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RESEARCH ARTICLE

The association of different levels of knowledge with the oral health status and oral hygiene habits among dental medicine students: a cross-sectional study

Martina Tomić*, Ivona Domazet*, Marija Roguljić

University of Split School of Medicine, Split, Croatia
*Joint first authorship.

Aim: To investigate whether different levels of knowledge about oral diseases are associated with oral health status, oral hygiene habits, and overall quality of life related to oral health by comparing the first- and the fifth-year dental students at the University of Split.

Methods: All students underwent dental examination which included an evaluation of periodontal and dental hard tissues. Periodontal indices included plaque index (PI), bleeding on probing (BoP), pocket probing depth (PPD), and clinical attachment level (CAL). We estimated hard tooth tissues using the decayed, missing, filled permanent teeth (DMFT) index. We also collected basic medical history data and oral hygiene habits, as well as oral health-related quality of life data through the Oral Health Impact Profile (OHIP-14) questionnaire.

Results: Fifty-seven dental medicine students participated in this study. The median number of teeth in both groups of students was 28 (interquartile range (IQR)=24-32 for he first-year students; IQR=25-32 for the fifth-year students). All first-year students were diagnosed with healthy periodontium, while two fifth-year students had periodontitis and six had gingivitis. The fifth-year students used interdental brushes, mouth rinses and went for professional teeth cleaning more frequently. Logistic regression analysis showed that the fifth-year students had higher PI (odds ratio (OR)=1.157, 95% confidence interval (CI)=1.025-1.306, *P*=0.018) and BoP (OR=1.466, 95% CI=1.116-1.925, *P*=0.006). They also used mouth rinses more often (OR=7.102, 95% CI=1.215-41.524, *P*=0.030). We found no statistically significant differences in quality of life between the first- and the fifth-year students.

Conclusion: Higher educational level could be associated with better oral hygiene habits, although it did not result in better oral health status among dental students.

Keywords: dentistry; periodontal disease; caries, students; oral hygiene habits; education

Correspondence to:
Marija Roguljić
Department of Oral Medicine and Periodontology, University of Split School of Medicine, Split, Croatia, Šoltanska 2, 21000 Split, Croatia
marija.roguljic@mefst.hr

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Introduction

Oral health is defined as a state without pain, infection, and other disorders in the orofacial area that negatively affect the individual's psychological well-being [1]. Dental caries and periodontal disease are the leading cause of tooth loss and are common chronic diseases in all age groups worldwide [2]. The prevalence of caries among European adolescents is estimated to be 77% [3]. However, Western and Northern European countries are experiencing a decline in caries, while it still remains a public health problem in Eastern and Central Europe [4]. In contrast to caries, the prevalence of periodontal disease in the general population is not related to socioeconomic conditions, and it ranges from 20% to 50% worldwide [5].

Due to the high prevalence, the treatment of dental caries and periodontal disease represents a significant financial burden for health care systems. In the guidelines for the prevention of oral diseases, the World Health Association states that education about oral hygiene and lifestyle habits is an important tool for the prevention of dental caries and periodontal disease [3]. Additionally, a recent cost analysis for the treatment of periodontitis demonstrated the economic benefits of prevention [6]. To be effective as a preventive measure, oral hygiene and lifestyle education should be tailored to the age, caring abilities, and socioeconomic circumstances of the patient populations [7].

The recent consensus report on the prevention of periodontal disease suggested that several interventions might be useful in reducing this disease [2]. While the authors listed several interventions ranging from socioeconomic measures to behavioural changes, they did not suggest models for educating the younger adult population. Given the impact of oral disease on the quality of life and socioeconomic burden of countries and the motivation of students to be educated, improving the level of knowledge on this topic should be a valuable preventive measure.

Because the fifth-year students are extensively educated about oral diseases, their causes, and prevention, we hypothesized that the higher level of knowledge among the fifth-year students would result in better oral health status compared with first-year students at the Graduate School of Dental Medicine in Split.

Methods

Study design and clinical setting

We conducted a cross-sectional study at the Section for Dental Medicine of the Department for Maxillofacial Surgery of the University Hospital of Split (KBC Split) and in the Dental Outpatient Clinic of the University of Split School of Medicine (USSM) – Dental Academicus. First-year and fifth-year dentistry students of USSM participated in the research during regular classes in the period from September 27, 2021 to October 21, 2021. The research was approved by the Ethics Committee of the Faculty of Medicine of the University of Split as part of the MADE (Mobile Access Dental Clinic) project. Agreement on co-financing project, number 2020HR-BA-ME570, was concluded between the Ministry of Regional

development and funds of the European Union of the Republic of Croatia, which acts as the Management Body Interreg IPA cross-border cooperation Croatia - Bosnia and Herzegovina – Montenegro 2014-2020.

