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## Influence of COVID-19 Lockdown on Self-Efficacy in Endodontics among Dental Students

### Utjecaj zatvaranja zbog pandemije bolesti COVID-19 na samoučinkovitost studenata dentalne medicine u endodonciji

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#### Abstract

**Objectives:** The aim of this study was to evaluate the change in self-efficacy in endodontics among dental students during their studies and to make a comparison between the generations affected and not affected by the COVID-19 lockdown. **Materials and Methods:** The Endodontic General Self-Efficacy Scale was used. Data for this longitudinal study were obtained from two generations of students who have completed the same three self-efficacy questionnaires at the end of each academic year over a three-year period. **Results:** Repeated measurements of each participant revealed a statistically significant difference in self-efficacy level among the three repeated measures over a three-year period ( $F(1, 580) = 80.226; p < 0.05$ ). The effect size between groups showed a statistically significant difference in self-efficacy in performing endodontic treatments across all three repeated measures ( $F(1) = 13.958; p < 0.05$ ). The post hoc analysis confirmed the between-group difference (2.838;  $p < 0.05$ ) in the arithmetic mean between the lockdown-affected and non-lockdown-affected groups. Active participation and length of time in a dental office (between several days and one year of experience) were associated with an increase in self-efficacy. **Conclusions:** Self-efficacy increased as students progressed in their studies. The self-efficacy of students who were not affected by the lockdown tended to increase; however, in the final year of study, the level of self-efficacy was similar for students affected and not affected by the lockdown. The social persuasion component could explain the alignment in self-efficacy levels. It means that individuals who receive verbal encouragement affirming their abilities to succeed in specific tasks are more likely to exert increased efforts and maintain persistence.

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## Introduction

Self-efficacy is considered one of the most important factors in Motivation theory (1,2). Albert Bandura, the creator of the Self-efficacy theory, defines it as an individual's belief in their personal ability to organize and perform certain actions that are necessary to achieve the desired outcomes (3). The term self-efficacy does not refer to one's objective ability to perform a particular task but, instead, it refers to one's subjective assessment of whether that task can be successfully performed. It is an assessment of personal competence that is directed toward future behaviours rather than an assessment of one's current level of ability (4). Self-efficacy has a major impact on human actions, as it determines and predicts the level of performance that a person will ultimately achieve (5).

## Uvod

Samoučinkovitost se smatra jednim od najvažnijih čimbenika u teoriji motivacije (1, 2). Albert Bandura, tvorac teorije, definira samoučinkovitost kao vjerovanje pojedinca u vlastitu sposobnost organiziranja i obavljanja određenih radnji potrebnih za postizanje željenih rezultata (3). Pojam samoučinkovitosti ne odnosi se na objektivnu sposobnost pojedinca da obavi određeni zadatak, nego na subjektivnu procjenu može li taj zadatak uspješno završiti. To je procjena vlastite kompetencije usmjerena na buduća ponašanja, a ne realna razina sposobnosti (4). Samoučinkovitost ima značajan utjecaj na ljudske aktivnosti jer određuje i predviđa razinu uspješnosti koju će osoba u konačnici postići (5).

In terms of dentistry, endodontic treatment is considered by both dentists and dental students to be a demanding and stressful part of dental therapy (6-8). It requires an understanding of the complex anatomy of the root canal, physiological and pathophysiological knowledge combined with great manual competency, and a sense of visualization (9-11). Feelings of frustration, anxiety, exhaustion, and stress were observed in general practitioners while negotiating root canal therapy. A study by Dahlstrom et al. showed high levels of stress and frustration related to endodontics reported by general practitioners (12). When individuals struggle to manage a demanding task, the resulting stress can diminish their sense of self-efficacy (13). Root canal therapy is often perceived as a complex procedure, frequently accompanied by feelings of limited control (12). Other studies have emphasized the need to improve undergraduate endodontic education to boost students' confidence in performing endodontic treatments effectively (8,14). Zimmerman et al. found that individuals with higher self-efficacy are generally more willing to take on challenging tasks (15). According to Bandura's theory, high levels of self-efficacy have a major impact on the achievement of specific goals (1). It is believed that mastering the experience is the most effective way to generate a strong sense of self-efficacy, followed by vicarious experiences provided by social models and social persuasion (5).

Although lifelong learning remains crucial for dentists (11), self-efficacy at graduation can significantly shape their professional choices (16). Consequently, numerous studies in this field use post-graduation self-efficacy as a starting point (17-23). Likewise, research on endodontic self-efficacy in dental students remains limited (17, 18, 24), with a notable lack of data tracking changes in self-efficacy throughout their schooling.

The COVID-19 pandemic has had a profound global impact, significantly disrupting health systems and educational institutions alike. It led to the reduction or postponement of numerous educational activities and caused a widespread transition to online teaching that could affect the self-efficacy levels in students (25, 26).

In this research, the lockdown period provided us a unique opportunity to access difference in self-efficacy levels in dental students under different educational circumstances. Namely, the sudden transition from live courses to online teaching due to the pandemic was a unique time frame during which a change in self-efficacy could be examined within a different teaching model.

This longitudinal study aimed to determine changes in self-efficacy over time among undergraduate dental students unaffected by lockdown (non-LDA students) and to compare these changes with those in students affected by the COVID-19 lockdown (LDA students). The null hypothesis tested was that LDA students would exhibit a lower level of self-efficacy.

