

CLINICAL STUDY

Oral health of schoolchildren before and after the COVID-19 pandemic

Boris EGIC¹, Vojko BERCE²

Murska Sobota Community Health Centre, Department of Dentistry, Murska Sobota, Slovenia.
borisegic@gmail.com

ABSTRACT

BACKGROUND: The COVID-19 pandemic reduced access to medical services and led to an increase in complications and exacerbation of many diseases that occurred during and after the pandemic, including deterioration in oral health. One of the main oral health indicators is the index of the number of decayed, extracted, and filled primary teeth (deft) or decayed, extracted, and filled permanent teeth (DEFT). The aim of this study was to determine whether restricted access to dental services during the COVID-19 pandemic led to a deterioration in oral health among schoolchildren.

METHOD: Data of oral systematic examinations before (school year: 2018–2019) and after (school year: 2021–2022) the pandemic were used for the study. Systematic oral examinations were conducted for all primary school students from the first to ninth grades at Murska Sobota Public Health Center, and the number of decayed, filled, and extracted (due to caries) primary and permanent teeth were recorded for each student. The deft and DEFT index values before and after the pandemic were calculated and compared for students in first (age range: six to seven years) to fifth (age range: 10–11 years) grades and students in fifth to ninth (age range 14–15 years) grades, respectively.

RESULTS: We found that the median deft index of the whole population before the pandemic was 3, whereas it was 2 afterwards ($p < 0.01$). For students in the first and second grades, the median deft index was 3 before the pandemic and 2 afterwards ($p = 0.01$), and for students in the third grade, it was 4 ($p = 0.02$) before the pandemic and 2 afterwards ($p < 0.01$). The median DEFT index of the whole population was 1 before the pandemic and 0 afterwards ($p < 0.01$). For students in the seventh, eighth and ninth grades, the median DEFT index values were 1, 2 and 2, respectively, before the pandemic and 0, 0 and 1, respectively, afterwards ($p < 0.01$ for seventh and eighth grades and $p = 0.02$ for ninth grade).

CONCLUSION: The results of our study showed a lower deft/DEFT index after the pandemic, which could be explained by increased health and hygiene awareness during the pandemic, as children/parents were mostly responsible for maintaining good oral health. Limited access to dental services does not necessarily imply poor oral health (Tab. 1, Ref. 25). Text in PDF www.elis.sk

KEY WORDS: oral health, COVID-19, schoolchildren.

Introduction

The COVID-19 pandemic has changed the usual methods of ordering patients, preparing and protecting patients and health personnel. During the pandemic the number of patients who were treated by dentists, during workday, was reduced. This is because of the new measures, i.e. the new protocol, which involved the use of special protective equipment, disinfection, and ventilation of the workplace, required more time, resulting in a lower number of patients being treated than after the pandemic. During the first wave of COVID-19 in Slovenia, only emergency dental practices were available. Since then, there have been significant changes in

dental treatment practices. The situation was similar in the other medical specialties (1, 2, 3). Existing research has shown that the measures taken to prevent the spread of COVID-19 led to limited access to medical services (4, 5, 6) an increase in the risk of medical complications, and the aggravation of many diseases that occurred during and after the pandemic (7, 8, 9, 10). This has been confirmed by studies conducted in the field of dentistry (11, 12, 13).

During the pandemic, collective preventive measures were not implemented; only individual treatments were implemented. Collective preventive measures (School for future parents and lectures and workshops for preschool and school children) were implemented through different digital platforms, such as Skype, Zoom, and Google Meet. The medical personnel who performed collective preventive activities, managed to adapt to the new circumstances due to the pandemic through new ideas, imagination and ingenuity to continue preventive healthcare activities and maintain good oral health among children. The pandemic also highlighted the advantages (14, 15, 16) and disadvantages (17, 18) of telemedicine. The pandemic resulted in a lack of system-

¹Murska Sobota Community Health Centre, Department of dentistry, Murska Sobota, Slovenia, and ²University Medical Centre Maribor, Department of pediatrics, Maribor, Maribor, Slovenia

Address for correspondence: Boris EGIC, Murska Sobota Community Health Centre, Department of dentistry, Grajska ulica 24, 9000 Murska Sobota, Slovenia.

atic examinations of schoolchildren, thereby neglecting to monitor their oral health for over two years. Systematic examinations are the best indicators of the health status of the entire population. The indicator of oral health is either the index of the number of decayed, extracted, and filled primary teeth (deft) or decayed, extracted, and filled permanent teeth (DEFT) (19).