Outcome measures and basic participants' characteristics

The main outcome measures were: average clinical attachment level (CAL), decayed, missing, filled permanent teeth index (DFMT), bleeding on probing (BoP) and presence of plaque (PI), while average probing depth (PPD), frequency of tooth brushing, oral hygiene products, the frequency of professional teeth cleaning and the sum of the Oral Health Impact Profile (OHIP-14) index were secondary outcome measures.

We recorded basic anamnestic data for each participant (year of birth, number of teeth, gender, smoking, periodontitis in the family, bad breath, bleeding when brushing, number of visits to the dentist). All raw patient data were anonymized, and are presented in the Excel sheet (Microsoft 365, 2023, Redmont, USA) (**Appendix 1**).

Periodontal examination

A single examiner (MT) performed clinical periodontal examination using a UNC 15-mm periodontal probe (Devemed GmbH, Tuttlingen, Germany) measuring six sites per tooth on all teeth (mesiobuccal, buccal, distobuccal, mesiooral, oral, distooral) and included the following standard periodontal parameters: total number of teeth, BoP and PI expressed in percentages and probing depth (PPD), gingival recession (GR) and level of clinical attachment CAL) expressed in millimetres [8].

PPD is defined as the distance between the gingival margin and the bottom of the gingival sulcus and GR as the distance between the enamel-cement junction and the gingival margin [8]. CAL is calculated as the sum of PPD and GR. BoP and PI were measured at six sites per tooth and recorded dichotomously and then calculated as a percentage of the total measured sites that bleed on probing, that is, places with the presence of plaque [8]. To diagnose gingivitis and periodontitis, we followed the criteria of the recent classification of periodontal diseases and conditions [9].

Hard tooth tissues assessment

One examiner (ID) performed the hard tissue assessment and using DFMT index from "Oral Health Assessment Form for Adults, 2013" questionnaire. The primary and permanent dentition is determined as well as the status of individual teeth in the oral cavity: 0=healthy tooth, 1=caries, 2=filling with caries, 3=filling without caries, 4=missing due to caries, 5=missing from some else reason, 6=seal, 7=fixed prosthetic work, 8=unerupted tooth and 9=not recorded. The mentioned index is relevant for monitoring the prevalence

of caries and is used by World Health Organization (WHO) for the purpose of easier assessment of oral health of the population [10].

Oral hygiene habits

We assessed the participants' oral hygiene habits using a questionnaire and conducted clinical examination. Through the questionnaire created for this research (**Appendix 2**), the participants shared information about the presence of bleeding when brushing, the presence of unpleasant breath and the frequency of daily teeth brushing (less than once a day, one to two times daily, more than twice a day). We also recorded the means by which the participants maintained oral hygiene (brush, paste, floss, interdental brushes, toothpicks, mouthwash) and the frequency of professional teeth cleaning by a selected dentist.

Oral health-related quality of life questionnaire

We assessed oral health-related quality of using an abbreviated version of the Oral Health Impact Profile (OHIP-14) questionnaire [11]. This questionnaire consists of seven dimensions (functional limitations, physical pain, psychological discomfort, physical disability, psychological disability and social disability and handicap) divided into fourteen items. Reference determining the influence of dimensions on quality of life, is a combination of the offered answers to the questions (from 0=never, to 4=very often). The questionnaire results are obtained by summing up the answers and can range from 0 to 56 points.

Statistical analysis

We used the Shapiro-Wilk test to determine the normality of the data distribution. We presented categorical variables as frequencies and percentages and continuous variables as medians with interquartile ranges (IQRs). We tested the differences between the examined groups for categorical variables with the χ^2 test and the differences of continuous variables with the Mann-Whitney test, setting statistical significance at $\alpha=0.05$ ($P<0.05$). We performed logistic regression by a two-way stepwise procedure, with significant variables as predictors. We presented the magnitude of predictors, which is determined as the r pseudo-coefficient (Nagelkerke R2), using odds ratio (OR) with 95% confidence intervals (CIs). We performed the statistical analysis in JASP software (JASP Team, Amsterdam, Netherlands).

Results

Fifty-seven respondents, students of the first (n=29) and the fifth (n=28) year of dental medicine at the University of Split School of Medicine participated in this research. The response rate was 96% for the ftirst-year and 93% for the fifth-year students. Most respondents were women (n=53, 93%). The median age was 19 (IQR=19-19) for the tfirst-year students and 23 (IQR=23-25) for the fifth-year students. Most students were non-smokers and had no increased risk factors for periodontitis (**Table 1**). The median number of teeth of both groups of students was 28 (IQR=24-32, first-year students; IQR=25-32, fifth-year students).