Endodontska terapija smatra se zahtjevnim i stresnim dijelom dentalne terapije kako za doktora dentalne medicine, tako i za studente (6 – 8). Zahtijeva razumijevanje složene anatomije korijenskog kanala i pato-fiziološko znanje u kombinaciji s izvrsnom manualnom vještinom i sposobnošću vizualizacije (9 – 11). Osjećaji frustracije, tjeskobe, iscrpljenosti i stresa opaženi su kod doktora dentalne medicine tijekom terapije korijenskih kanala. Dahlstrom i suradnici u svojoj su studiji istaknuli visoke razine stresa i frustracije povezane s endodoncijom kod doktora dentalne medicine (12). Ako pojedinci imaju poteškoća s obavljanjem zahtjevnoga zadatka, stres koji zbog toga nastaje može smanjiti njihov osjećaj samoučinkovitosti (13). Terapija korijenskih kanala doživljava se kao zahtjevan terapijski proces praćen osjećajem ograničene kontrole (12). A autori drugih studija istaknuli su da je potrebno poboljšati dodiplomsku nastavu iz endodoncije u svrhu povećanja samopouzdanja studenata pri obavljanju endodontskih zahvata (8 – 14). Zimmerman i suradnici otkrili su da pojedinci s višim stupnjem samoučinkovitosti općenito spremnije prihvaćaju zahtjevne zadatke (15). Prema Bandurinoj teoriji visok stupanj samoučinkovitosti znatno utječe na postizanje specifičnih ciljeva (1). Smatra se da je stjecanje iskustva najučinkovitiji način za razvijanje snažnog osjećaja samoučinkovitosti, a slijede ga posredna iskustva na temelju socijalnih modela i socijalnih uvjerenja (15).

Iako se cjeloživotno učenje smatra iznimno važnim za doktore dentalne medicine [11], razina samoučinkovitosti u trenutku završetka studija može značajno utjecati na daljnje profesionalne odluke pojedinca (16). Znanstvena istraživanja o toj temi većinom se koriste razinom samoučinkovitosti na kraju studija kao „početnom točkom” u njezinu mjerenju (17 – 23). Istraživanja o samoučinkovitosti kod studenata dentalne medicine ograničena su (17, 18, 24), s primjetnim nedostatkom podataka o praćenju promjena samoučinkovitosti tijekom studija.

Pandemija bolesti COVID-19 imala je dubok globalni utjecaj i značajno je narušila rad zdravstvenih sustava i obrazovnih institucija. To je rezultiralo smanjenjem ili odgađanjem mnogobrojnih obrazovnih aktivnosti i prouzročilo prelazak na online nastavu (25, 26), što je moglo utjecati na razinu samoučinkovitosti studenata.

U ovom je istraživanju dvomjesečno razdoblje zatvaranja zbog pandemije bolesti COVID-19 (engl. *Lockdown*) pružilo jedinstvenu priliku za mjerenje samoučinkovitosti kod studenata dentalne medicine u različitim obrazovnim okolnostima. Naime, nagli prijelaz s nastave uživo na nastavu na daljinu zbog pandemije bio je jedinstveni vremenski okvir tijekom kojega se promjena samoučinkovitosti mogla ispitati unutar drukčijega modela poučavanja.

Cilj ove longitudinalne studije bio je utvrditi promjene u samoučinkovitosti tijekom endodontskih zahvata među studentima dodiplomskog studija dentalne medicine na koje zatvaranje nije utjecalo (ne-LDA skupina) i usporediti ih s promjenama među studentima pogođenima zatvaranjem (LDA skupina). Nulta hipoteza bila je da će LDA studenti ostvariti nižu razinu samoučinkovitosti.

## Materials and Methods

This study was reviewed and approved by the Ethics Committee of the Faculty of Dental Medicine, University of Rijeka (ethical approval code: 035-01/22-01/149). In Croatia, the study of dental medicine takes 6 years. The undergraduate education in endodontics is based on the ESE Undergraduate Curriculum Guidelines for Endodontology (27). The module starts in the fourth year with one semester of preclinical exercises followed by clinical exercises until the end of the study. Clinical practicals continue until the sixth year of study occurring once a week for 2.5 h in groups of 10 students under the supervision of two endodontic specialists.

In the seminars, students are theoretically prepared and guided for clinical practicals through case presentations, recent guidelines, scientific literature updates, and discussion. During clinical practicals, students plan and perform endodontic treatments based on clinical, anamnestic, and diagnostic findings. Radiological and CBCT analyses are also discussed with the students. The clinician evaluates the student's endodontic treatment and discusses each case with the student.

During the COVID-19 lockdown, no clinical practicals took place for two months (period from March to May 2020) due to epidemiological reasons; instead, clinical practicals were held in seminar form via online platforms. The lack of clinical work was replaced by watching video material, studying scientific articles, and analysing clinical cases on a particular topic, thus leaving plenty of room for discussion. After the lockdown, clinical practicals were conducted with a smaller number of students (5 students per group), in adherence with current epidemiological recommendations.

The Endodontic General Self-Efficacy Scale by Baaij and Özok (18) was used in the present study, which was translated and validated to be fully understandable. Ten questions in the self-efficacy scale assess personal attitude towards self-confidence in endodontic treatment. Two generations of dental undergraduate students ( $N = 63$ ) voluntarily completed the same three self-efficacy questionnaires over three years at the end of each academic year (fourth, fifth and sixth). In this way, the changes in self-efficacy could be tracked during their dental education. There were two groups of respondents: students who experienced Covid-19 pandemic and two-month lockdown (LDA students) and the other one who attended classes before pandemic (non-LDA students). Initially, the students received a code, which they used when re-filling the questionnaire. Responses were provided in the form of a Likert scale from 1 to 4, coded as not at all true, hardly true, moderately true, or exactly true.

The survey was supplemented with additional questions related to any previous experience in a private dental practice (Table 1). Data on previous experience, time spent in practice, and active or assisting participation in dental work were collected. Previous experience was characterized as volunteering in a private dental office. Participants were also questioned about the duration and complexity of performed dental procedures (Table 1).

