate	Ceramic	4	.4
	Composite	574	55.1
	GIC	463	44.5
Materials that have a higher surface roughness	Ceramic	60	5.8
	Composite	365	35.1
	GIC	616	59.2
Prescribe chlorhexidine-containing mouthwash to a patient with esthetic restoration	Yes	735	70.6
	No	306	29.4
Prescribe betadine-containing mouthwash to a patient with esthetic restoration	Yes	466	44.8
	No	575	55.2
Prescribe an alcohol-containing mouthwash to a patient with esthetic restoration	Yes	551	52.9
	No	490	47.1
Prescribe a fluoride-containing mouthwash to a patient with esthetic restoration	Yes	409	39.3
	No	632	60.7
A toothbrush affects the restoration	Yes	829	79.6
	No	212	20.4
Type of toothbrush used with esthetic restoration	Hard	2	.2
	Medium	60	5.8
	Soft	979	94.0

The data presented in **Figure 1** provided a breakdown of the frequency and percentage distribution of individuals categorized by their level of knowledge. The parameter "High knowledge" is represented by 179 individuals, accounting for 17.2% of the total sample. Meanwhile, "Average knowledge" encompasses 552 individuals, making up 53.0% of the population. Finally, "Low knowledge" is attributed to 310 individuals, constituting 29.8% of the dataset (**Figure 1**).

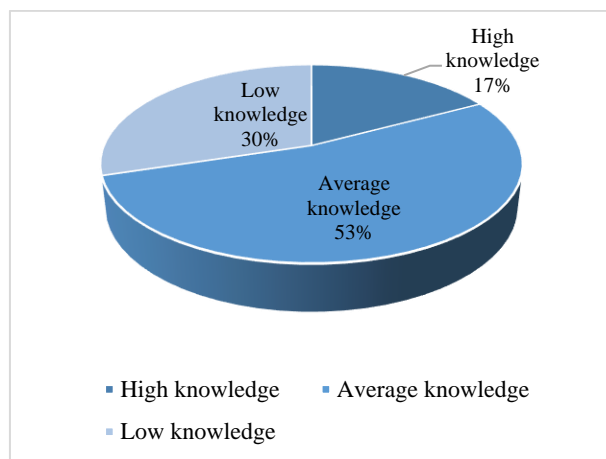


Figure 1. Knowledge score of participants on the effect of mouth rinse (CHX) on tooth-colored composite

restoration

Table 3 presented data on knowledge scores, age, gender, province of residency, and university, along with corresponding percentages and p-values. Firstly, let's focus on the age distribution and its association with knowledge scores. The analysis of knowledge scores based on age groups reveals significant variations. Notably, the 21-25 age group comprises the largest proportion of the sample, with 48.0% possessing average knowledge, while 16.6% demonstrate high knowledge and 28.3% exhibit low knowledge. In contrast, the 18-20 age group shows a lower overall knowledge level, with only 4.2% possessing average knowledge and 0.1% demonstrating low knowledge. The observed p-value of 0.001 indicates a statistically significant association between age and knowledge levels. Furthermore, the gender-based analysis demonstrates a similar pattern, with a notable discrepancy in knowledge levels between males and females. Specifically, 48.4% of

males exhibit average knowledge compared to 19.1% with high knowledge and 15.3% with low knowledge. In contrast, 51.6% of females demonstrate average knowledge, while 33.9% exhibit high knowledge, and 14.5% display low knowledge. The associated p-value of 0.001 underscores the significance of this gender-based disparity in knowledge distribution. Province of residency exhibited significant association with p-value Of 0.001, as Riyadh residents exhibited the highest knowledge among participants (7.3%), followed by Asir region (3.7%). GPA exhibited a significant association with a p-value of 0.001, as participants with a GPA of (3.74 - 3.5) exhibited the highest knowledge among participants (6%). University exhibited a significant association with p-value Of 0.001, as Majmaah University students exhibited the highest knowledge among participants (4.1%), followed by King Khalid University (3.7%).