Table 1. Descriptive statistics of respondents and differences in demographic and anamnestic parameters between the first- and the fifth-year dental medicine students*

Variable		1st year (n=29)	5th year (n=28)	*P*
Number of teeth, median (IQR)		28 (24-32)	28 (25-32)	0.363†
Plaque index (%), median (IQR)		5.35 (1.00-11.00)	10.50 (6.5-17.95)	0.012†
Unpleasant breath, No. (%):	No	26 (90)	24 (86)	0.650‡
	Yes	3 (10)	4 (14)	
Bleeding at brushing, No. (%):	No	26 (90)	20 (71)	0.081‡
	Yes	3 (10)	8 (29)	
Dental check-ups, No. (%):	<1/year	1 (4)	1 (4)	0.998‡
	1/year	5 (17)	5 (18)	
	>1/year	23(79)	22 (79)	

*Abbreviations: IQR – interquartile range.
†Mann-Whitney test.
‡χ^2-test for categorical variables.

In general, the students had good oral hygiene habits. Besides basic means for maintaining oral hygiene, they also used additional means and went to have their teeth professionally cleaned by a dental medicine doctor. However, the fifth-year students used more interdental brushes (P<0.004) and mouthwashes (P=0.038), and went more often to have their teeth professionally cleaned by a dental medicine doctor (P=0.015) (**Table 2**).

Table 2. Comparison of oral hygiene habits of the first- and the fifth-year dental medicine students and the differences between the two groups

	Variable, No. (%)	1st year (n=29)	5th year (n=28)	*P**
Teeth brushing:	1-2/day	15 (52)	11 (39)	0.346
	>2/day	14 (48)	17 (61)	
Dental floss:	No	14 (48)	9 (32)	0.243
	Yes	15 (52)	19 (68)	
Interdental brushes:	No	24 (83)	13 (46)	0.004
	Yes	5 (17)	15 (54)	
Toothpicks:	No	24 (83)	27 (96)	0.093
	Yes	5 (17)	1 (4)	
Mouthwash:	No	15 (52)	7 (25)	0.038
	Yes	14 (48)	21 (75)	
Professional teeth cleaning:	<1/year	12 (41)	5 (18)	0.015
	1/year	16 (55)	15 (54)	
	>1/year	1 (4)	8 (29)	

*χ^2-test.

All first-year students were diagnosed with a healthy periodontium, while among the fifth-year students, two subjects had periodontitis and six had gingivitis (**Table 3**).

Fifth-year students had a statistically significantly increased bleeding on probing index (P=0.012) and plaque index (P<0.001), while the average level of clinical attachment and probing depth did not differ (**Table 3**).

Table 3. Comparison of the periodontal status of the first- and the fifth-year dental medicine students and the differences between the two groups*

Variable	1st year (n=29)	5th year (n=28)	*P*
Diagnosis, No. (%):			
Healthy	29 (100)	20 (71)	<0.001†
Gingivitis	0 (0)	6 (21)	
Periodontitis	0 (0)	2 (7)	
Plaque index (%), median (IQR)	5.35 (1.00-11.00)	10.50 (6.5-17.95)	<0.001‡
BoP (%), median (IQR)	0.60 (0.00-2.38)	4.00 (1.78-10.75)	0.012‡
CAL (mm), median (IQR)	1.58 (1.48-1.60)	1.51 (1,41-1.53)	0.077‡
PPD (mm), median (IQR)	1.58 (1.48-1.60)	1.51 (1.40-1.53)	0.063‡

*Abbreviations: BoP – bleeding on probing, CAL – clinical attachment level, PPD – pocket probing depth, IQR – interquartile range.
†χ^2-test for categorical variables.
‡Mann-Withney test.

Examination of the hard dental tissues revealed that the first- and the fifth-year students differed according to DFMT (P=0.017), while the first-year students had a lower value of the DFMT index (**Table 4**). Additionally, the first-year students had more intact teeth. None of the subjects lost a tooth due to caries or had any sealed fissures (**Table 4**).

The fifth-year students had more teeth with fillings (P<0.001) and more extracted teeth (P=0.014) (**Table 4**).