A total of 63 dental students were included in this pro-

## Materijali i metode

Istraživanje je odobrilo Etičko povjerenstvo Fakulteta dentalne medicine Sveučilišta u Rijeci (šifra etičkog odobrenja: 035-01/22-01/149). U Hrvatskoj studij dentalne medicine traje 6 godina. Dodiplomsko obrazovanje iz endodoncije temelji se na smjernicama ESE, dodiplomskoga kurikulumuma za endodonciju (27). Kolegij počinje na četvrtoj godini s jednim semestrom pretkliničkih vježbi poslije čega slijede kliničke vježbe do kraja studija. Kliničke vježbe održavaju se u skupinama od 10 studenata jedanput na tjedan i traju 2,5 sata, uz nadzor dvaju specijalista endodoncije.

Na seminarima se studenti teoretski pripremaju i usmjeravaju za kliničke vježbe na temelju prezentacije slučajeva, najnovijih smjernica te ažuriranja znanstvene literature i rasprava. Na kliničkim vježbama oni planiraju i obavljaju endodontske zahvate na temelju kliničkih, anamnestičkih i dijagnostičkih nalaza. Sa studentima se također raspravlja o radiološkim i CBCT nalazima. Voditelj vježbi procjenjuje kvalitetu učinjenoga endodontskog zahvata te sa studentom razgovara o pojedinačnom slučaju.

Tijekom zatvaranja zbog pandemije bolesti COVID-19 dva mjeseca nije bilo kliničkih vježbi (razdoblje od ožujka do svibnja 2020.) zbog epidemioloških razloga. Umjesto toga održavale su se u seminarskom obliku putem online platformi. Nedostatak kliničkoga rada zamijenjen je gledanjem videomaterijala, proučavanjem znanstvenih članaka i analizom kliničkih slučajeva o određenoj temi, ostavljajući dovoljno prostora za raspravu. Nakon dvomjesečnog prekida, poštujući epidemiološke preporuke, kliničke su se vježbe obavljale s manjim brojem studenata (5 studenata po skupini).

U ovom istraživanju korištena je endodontska ljestvica samoučinkovitosti Baaija i Özoka (18). Prevedena je i validirana na hrvatski jezik kako bi bila potpuno razumljiva ispitaniku. Na temelju deset pitanja na ljestvici samoučinkovitosti procjenjuje se osobno stajalište studenta kad je riječ o endodontskom liječenju. Dvije generacije studenata diplomskog studija dentalne medicine ( $N = 63$ ) dobrovoljno su ispunjavale upitnik tijekom triju godina na kraju svake akademske godine (četvrte, pete i šeste) kako bi se mogle pratiti promjene u samoučinkovitosti tijekom studiranja. Studenti su bili podijeljeni u dvije skupine: one koji su doživjeli pandemiju bolesti COVID-19 i dvomjesečni prekid nastave uživo (LDA grupa) i one koji su pohađali kolegij prije početka pandemije (neLDA grupa). Studenti su na početku istraživanja dobili šifru kojom su se koristiti tijekom svakoga ponovnog ispunjavanja upitnika. Ponudeni odgovori u obliku Likertove ljestvice numerirani su od 1 do 4 na sljedeći način: uopće se ne slažem, uglavnom se ne slažem, uglavnom se slažem ili potpuno se slažem.

Anketi su dodana pitanja koja se odnose na iskustvo u privatnoj ordinaciji dentalne medicine (tablica 1.). Prikupljeni su podatci o stečenom iskustvu, vremenu provedenom u ordinaciji u obliku asistiranja ili aktivnog sudjelovanja u stomatološkom radu. Prethodno iskustvo okarakterizirano je kao volontiranje u privatnim ordinacijama dentalne medicine. Sudionici su također ispitivani o trajanju i složenosti obavljenih stomatoloških zahvata (tablica 1.).

**Table 1** Additional questions included in the questionnaire**Tablica 1.** Dodatna pitanja pridružena upitniku

Have you had any type of working experience in a dental office? •

- (a) yes •
- (b) no •

What type of dental procedures did you perform? •

- (a) dental assisting •
- (b) less complex procedures (e.g. tartar removal, tooth polishing, preventive fissure and pit sealing, etc.) •

(c) more complex dental procedures (e.g. taking an impression, small caries lesion restoration, cementation of temporary crown, etc.) •

Period of time spent in the dental office • :

- (a) few days •
- (b) few months •
- (c) a year •
- (d) more than a year •

spective study over a three-year period. The sample consisted of 17 males (17%) and 46 females (73%), divided into groups affected by the lockdown during the COVID-19 pandemic (30 respondents, 47.6%) and those who were not (33 respondents, 52.4%).

The exclusion criteria included incomplete questionnaires, instances where a student lost or forgot their code when re-filling the questionnaire, completed questionnaires without a code, and incorrect codes. Additionally, one student declined to sign the informed consent and was therefore excluded from the study. In total, 5 participants could not participate due to an uncompleted questionnaire and, thus, were omitted from the analysis.

### Statistical Analysis

Complete data were analyzed using IBM SPSS version 26.0 software (IBM Corp, Armonk, NY, USA). Internal consistency was assessed with Cronbach's alpha for all items. The LDA group data were collected and tabulated separately from those of the non-LDA group. A repeated measures ANOVA was carried out to test the differences between the LDA and non-LDA groups. The multivariate effect was calculated using Wilks' Lambda test. Mauchly's sphericity test and the Huynh-Feldt correction were used to determine statistical significance between the self-efficacy levels of subjects in all three measurements. A post hoc analysis was conducted using the Bonferroni correction.

### Results

The validation results of the endodontic general self-efficacy scale for Croatian population analysis showed high internal consistency (mean Cronbach's alpha = 0.915). The distribution of the responses given for all three measurements in both groups is shown in Figure 1.