Table 3. Association between sociodemographic characteristics and knowledge score of participants of the effect of mouth rinse (CHX) on tooth-colored composite restoration (n=1041).

Parameter	Knowledge score			Total (N=1041)	P value	
	High knowledge	Average knowledge	Low knowledge			
Age	18-20	0 0.0%	44 4.2%	1 0.1%	45 4.3%	0.001
	21_25	173 16.6%	500 48.0%	295 28.3%	968 93.0%	
	26_30	6 0.6%	6 0.6%	13 1.2%	25 2.4%	
	more than 30	0 0.0%	2 0.2%	1 0.1%	3 0.3%	
		Male	146 14.0%	199 19.1%	159 15.3%	
Female	33 3.2%	353 33.9%	151 14.5%	537 51.6%		
Province of Residency	Asir	39 3.7%	56 5.4%	110 10.6%	205 19.7%	0.001
	Baha	0 0.0%	1 0.1%	39 3.7%	40 3.8%	
	Eastern Province	2 0.2%	114 11.0%	5 0.5%	121 11.6%	
	Hail	0 0.0%	76 7.3%	0 0.0%	76 7.3%	
	Jazan	29 2.8%	0 0.0%	2 0.2%	31 3.0%	
	Jouf	0 0.0%	0 0.0%	1 0.1%	1 0.1%	
	Madinah	1 0.1%	0 0.0%	31 3.0%	32 3.1%	
	Makkah	0 0.0%	72 6.9%	9 0.9%	81 7.8%	
	Najran	32 3.1%	0 0.0%	0 0.0%	32 3.1%	
	Qassim	0 0.0%	39 3.7%	0 0.0%	39 3.8%	

		0.0%	3.7%	0.0%	3.7%	
	Riyadh	76	194	113	383	
		7.3%	18.6%	10.9%	36.8%	
GPA if out of 5	(3.24 - 3)	0	1	1	2	
		0.0%	0.1%	0.1%	0.2%	
	(3.74 - 3.5)	62	71	42	175	
		6.0%	6.8%	4.0%	16.8%	
	(3.99 - 3.75)	0	40	34	74	
		0.0%	3.8%	3.3%	7.1%	
	(4.24 - 4)	36	32	49	117	
		3.5%	3.1%	4.7%	11.2%	
	(4.49 - 4.25)	40	270	76	386	
		3.8%	25.9%	7.3%	37.1%	0.001
	(4.74 - 4.5)	38	88	89	215	
		3.7%	8.5%	8.5%	20.7%	
	(5-4.75)	3	7	14	24	
		0.3%	0.7%	1.3%	2.3%	
	The GPA used in my university is out of 3	0	0	1	1	
		0.0%	0.0%	0.1%	0.1%	
	The GPA used in my university is out of 4	0	43	4	47	
		0.0%	4.1%	0.4%	4.5%	
GPA if out of 4	(2.99 - 2.75)	0	0	1	1	
		0.0%	0.0%	2.1%	2.1%	
	(3.49 - 3.25)	0	42	4	46	
		0.0%	87.5%	8.3%	95.8%	0.001
	(4 - 3.75)	0	1	0	1	
		0.0%	2.1%	0.0%	2.1%	
University	Al Baha University	0	1	39	40	
		0.0%	0.1%	3.7%	3.8%	
	Al Qussaim University	0	40	0	40	
		0.0%	3.8%	0.0%	3.8%	
	Al-Jouf University	0	35	1	36	
		0.0%	3.4%	0.1%	3.5%	
	Bisha University	0	0	38	38	
		0.0%	0.0%	3.7%	3.7%	
	Ha'il University	0	41	1	42	
		0.0%	3.9%	0.1%	4.0%	
	Imam Abdul Rahman bin Faisal University	1	112	2	115	
		0.1%	10.8%	0.2%	11.0%	
	Jazan University	29	0	2	31	
		2.8%	0.0%	0.2%	3.0%	
	King Abdulaziz university	0	0	4	4	
		0.0%	0.0%	0.4%	0.4%	
King Faisal University	0	39	1	40		
	0.0%	3.7%	0.1%	3.8%		
King Khalid University	39	56	76	171		
	3.7%	5.4%	7.3%	16.4%		
King Saud bin Abdulaziz University for Health Sciences	0	31	0	31		
	0.0%	3.0%	0.0%	3.0%		
King Saud University	0	45	106	151		
	0.0%	4.3%	10.2%	14.5%		
Majmaah University	43	43	5	91		
	4.1%	4.1%	0.5%	8.7%		
Najran university	32	0	0	32		
	3.1%	0.0%	0.0%	3.1%		