This study aimed to determine whether limited access to dental services during the pandemic negatively impacted oral health among schoolchildren. We hypothesized that oral health would worsen during the pandemic.

Methods

The dental systematic examinations of schoolchildren were based on the legislation of the Republic of Slovenia (Rules to carry out preventive health care at the primary level, Uradni list Republic of Slovenia) (20). This law defines all preventive activities in dentistry, including preventive examinations, data processing, workshops in schools and kindergartens, and lectures for children. A parental signature is necessary to allow a child to participate in any of these preventive activities. At the beginning of enrollment, all parents (if they agreed to allow their child to take part) signed consent forms to participate in the implementation of the preventive care program. The signed forms were stored in the Dental Department of the Murska Sobota Community Health Centre; no additional approval from the ethics committee was required. In agreement with school management, the schoolchildren visited the health center for dental systematic examinations. Systematic examinations were conducted for students in the first to ninth grades at all primary schools in the region of the community health center Murska Sobota (in Slovenia, the primary school has nine grades; for children from six to fourteen/fifteen years of age). The dental systematic examinations were performed by five dentists at their offices using a dental chair and regular instruments. The forms for these examinations were filled in with the following information: first name, last name, gender and dental status (healthy, decayed, and extracted teeth). Caries assessment was based on the detection of a cavity, undermined enamel and softened hard tissue. The dentists noted the detected condition on the form. The completed forms were sent to a pediatric dental specialist. The pediatric dental specialist processed the data. We examined all schoolchildren and observed a prevalence of caries among the entire population of primary schoolchildren in the region of Murska Sobota Community Health Center.

The data variables processed included gender and the number of decayed, extracted, and filled (due to caries) primary teeth and permanent teeth. The deft and DEFT indexes were calculated for schoolchildren from first (age: six years) to fifth (age: 10–11 years) grades and from fifth to ninth (age: 14–15 years old) grades, respectively. This prospective study used data for the 2018–2019 school year (the year before the pandemic) and the 2021–2022 school year (the first year after the pandemic).

Statistical analysis

Statistical analysis was performed using IBM SPSS 26.0 software (IBM Inc., Chicago, IL, USA). Descriptive statistical analy-

sis was conducted on data of all included schoolchildren in each grade (from first to ninth) for the 2018–2019 and 2021–2022 school years. The Kolmogorov–Smirnov test was used to evaluate the normality of the distribution. The Mann–Whitney U test was performed to compare the deft and DEFT indexes for the 2018–2019 and 2021–2022 school years. The α -level was set to 0.05 for all tests, and p values are presented for two-tails tests. The statistical analysis was upgraded by including a multiple linear regression analysis, accounting for gender as a confounding factor.

Results

For the study period of two years, 4,960 systematic examinations were conducted (boys: 2,550, 51.4%; girls: 2,410, 48.6%). Of these, 2,296 examinations were performed during the 2018–2019 school year (a year before the pandemic), and 2,664 examinations were carried out in the year after the pandemic (the 2021–2022 school year).

The Kolmogorov–Smirnov test showed that the distributions of deft/DEFT indexes were not normal. Therefore, non-parametric tests were used for further statistical analysis.

Deft indexes for students in the first grade were 3.8 and 3.1 before and after the pandemic, respectively. Deft indexes for the second graders were 4 and 3 before and after the pandemic, respectively. Deft indexes for the third graders were 3.9 and 3 before and after the pandemic, respectively. Deft indexes for the fourth graders were 2.8 and 2.5 before and after the pandemic, respectively. Deft indexes for the fifth graders were 2 and 1.4 before and after the pandemic, respectively. Deft indexes for the whole population (all schoolchildren from first to fifth grades) were found to be 3.3 and 2.6 before and after the pandemic. The deft index was higher for each grade of primary school before than after the pandemic. Deft index values increased before the pandemic to the second grade and decreased to the fifth grade. However, deft index values were the same after the pandemic to the third grade and decreased to the fifth grade.

The median deft index for the whole population (all schoolchildren from first to fifth grades) was found to be 3 in the school year 2018–2019 (before the pandemic) and 2 in the school year 2021–2022 (after the pandemic). The Mann–Whitney U test for deft index for the whole population (all schoolchildren from the first to fifth grades) showed a statistical difference ($p < 0.01$) between the years. The statistical differences were in the first, second, third, and fifth grades (Tab. 1).