Statistical analysis revealed an increase in self-efficacy values during the study. The mean value of self-efficacy increased from 19.97 in the first measurement to 28.86 in the final measurement. Furthermore, a steep increase between the first and second measurements with a gradual deceleration in self-efficacy increase toward the third measurement was observed (Figure 2). Repeated measurements of each participant revealed a statistically significant difference in

Ukupno 63 studenta dentalne medicine bila su uključena u ovu prospektivnu studiju tijekom trogodišnjeg razdoblja. Uzorak se sastojao od 17 muškaraca (17 %) i 46 žena (73 %) podijeljenih u skupine pogođene karantenom (30 ispitanika, 47,6 %) i one koji nisu (33 ispitanika, 52,4 %).

Kriteriji za isključivanje iz istraživanja bili su nepotpuno ispunjeni upitnici, zaboravljena ili izgubljena šifra pri ponovnom ispunjavanju upitnika, upitnik ispunjen bez šifre i netočna šifra. Osim toga, jedan je student odbio potpisati informirani pristanak te je isključen iz studije. Iz istraživanja je izostavljeno ukupno 5 sudionika.

### Statistička analiza

Statistički podatci analizirani su s pomoću kompjutorskog softvera IBM SPSS, verzija 26.0 (IBM Corp, Armonk, NY, SAD). Unutarnja konzistencija procijenjena je Cronbachovom alfa. Podatci dviju ispitanih skupina prikupljeni su i tabelirani odvojeno. Provedena je ANOVA ponovljenih mjerenja kako bi se testirale razlike između LDA i neLDA skupina. Multivarijatan učinak izračunat je s pomoću Wilksova lambda testa. Mauchlyjev test sferičnosti i Huynh-Feldtova korekcija korišteni su za određivanje statističke značajnosti između razina samoučinkovitosti ispitanika u svim trima mjerenjima. Post hoc analiza provedena je korištenjem Bonferronijske korekcije.

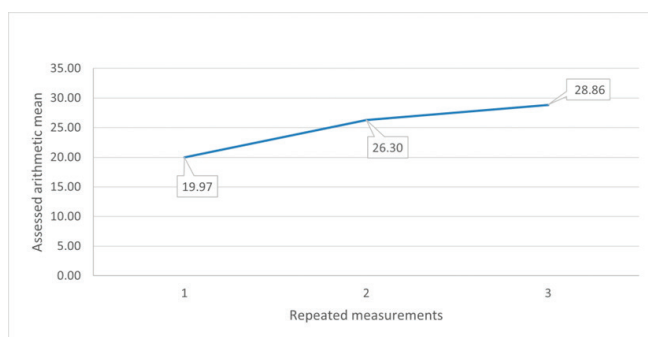
### Rezultati

Rezultati validacije upitnika za hrvatsku populaciju pokazali su visoku unutarnju konzistentnost (srednja Cronbachova alfa = 0,915). Distribucija odgovora danih za sva tri mjerenja u objema skupinama prikazana je na slici 1.

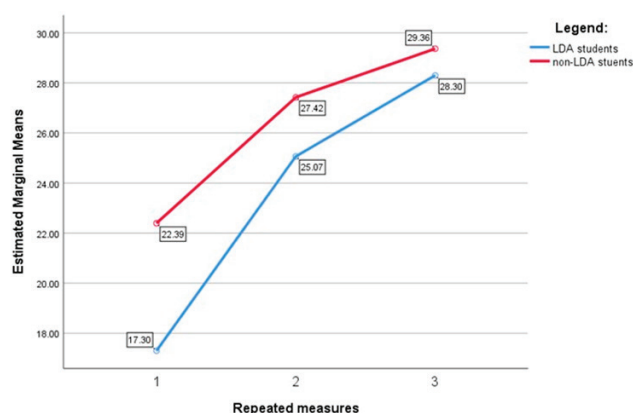
Statistička analiza otkrila je povećanje samoučinkovitosti tijekom istraživanja. Srednja vrijednost samoučinkovitosti porasla je s 19,97 u prvom mjerenju na 28,86 u završnom mjerenju. Nadalje, primijećen je nagli porast između prvoga i drugog mjerenja s postupnim usporavanjem rasta samoučinkovitosti prema trećem mjerenju (slika 2.). Ponovljena mjerenja svakog sudionika otkrila su statistički značajnu razliku u razinama samoučinkovitosti između triju ponovljenih mjerenja tijekom triju godina [ $F(1,580) = 80,226; p < 0,05$ ].



**Figure 1** Distribution of LDA (a) and non-LDA (b) students' responses to the questionnaire  
**Slika 1.** Distribucija odgovora studenata iz LDA (a) i ne-LDA skupine (b)



**Figure 2** Changes in self-efficacy during all three measurements  
**Slika 2.** Promjene samoučinkovitosti u svim trima mjerenjima



**Figure 3** The difference in self-efficacy change between LDA and non-LDA groups in repeated measurements  
**Slika 3.** Razlika u promjeni samoučinkovitosti između LDA i ne-LDA skupina u ponovljenim mjerenjima

self-efficacy levels among the three repeated measurements during three years ( $F(1,580) = 80.226; p < 0.05$ ).

A statistically significant difference was observed between the LDA and non-LDA groups regarding the first and second measurements ( $p = 0.000$  and  $p = 0.018$ , respectively). However, the last measurement did not reveal a statistically significant difference between the groups ( $p = 0.317$ ); see Figure 3.

The ANOVA for repeated measurements revealed the statistically significant impact of time on the level of self-efficacy during endodontic treatment. The multivariate effect was calculated using Wilks' lambda of 0.373 ( $F(2, 61) = 51.258; p < 0.05$ ).