Prince Sattam bin Abdulaziz University	34	0	0	34
	3.3%	0.0%	0.0%	3.3%
Princess Ora bint Abdulrahman University	0	37	0	37
	0.0%	3.6%	0.0%	3.6%
Taibah University	0	0	31	31
	0.0%	0.0%	3.0%	3.0%
Taif University	0	37	0	37
	0.0%	3.6%	0.0%	3.6%
Umm Al Qura University	0	33	1	34
	0.0%	3.2%	0.1%	3.3%
Vision college	1	2	3	6
	0.1%	0.2%	0.3%	0.6%

The knowledge and awareness level of the effect of mouth rinse, specifically chlorhexidine (CHX), on tooth-colored composite restorations among dental students in the Kingdom of Saudi Arabia (KSA) is an important topic to discuss. As future dental professionals, students must be well-informed about the potential impact of mouth rinses on dental restorations to provide the best possible care for their patients [3].

Firstly, it is important to understand the significance of tooth-colored composite restorations in modern dentistry. These restorations are widely used to restore the function and aesthetics of teeth affected by decay or damage. They are popular due to their ability to closely match the natural color of the tooth, providing a more aesthetically pleasing result compared to traditional amalgam fillings. However, tooth-colored composite restorations are also more susceptible to staining and degradation, making it essential for dental professionals to be aware of factors that may affect their longevity and appearance [4].

One such factor is the use of mouth rinses, particularly those containing chlorhexidine. Chlorhexidine is a common antiseptic and antimicrobial agent used in mouth rinses to help reduce plaque and gingivitis. However, research has shown that chlorhexidine can potentially have adverse effects on tooth-colored composite restorations, including discoloration and surface degradation. It is therefore important for dental students to be knowledgeable about the potential impact of chlorhexidine mouth rinses on these restorations to make informed recommendations to their patients [7].

The knowledge score exhibited by our participants was adequate, as 70.2% of participants exhibited high or average knowledge. Our study showed that the main causes of prescribing a mouthwash to patients were gingivitis (87.7%) and periodontitis (6.6%); similarly, a cross-sectional study conducted in Riyadh city showed that 70.39% of the participants selected gingivitis or periodontitis as the primary indication for prescription mouthwashes to patients [14], which as well aligns with the indication for prescribing mouth rinses according to Kocak [15].

Our study showed that 88.6% of participants used mouthwash twice daily which suggests a strong knowledge of personal oral hygiene, and 56.9% said that mouthwashes increase surface roughness of esthetic restorations, while 31.9% opposed, although the majority answered correctly, a significant proportion didn't and this may be due to the insufficient knowledge provided in dental schools at the undergraduate level on the impact of mouthwash on the smoothness of cosmetic dental restorations. Consistent with a study in Riyadh which found that over 60% of the participants utilize mouthwash daily. Conversely, 51.91% of individuals are unaware of the potential impact of mouthwashes on the surface roughness of esthetic restorations. Additionally, 20.21% believe that there is no effect, indicating that just 27.88% possess knowledge regarding the potential impact of mouthwashes on the surface roughness of esthetic restorations [14].