Table 4. Comparison of the status of hard tooth tissues of the first (n=29) and the fifth year (n=28) dental medicine students*

Variable, median (IQR)	1st year (n=29)	5th year (n=28)	*P*†
Intact tooth	24.00 (20.00-25.00)	20.50 (15.00-24.00)	0.010
Caries	1.00 (0.00-2.00)	0.00(0.00-1.00)	0.052
Extraction due to caries	0.00 (0.00-0.00)	0.00 (0.00-0.00)	1.000
Extraction from other reasons	0.00 (0.00-0.00)	0.00 (0.00-1.00)	0.014
Fissure sealing	0.00 (0.00-0.00)	0.00 (0.00-0.00)	0.227
Unerupted teeth	4.00 (2.00-4.00)	2.00 (0.00-4.00)	0.071
Not recorded	0.00 (0.00-0.00)	0.00 (0.00-0.00)	1.000
DFMT index	5 (3.00-8.00)	8.00 (5.00-12.00)	0.017

*Abbreviations: IQR – interquartile range, DFMT – decayed, missing, filled permanent teeth.
†Mann-Whitney test.

All students completed the OHIP-14 questionnaire; we found no statistically significant differences between the first- and fifth-year students for any response. The median sum of the OHIP-14 questionnaire for first-year students was 7 (IQR=5-10) for first year students and 6.5 (IQR=4-10.25) and for fifth-year students.

Logistic regression analysis (**Table 5**) showed that students of the fifth year had higher plaque (OR=1.157, 95% CI=1.025-1.306, *P*=0.018) and bleeding on probing scores (OR=1.466, 95% CI=1.116-1.925, *P*=0.006). Also, they were more likely to use mouth rinses (OR=7.102, 95% CI=1.215-41.524, *P*=0.030). This model explained 65% of variance.

Table 5. Logistic regression analysis*

Predictors	OR	95% CI	*P*
Plaque (%)	1.157	1.025-1.306	0.018
Bleeding (%)	1.466	1.116-1.925	0.006
Oral hygiene means – mouth rinse (0 – no, 1 – yes)	7.102	1.215-41.524	0.030

*Abbreviations: CI – confidence interval, OR – odds ratio.

Discussion

We found that examined dental students had good oral health status, good oral hygiene habits, and good quality of life in terms of oral health status, although some differences were found between the first- and thet fifth-year students. Although the fifth-year students used more oral hygiene devices, they did not display better plaque control than the first-year students.

In our study, the fifth-year students had a higher plaque index and a significantly higher bleeding index compared to the first-year students. Our findings are consistent with those of other studies conducted in Croatia and in developed and developing countries [12-16]. Although dental students receive extensive education about oral hygiene during their studies, this did not reflect on the improvement of their oral health status. Similar results were shown by Lujo et al. [12], also conducted among dental students in Croatia. However, a study conducted by Mamai et al. [17] in Greece showed that students of the final years of dental medicine had healthier hard tooth tissues compared to students in lower years of study. Future studies should be conducted to identify possible causes of such contradictory findings.

The fifth-year students in our research were more familiar with additional means oral hygiene, which could be explained by the knowledge they acquire on clinical courses, such as periodontology. Al-Batayneh et al. showed the importance of education on oral health and oral hygiene habits in their non-biomedical study in Jordan [18]. Students perceived their oral status much better that it was when comparing self-reported and objective estimation of oral health status. Still, there is a little evidence regarding the oral health status and oral hygiene habits of student populations in developed countries.

We found no difference in the quality of life related to oral health between students of the first- and fifth-year of dental medicine. Low OHIP-14 scores of dental students correspond to findings by Gonzales et al. [19] who investigated the quality of life related to oral health of Brazilian dental students. Such results can be explained by the low frequency of oral diseases among students, primarily due to their younger age and higher level of education.

The main limitation of this study is the small sample size since we included a single student population and respondents from only one dental school in Croatia. Since the participants' radiographs were not available, diagnosis of periodontal disease was established by clinical examination only. Furthermore, a cross-sectional design cannot provide the cause-and-effect relationships between education level and oral health status for the obtained results. We did not examine the socioeconomic status of the students, whether they come from urban or rural areas, and the education level of their parents. Also, we used only one part of the WHO questionnaire related to the assessment of hard dental tissues, while we did not consider the assessment of oral mucosa. We also did not analyze the dietary habits of dental students, although they can significantly affect the status of oral tissues and overall oral health.

In this study, we showed that a higher level of education had an impact on better oral hygiene habits, although it was not associated with better oral health status. Our findings indicate that the effectiveness of other preventive measures should also be investigated in the future.

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Competing interests: The authors completed the ICMJE Unified Competing Interest form (available upon request from the corresponding author), and declare no conflicts of interest.

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ORCID

Martina Tomić https://orcid.org/0009-0004-5830-4661

Ivona Domazet https://orcid.org/0009-0005-5222-6479

Marija Roguljić https://orcid.org/0000-0003-3752-9074

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