Table 2 shows the linear regression analysis for repeated measures, revealing a relationship between specific variables and self-efficacy. Dummy variables were used to include qualitative information in the regression analysis. The dummy variable of the predictor analysis showed that at the first level (which refers to the variability among respondents themselves), the R-squared value had a moderate percentage of explained variability among participants (30.4%). When the second level of predictors was included, the R-squared

Uočena je statistički značajna razlika između LDA i ne-LDA skupina kad je riječ o prvom i drugom mjerenju ( $p = 0,000$ , odnosno  $p = 0,018$ ). No posljednje mjerenje nije otkrilo statistički značajnu razliku između skupina ( $p = 0,317$ ) (slika 3).

ANOVA test za ponovljena mjerenja otkriva statistički značajan utjecaj vremena provedenog u ordinaciji dentalne medicine na razinu samoučinkovitosti tijekom endodontskog liječenja. Multivarijantni učinak izračunat je s pomoću Wilksove lambda od 0,373 [ $F(2,61) = 51,258; p < 0,05$ ].

Tablica 2. prikazuje analizu linearne regresije za ponovljena mjerenja i otkriva odnos između specifičnih varijabli i samoučinkovitosti. Lažne varijable korištene su za uključivanje kvalitativnih informacija u regresijskoj analizi. Lažna varijabla prediktorske analize pokazala je da je na prvoj razini (koja se odnosi na varijabilnost među samim ispitanicima) vrijednost R-kvadrata imala umjereni postotak objašnjene varijabilnosti među sudionicima (30,4 %). Kada je uključena druga razina prediktora, vrijednost R-kvadrata porasla je za 36,2 %, objašnjavajući 66,6 % varijabilnosti rezultata.

Aktivno sudjelovanje u radu (manje složeni i složeniji završiti;  $p = 0,016$ , odnosno 0,007) i vrijeme provedeno u or-

**Table 2** Linear regression analysis for repeated measurements**Tablica 2.** Linearna regresijska analiza za ponovljena mjerenja

Model Results							
Model	R	R-Squared	Change Statistics				
			R-Squared Change	F-value Change	df1	df2	Sig. F Change
1	0.551 a	0.304	0.304	0.886	62	126	0.699
2	0.816 b	0.666	0.362	18.98	7	119	0.000

<sup>a</sup>. First-level predictors: participants' dummy variable. <sup>b</sup>. Second level predictors: dental practise = one year experience = less complex procedures; dental practise = more than a year with work experience; dental practise = few days experience = assisting. <sup>c</sup>. Dependent variable: results of General Self-Efficacy Scale in Croatian population

**Table 3** Dependent variable: The General Self-Efficacy Scale results among participants**Tablica 3.** Zavisne varijable: rezultati dobiveni endodontskom ljestvicom samoučinkovitosti među sudionicima

Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
1 Constant	25.667	3.518		7.296	.000
Constant	14.903	2.771		5.378	.000
Dental work assistance	10.389	5.855	.804	1.774	.079
Less complex procedures	13.695	5.597	1.091	2.447	.016
More complex procedures	15.706	5.688	1.034	2.761	.007
A few days experience in the dental office	-4.415	1.405	-.294	-3.143	.002
2 A year of experience in the dental office	3.621	1.323	.195	2.736	.007
More than a year of experience	3.013	1.752	.137	1.720	.088
The participant currently works in the dental office	-3.182	5.486	-.200	-5.80	.563

<sup>a</sup>. Dependent variable: General Self-Efficacy Scale results among participants

value increased by 36.2%, explaining 66.6% of the variability of the results.

Active participation (less complex and more complex procedures performed;  $p = 0.016$  and  $0.007$ , respectively) and duration of time spent in dental office (between several days and a year of experience;  $p = 0.002$  and  $0.007$ , respectively) were associated with an increase in self-efficacy (Table 3).

## Discussion

The statistical analysis revealed an increase in the self-efficacy of students with the progression of their studies. To the best of our knowledge, this is the first prospective study analyzing self-efficacy in dental students throughout their undergraduate endodontic education. These results are in line with previous studies, which observed an increase in self-efficacy with the number of treated root canals (6). Furthermore, according to a follow-up study conducted by Baaij et al., self-efficacy increased with experience in performing root canal treatments during the year following graduation (17).

Although a two-month break from clinical practicals may seem a relatively short period and its impact on self-efficacy may be questioned, the students are typically young adults with minimal or no professional experience. In the LDA group, the interruption of the continuity for two months was a major disadvantage, considering that a semester lasted four to four and a half months. This interruption

dinaciji (između nekoliko dana i godinu dana iskustva;  $p = 0,002$ , odnosno  $0,007$ ) usko su povezani s povećanjem samoučinkovitosti (tablica 3.).

## Rasprava

Statističkom analizom otkriven je porast samoučinkovitosti studenata s napredovanjem studija. Koliko znamo, ovo je prva prospektivna studija u kojoj je analizirana samoučinkovitost pri obavljanju endodontskog zahvata studenata dentalne medicine tijekom njihova dodiplomskog obrazovanja. Rezultati su u skladu s dosadašnjim studijama u kojima je uočeno povećanje samoučinkovitosti s brojem liječenih korijenskih kanala (6). Nadalje, prema studiji Baaija i suradnika, samoučinkovitost se povećava s iskustvom u obavljanju endodontskog tretmana tijekom godine dana poslije stjecanja diplome (17).

Iako se dvomjesečni prekid kliničkih vježbi može činiti kao razmjerno kratko razdoblje te dovesti u pitanje njegov utjecaj na samoučinkovitost, studenti su obično mlade odrasle osobe s minimalnim ili nikakvim profesionalnim iskustvom. U LDA skupini veliki je nedostatak dvomjesečni prekid kontinuiteta kliničkih vježbi s obzirom na to da semestar traje od četiri do četiri i pol mjeseca. Nakon toga prekida slijedi ljetna (ili zimska) stanka, što dodatno ometa njih-

was followed by the subsequent summer (or winter) break, thus further disrupting their practical training and the development of essential manual skills. In addition, this two-month break also meant a lack of clinical experience in performing root canal treatments, and most students could not fully compensate the lack of clinical experience later, when the lockdown was over.