When asked about their opinion on prescribing mouthwash containing chlorhexidine to patients with esthetic restorations, around 70.6% said yes, indicating a contradiction between prescribing chlorhexidine mouthwash and its impact on esthetic restorations. When inquiring about the presence of betadine in a mouthwash, 55.2% of participants responded negatively about the recommendation of betadine-containing mouthwash for patients with esthetic restorations. Regarding alcohol, 47.1% of respondents indicated that they would not recommend alcohol-containing mouthwashes for patients with esthetic restorations. Similarly, Alsulayhim indicated that when surveying participants regarding their stance on prescribing chlorhexidine to patients with esthetic restorations, around 50.87% responded affirmatively. When asked about the presence of betadine in a mouthwash, 59.24% of participants responded with a no in terms of recommending a mouthwash containing betadine to patients with esthetic restorations. With regard to alcohol, 54.35% of respondents indicated that they would not recommend alcohol-containing mouthwashes for patients with esthetic restorations [14]. Moreover, Listerine's alcohol content significantly affects the rate at which the composite restoration absorbs, particularly in the case of hybrid and nanohybrid materials [16].

54.6% of participants said they would prescribe fluoride-containing mouthwash for patients suffering from high-risk caries, while 39.3% said that they would prescribe a fluoride-containing mouthwash to patients with esthetic restorations, finally 94% said that a soft toothbrush is used with esthetic restorations. A study showed that when surveying participants on the use of fluoride-containing mouthwash for patients with esthetic restorations, 79.8% responded affirmatively. This indicates that it is effective in reducing the advancement of dental decay. However, extended use may also cause a change in the color of tooth restorations. Over 80% of the participants favor utilizing a gentle toothbrush with satisfactory esthetic restoration [14].

In the context of KSA, dental students need to be aware of the prevalence of chlorhexidine mouth rinse use among the population, as well as the potential impact on dental restorations. This knowledge will enable them to provide accurate and relevant advice to their patients regarding oral hygiene practices and product selection. Additionally, dental students should be aware of alternative oral hygiene products and practices that can be recommended to patients with tooth-colored composite restorations, to minimize the risk of adverse effects [11].

Furthermore, dental education programs in KSA need to incorporate comprehensive and up-to-date information on the effects of mouth rinses, including chlorhexidine, on dental restorations into their curriculum. This will ensure that future dental professionals are well-equipped to address the potential impact of mouth rinses on tooth-colored composite restorations in their clinical practice [14].

This study has provided valuable insights into the understanding of dental students in Saudi Arabia regarding the impact of mouth rinse on tooth-colored composite restorations. However, it is important to note that the study has certain limitations. One limitation is the potential for bias in self-reported knowledge and awareness levels among the participants. Additionally, the study may not have accounted for other factors that could influence the effectiveness of mouth rinse on composite restorations, such as the frequency of use or individual oral hygiene habits. Future research could benefit from addressing these limitations to provide a more comprehensive understanding of the topic.

The findings of this study could potentially lead to a greater understanding of the impact of mouth rinse on dental restorations, which could in turn influence the way dental students are taught and how dental professionals approach patient care. Additionally, this research could contribute to the development of new guidelines and protocols for the use of mouth rinse in dental practice, ultimately improving the quality of dental care in the region. Overall, this study has the potential to shape the future of dental education and practice in KSA.

Conclusion

In conclusion, the knowledge and awareness level of the effect of mouth rinse, specifically chlorhexidine, on tooth-colored composite restorations among dental students in KSA is an important aspect of their education and training. The knowledge score exhibited by our participants was adequate. By being well-informed about the potential impact of mouth rinses on dental restorations, dental students can provide better care for their patients and contribute to the overall oral health of the population. Dental education programs in KSA need to prioritize this topic and ensure that students are adequately prepared to address the implications of mouth rinses on dental restorations in their future practice.

Acknowledgments: We thank the participants who all contributed samples to the study.

Conflict of interest: None

Financial support: None

Ethics statement: Written informed consent was obtained from all individual participants included in the study.