The studies by Zimmerman (15) and Michael et al. (28) have shown that students with higher levels of self-efficacy are more likely to master challenging tasks compared to students with low self-efficacy. A cross-sectional multicounty study of university students by Chinna et al. (29) showed that mild to moderate anxiety levels during lockdown was triggered by stressors such as online distance learning, uncertainty about academic performance and concern about future career. Likewise, in the study conducted by Adam et al., all students reported experiencing some level of anxiety and expressed concerns about their future competence (26). Another study has shown that a sufficient level of self-efficacy can affect students emotionally and reduce their anxiety, stress and depression (3). Thus, it can be concluded that the anxiety associated with the two-month break adversely impacted students' self-efficacy.

Moreover, self-efficacy was found to be a predictor of the student's academic performance (24). The graphic representation of self-efficacy changes in three repeated measurements presented a steeper slope between the second measurement and baseline, when compared to the difference between the third and second measurements. The concept of self-efficacy differs from the concept of 'efficiency', as it is not an actual representation of a person's efficiency but how much confidence they have in performing a certain task. This perceived ability changes and can act in a self-reinforcing manner. Conversely, a failure to perform a certain task can result in a decrease in self-efficacy, lowering the probability of successfully achieving the subsequent goal (1).

A gradual slowdown in the growth of self-efficacy in the final year could be due to the more modest self-assessment of students' skills in performing endodontic treatments. This is because the clinical work and experience of students are highly dependent on the availability of patients and the type of treatments that they require. In the final year, students are confronted with more complex cases, such as the endodontic treatment of molars, and are encouraged to tackle these cases more independently than in the fifth year. In the final year of study, they may be confronted with treatment demands that exceed their current abilities. An increase in self-efficacy was, therefore, still present in the final year, but was not as pronounced as that in the fifth year.

There are no specific guidelines for the complexity and load of cases during undergraduate endodontic education. According to the guidelines of the European Society of Endodontology, students should obtain adequate experience in the endodontic treatment of anterior teeth, premolars, and molars (27). However, the complexity and appropriateness of these cases should be carefully evaluated by endodontists, to prevent frustration, feelings of failure, and consequent low student self-efficacy.

vu praktičnu izobrazbu i razvoj prijeko potrebnih manualnih vještina. Uz to, taj dvomjesečni prekid znači i nedostatak kliničkog iskustva u liječenju korijenskih kanala, a većina studenata taj nedostatak nije uspjela potpuno nadoknaditi poslije kada je izolacija završila.

Istraživanja Zimmermana (15) i Michaela i suradnika (28) pokazala su kako je vjerojatnije da će studenti s višom razinom samoučinkovitosti uspješnije svladati izazovne zadatke u usporedbi s onima s niskom samoučinkovitošću. Pre-sječna studija Chinna i suradnika (29) pokazala je da su blage do umjerene razine anksioznosti tijekom zatvaranja zbog bolesti COVID-19 izazvane stresorima poput online učenja, neizvjesnošću kad je riječ o akademskom uspjehu i zabrinutošću za buduću karijeru. Isto tako, u studiji koju su proveli Adam i suradnici, svi su studenti izjavili da su doživjeli određenu razinu tjeskobe i izrazili zabrinutost za buduću radnu kompetenciju (26). Nadalje, autori istraživanja također upozoravaju da dovoljna razina samoučinkovitosti može emocionalno utjecati na studente i smanjiti njihovu anksioznost, stres i depresiju (3). Zato se može zaključiti da je anksioznost povezana s dvomjesečnim zatvaranjem zbog pandemije bolesti COVID-19 nepovoljno utjecala na samoučinkovitost studenata.

Utvrđeno je da je samoučinkovitost prediktor akademskog uspjeha (24). Grafički prikaz promjena samoučinkovitosti u trima ponovljenim mjerenjima pokazuje strmiji porast između prvoga i drugoga mjerenja u usporedbi s umjerenijim porastom između drugoga i trećega mjerenja. Koncept samoučinkovitosti razlikuje se od koncepta „efikasnosti”, jer to nije stvarni prikaz učinkovitosti osobe, nego pokazuje koliko povjerenja u sebe ta osoba ima u obavljanju određenog zadatka. Ta percipirana sposobnost mijenja se i može djelovati na samopouzdanje. Naprotiv, neuspjeh u obavljanju određenog zadatka može rezultirati smanjenjem samoučinkovitosti i smanjuje vjerojatnost uspješnog postizanja sljedećeg zadatka (1).

Postupno usporavanje rasta samoučinkovitosti na završnoj godini studija može biti posljedica skromnije samoprocjene studentskih vještina u obavljanju endodontskih zahvata. Naime, klinički rad i iskustvo studenata uvelike ovise o dostupnosti pacijenata i vrsti liječenja. Na završnoj godini studenti se suočavaju sa složenijim endodontskim slučajevima, poput liječenja kutnjaka, te se potiču na samostalniji rad. Također se mogu suočiti sa zahtjevnijim slučajevima koji nadilaze njihove trenutačne mogućnosti. Dakle, povećanje samoučinkovitosti još je uvijek prisutno na posljednjoj godini studija, ali nije tako izraženo kao na petoj.

Ne postoje posebne smjernice za složenost pri obavljanju endodontskog zahvata tijekom dodiplomske endodontske edukacije. Prema smjernicama Europskoga endodontskoga društva, studenti trebaju steći odgovarajuće iskustvo u endodontskom liječenju prednjih zuba, pretkutnjaka i kutnjaka (27). No složenost i prikladnost tih slučajeva trebalo bi pozorno procijeniti da bi se spriječila frustracija i osjećaj neuspjeha koji rezultiraju niskom samoučinkovitošću studenata.

Pandemija bolesti COVID-19 i kasnije zatvaranje zbog pandemije nametnulo je mnogobrojna ograničenja te je negativno povezano s cijelim spektrom akademskoga, fizičko-

The COVID-19 pandemic and subsequent lockdown, imposing limitations on clinical courses, have been negatively related to a range of academic, physical, health, and emotional status variables in dental students (30).

Numerous studies have addressed the impact of COVID-19 on dental students. In a study by Hung et al., researchers found that most dental students reported elevated stress levels and felt their clinical training was significantly affected (31). Another study demonstrated that Covid-19 introduced substantial challenges to dentistry, causing long-term impacts on dental education affecting three key learning domains: cognitive, psychomotor, and affective (32). Additionally, research by Jeremic Knezevic et al. highlighted a significant difference in confidence levels (a term closely related to self-efficacy) between dental students impacted by the pandemic and those who were not (33, 34). Students unaffected by Covid-19 showed greater confidence in practical skills, while both groups reported comparable confidence in their theoretical knowledge gained throughout their courses (33).

In our research, the comparison of self-efficacy levels between groups revealed a statistically significant difference in the first two measurements, with the levels of non-LDA exceeding those of LDA students (Figure 3). This observation was in accordance with the null hypothesis and the expectation that the lockdown would have a negative impact on the self-efficacy of students. Interestingly, despite the initial lower scores, the self-efficacy of LDA students increased and approached that of the non-LDA students at the final measurement, thus leading to a partial acceptance of the null hypothesis. As higher self-efficacy levels have been associated with better academic achievement (29) and a higher likelihood of completing a task (31, 35-37), during the lockdown, the emphasis was placed on thorough discussion of clinical cases during online seminars as a preparation for the cases that they would later encounter in clinical work. These thorough discussions conducted by endodontists could have contributed to the positive effect on their self-efficacy level in endodontics, as well as the social persuasion component of self-efficacy (3). Evaluation and persuasive communication are most effective when provided by people who are perceived by students as knowledgeable (38), which was the case in these seminars. To the contrary, a study conducted in the Netherlands showed that, although an increased number of tutorials in endodontics increased the self-perceived competencies of students, it did not increase their self-efficacy in a statistically significant way (18). In addition to the factors mentioned above, the increase in self-efficacy in LDA students could also have been influenced by the clinical exercises after the lockdown, which were held in smaller groups for epidemiological reasons.

In the study by Vražić et al., seminars and lectures were recognized as valuable alternatives to traditional learning; however, clinical practicals cannot be effectively replaced by online methods (39). In our study, several variables concerning additional experience in a dental office outside of the School were associated with an increase in self-efficacy. Performances of less and more complex procedures in private

ga, zdravstvenoga i emocionalnoga statusa studenata dentalne medicine (30)

Autori mnogobrojnih istraživanja bave se utjecajem bolesti COVID-19 na studente dentalne medicine. U studiji Hunga i suradnika većina studenata prijavila je povišenu razinu stresa, što je značajno utjecalo na njihovu kliničku izobrazbu (31). U drugoj se studiji ističe da je COVID-19 potaknuo mnogobrojne izazove u dentalnoj medicini i proizveo dugoročne posljedice u stomatološkom obrazovanju u trima ključnim domenama učenja: kognitivnoj, psihomotornoj i afektivnoj (32). U istraživanju Jeremić Knežević i suradnika ističe se značajna razlika u razinama samopouzdanja (pojam usko povezan sa samoučinkovitošću) između studenata dentalne medicine zahvaćenih i nezahvaćenih pandemijom (33, 34). Studenti koji nisu bili pogođeni pandemijom pokazali su veće samopouzdanje u primjeni praktičnih vještina, dok su obje skupine prijavile slično samopouzdanje za svoje teorijsko znanje stečeno tijekom trajanja kolegija (33).

U našem istraživanju usporedba razina samoučinkovitosti između skupina otkrila je statistički značajnu razliku u prva dva mjerenja, pri čemu je samoučinkovitost ne-LDA skupine veća od LDA skupine (slika 3.). To zapažanje u skladu je s nultom hipotezom i očekivanjem da će zatvaranje zbog pandemije negativno utjecati na samoučinkovitost studenata. Zanimljivo je da se, unatoč nižim početnim rezultatima, samoučinkovitost LDA studenata povećala i približila razini samoučinkovitosti ne-LDA studenata, što je rezultiralo djelomičnim prihvaćanjem nulte hipoteze. Kako su više razine samoučinkovitosti povezane s boljim akademskim uspjehom (29) i većom vjerojatnošću dovršetka specifičnog zadatka (31, 35 – 37), tijekom dvomjesečnog prekida kliničke nastave naglasak je stavljen na temeljitu raspravu o kliničkim slučajevima tijekom online seminara kao pripremu za slučajeve s kojima će se studenti poslije susretati u kliničkome radu. Te rasprave vodili su specijalisti endodoncije te su mogle pridonijeti pozitivnom učinku na povećanje samoučinkovitosti i na komponentu društvenog uvjeravanja (3). Evaluacija i uvjerljiva komunikacija najučinkovitije su kada ih pružaju osobe koje studenti doživljavaju kao mjerodavne na specifičnom polju (38), što je bio slučaj na seminarima. Studija provedena u Nizozemskoj pokazala je da povećanjem lekcija iz endodoncije rastu samopercepcijske kompetencije studenata, no to nije statistički značajno utjecalo na povećanje samoučinkovitosti (18). Uz gore navedene čimbenike, na povećanje samoučinkovitosti kod studenata iz LDA skupine mogle su utjecati i kliničke vježbe poslije dvomjesečne stanke koje su se održavale u manjim skupinama iz epidemioloških razloga.