References

1. Hamdan-Nassar T, Bellot-Arcís C, Paredes-Gallardo V, García-Sanz V, Pascual-Moscardó A, Almerich-Silla JM, et al. Effect of 2% Chlorhexidine Following Acid Etching on Microtensile Bond Strength of Resin Restorations: A Meta-Analysis. *Medicina (Kaunas)*. 2019;55(12).
2. Hamdy TM, Abdelnabi A, Othman MS, Bayoumi RE, Abdelraouf RM. Effect of Different Mouthwashes on the Surface Microhardness and Color Stability of Dental Nanohybrid Resin Composite. *Polymers (Basel)*. 2023;15(4).
3. Polizzi E, Tetè G, Bova F, Pantaleo G, Gastaldi G, Capparè P, et al. Antibacterial properties and side effects of chlorhexidinebased mouthwashes. A prospective, randomized clinical study. *J Osseointegration*. 2020;12(1):2-7.
4. Baig AR, Shori DD, Shenoj PR, Ali SN, Shetti S, Godhane A. Mouthrinses affect color stability of composite. *J Conserv Dent*. 2016;19(4):355–9.
5. Ananya B, Karthickraj SM. Effects of mouthrinses on surface properties of CAD CAM manufactured temporary restorative materials Effects of mouthrinses on surface properties of CAD CAM manufactured temporary restorative mate. *J Popul Ther Clin Pharmacol*. 2022;29(1):178–88.
6. Cairo F, Pagliaro U, Buti J, Baccini M, Graziani F, Tonelli P, et al. Root coverage procedures improve patient aesthetics. A systematic review and Bayesian network meta-analysis. *J Clin Periodontol*. 2016;43(11):965–75.

7. Pisal NS, Shah NC, Gandhi NN, Dedania MS, Rao AS. Effect of Chlorhexidine Mouthwash, Povidoneiodine Gargles and Herbal Mouth Sanitiser on Colour Stability and Surface Roughness of Conventional Nanohybrid Composite An In-vitro Study. *J Clin Diagnostic Res.* 2022;16(5):14–7.
8. Erturk-Avunduk AST, Aksu S, Delikan E. The Effects of Mouthwashes on the Color Stability of Resin-Based Restorative Materials. *Odovtos - Int J Dent Sci.* 2021;23(1):91–102.
9. Akay C, Çakırbay Tanış M, Gulverdiyeva M. Coloration of provisional restoration materials: a comparison of the effects of mouth rinses and green tea. *Eur Oral Res.* 2018;52(1):19–24.
10. Hamdan-Nassar T, Bellot-Arcís C, Paredes-Gallardo V, García-Sanz V, Pascual-Moscardó A, Almerich-Silla JM, et al. Effect of 2% Chlorhexidine Following Acid Etching on Microtensile Bond Strength of Resin Restorations: A Meta-Analysis. *Medicina (Kaunas).* 2019;55(12).
11. Celik C, Yuzugullu B, Erkut S, Yamanel K. Effects of Mouth Rinses on Color Stability of Resin Composites. *Eur J Dent.* 2008;02(04):247–53.
12. Alsulayhim S, Alsaggaf K, Al Eissa M, Hamdi B, Aljafar M, Altabbakh A, et al. Knowledge and attitude of dental students in Riyadh City toward the effect of mouthwashes on surface roughness and color stability of some esthetic restorations. *J Fam Med Prim Care.* 2021;10(2):953.
13. Erturk-Avunduk AST, Aksu S, Delikan E. The Effects of Mouthwashes on the Color Stability of Resin-Based Restorative Materials. *Odovtos - Int J Dent Sci.* 2021;23(1):91–102.
14. Alsulayhim S, Alsaggaf K, Al Eissa M, Hamdi B, Aljafar M, Altabbakh A, et al. Knowledge and attitude of dental students in Riyadh City toward the effect of mouthwashes on surface roughness and color stability of some esthetic restorations. *J Fam Med Prim Care.* 2021;10(2):953.
15. Kocak MM, Ozcan S, Kocak S, Topuz O, Erten H. Comparison of the efficacy of three different mouthrinse solutions in decreasing the level of streptococcus mutans in saliva. *Eur J Dent.* 2009;3:57–61.
16. Haq MW, Batoool M, Ahsan SH, Qureshi NR. Alcohol use in mouthwash and possible oral health concerns. *J Pak Med Assoc.* 2009;59:186–90.