U studiji Vražića i suradnika, online seminari i predavanja prepoznati su kao vrijedne alternative tradicionalnom učenju, no kliničke vježbe ne mogu se učinkovito zamijeniti online metodama (39). U našem je istraživanju nekoliko varijabli koje se tiču dodatnog iskustva u ordinaciji izvan fakulteta bilo povezano s povećanjem samoučinkovitosti. Obavljanje manje složenih i složenijih zahvata u privatnim ordinacijama dentalne medicine i radno iskustvo do godinu dana značajno su povezani sa samoučinkovitošću. To bi moglo objasniti učinak „početnog poticaja” koji je rezultirao povećanjem samoučinkovitosti. Dentalno asistiranje čak ni ako



practices and up to a year of experience were significantly associated with self-efficacy in endodontic treatment. This could explain the effect of the 'initial push', which led to an increase in self-efficacy. Assisting for even a prolonged period (longer than one year) was not associated with a change in self-efficacy. Aside from the additional experience obtained in the dental office, vicarious experiences can have an influence on self-efficacy. According to Bandura, students receive information about their competencies through observing others. As they have little mastery knowledge or experience and are often uncertain of their capabilities, they can be susceptible to observations made by models (3).

There are several limitations of this study. Self-efficacy refers to a subjective evaluation of one's abilities and can be influenced by numerous factors, such as personality traits, that were not assessed in this study. The Endodontic Self-Efficacy Scale was validated before the study was conducted to ensure adequate validity and reliability; however, as the study relied on self-reported data, there remains a risk of bias.

Given that students' academic success is influenced by multiple cognitive and affective factors (40), further research on self-efficacy is needed to incorporate the abovementioned variables. Additionally, it would be beneficial to include students from various dental schools to address the limitations of this study.

## Conclusions

The results of this study suggested that self-efficacy is not exclusively influenced by personal clinical experience. Therefore, within the limitations of this study, it can be concluded that the lockdown did not have a significant impact on the self-efficacy level of dental students.

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dulje traje (dulje od jedne godine) nije povezano s promjenom samoučinkovitosti. Osim iskustva stečenoga u ordinaciji dentalne medicine i druga iskustva mogu utjecati na samoučinkovitost. Naime, prema Banduri, studenti dobivaju informacije o svojim sposobnostima na temelju promatranja drugih. Budući da imaju malo specifičnog znanja ili iskustva pa često nisu sigurni u svoje sposobnosti, mogu biti osjetljivi na opažanja mjerodavnih osoba iz specifičnog područja (3).

Nekoliko je ograničenja u ovoj studiji. Samoučinkovitost se odnosi na subjektivnu procjenu nečijih sposobnosti i na nju mogu utjecati mnogobrojni čimbenici poput osobina pojedinca koje nisu procijenjene u ovoj studiji. Endodontska ljestvica samoučinkovitosti validirana je prije nego što je studija provedena kako bi se osigurala odgovarajuća valjanost i pouzdanost. Međutim, budući da se studija oslanjala na podatke koje su studenti sami prijavili, treba uzeti u obzir rizik od pristranosti.

S obzirom na to da na akademski uspjeh studenata utječu mnogobrojni kognitivni i afektivni čimbenici [40], buduća istraživanja o samoučinkovitosti trebala bi uzeti u obzir i te varijable. Osim toga, valjalo bi uključiti studente drugih fakulteta dentalne medicine.

## Zaključak

Rezultati ovog istraživanja pokazuju da na samoučinkovitost ne utječe isključivo kliničko iskustvo. Zato, unutar ograničenja ove studije, može se zaključiti da prekid kliničkih vježbi nije znatnije utjecao na razinu samoučinkovitosti studenata dentalne medicine.

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**Sažetak**

**Cilj:** Svrha istraživanja bila je procijeniti promjenu samoučinkovitosti u endodonciji kod studenata dentalne medicine tijekom studija te usporediti generacije zahvaćenih i nezahvaćenih zatvaranjem zbog bolesti COVID-19. **Sudionici i metode:** Korištena je endodontska ljestvica samoučinkovitosti. Podatci za ovo longitudinalno istraživanje prikupljeni su u dvjema generacijama studenata koji su na kraju svake akademske godine (4., 5. i 6.) ispunili isti upitnik o samoučinkovitosti. **Rezultati:** Ponovljena mjerenja kod svakog su sudionika pokazala statistički značajnu razliku u razini samoučinkovitosti između mjerenja tijekom trogodišnjeg razdoblja [ $F(1, 580) = 80,226; p < 0,05$ ]. Veličina učinka između skupina pokazala je statistički veliku razliku u samoučinkovitosti pri obavljanju endodontskih zahvata u svim trima ponovljenim mjerenjima [ $F(1) = 13,958; p < 0,05$ ]. Post hoc analiza potvrdila je razliku između skupina (2,838;  $p < 0,05$ ) zahvaćenih i nezahvaćenih zatvaranjem zbog pandemije bolesti COVID-19. Aktivno sudjelovanje i razdoblje provedeno u privatnim ordinacijama dentalne medicine (između nekoliko dana i jedne godine iskustva) povezani su s porastom samoučinkovitosti. **Zaključak:** Samoučinkovitost raste s godinama studija. Kod studenata koji nisu bili pogođeni zatvaranjem pokazala je tendenciju rasta, no na završnoj godini bila je slična za studente obiju skupina. Komponenta „društvenog uvjerenja“ mogla bi objasniti izjednačavanje razina samoučinkovitosti među skupinama. Naime, pojedinci koji su dobivali verbalne poticaje, poput pohvale za uspješno obavljanje specifičnih zadataka, skloniji su većoj ustrajnosti i ulaganju većega truda.

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