DEFT indexes for students in the fifth grade were 0.7 and 0.6 before and after the pandemic, respectively. DEFT indexes for the sixth graders were 1.2 and 0.8 before and after the pandemic, respectively. DEFT indexes for the seventh graders were 1.5 and 1.1 before and after the pandemic, respectively. DEFT indexes for the eighth graders were 2.2 and 1.3 before and after the pandemic, respectively. DEFT indexes for the ninth graders were 2.4 and 1.8 before and after the pandemic, respectively. Deft indexes for the whole population (all schoolchildren from fifth to ninth grades) were found to be 1.6 and 1.1 before and after the pandemic. The DEFT index was higher for each grade of primary school before

Tab. 1. Deft/DEFT indexes before and after of the pandemic.

Grade	n	Deft [#] – median (IQR)		p*
		Year 2018/19	Year 2021/22	
1 st	567	3 (6)	2 (5)	0.01
2 nd	527	3 (7)	2 (5)	0.02
3 rd	566	4 (4)	2 (5)	<0.01
4 th	584	2 (5)	2 (4)	0.15
5 th	562	1 (4)	1 (2)	0.02
all	2806	3 (5)	2 (4)	<0.01
DEFT [#] – median (IQR)				
5 th	562	0 (1)	0 (1)	0.88
6 th	568	0 (2)	0 (1)	0.04
7 th	539	1 (3)	0 (2)	<0.01
8 th	554	2 (4)	0 (2)	<0.01
9 th	493	2 (4)	1 (3)	0.02
all	2716	1 (3)	0 (2)	<0.01

n – number of children, IQR-interquartile range, * p value of Mann-Whitney U test compared def[#]/DEFT indexes between year 2018–2019 and 2021–2022, [#] def[#] index (median and interquartile range) was calculated among children from the first to fifth grade and DEFT index from the fifth to ninth grade

than after the pandemic. The DEFT index values increased with the age before and after the pandemic.

The median DEFT index for the whole population (all schoolchildren from fifth to ninth grades) was found to be 1 in the school year 2018–2019 (before the pandemic) and 0 in the school year 2021–2022 (after the pandemic). The Mann–Whitney U test for DEFT index for the whole population (all schoolchildren from the fifth to ninth grades) showed a statistical difference ($p < 0.01$) between the years. The statistical differences were in the sixth, seventh, eighth, and ninth grades (Tab. 1).

The def[#] index values were higher than DEFT index values before and after the pandemic, respectively.

Statistical analysis was upgraded with a multiple linear regression that accounted for gender as a possible confounding factor.

Discussion

This study has two major findings related to the impact of COVID-19 on the dental health of schoolchildren: (1). The overall def[#] index value was higher than the overall DEFT index value (2). Both the def[#] and DEFT index value were higher before the pandemic (school year: 2018–2019) than after the pandemic (school year: 2021–2022).

This study is the first of its kind to examine the impact of oral health on the entire population of a specific age group in a given region. The study results indicated that dental caries was prevalent among the entire population of primary schoolchildren (considered a vulnerable population) in the given region before and after the pandemic. To the best of our knowledge, this is the first study to examine the impact of pandemic on oral health of the entire population of children or adults in a region.

Past studies have shown the COVID-19 pandemic negatively affected physical and mental health and general well-being (21), as well as worsened symptoms of psychiatric disorders and inflammatory bowel disease (22), whereas the number of cases

of infectious enterocolitis and sexually transmitted diseases decreased during the pandemic (23). However, no information exists on the prevalence of dental caries before and after the pandemic, (i.e., how the pandemic impacted the oral health of children). Existing studies have only shown that patients' access to dental services, both conservative and preventive, was limited during the pandemic (24, 25). All collective preventive activities in-person, such as courses for children and parents and workshops in kindergartens and schools, were not implemented during the pandemic. The cabinet's work on individual dental education was carried out with a minimal number of patients (to ensure compliance with the new guidelines for the protection of patients and medical staff). Systematic examinations as "a form of collective treatment", which are considered the best approach to identify the prevalence of diseases, were not performed during the pandemic. Therefore, it was difficult to identify the extent of a disease and its consequences.

During the lockdown, the use of telemedicine increased significantly. Our group's preventive activities (such as courses, workshops and quizzes for children, School for future parents, and counseling for parents) were remotely conducted using digital technology, such as the Zoom platform. One might infer that oral health would be worse after a pandemic. However, is that really the case?

The results of this study show that oral health among schoolchildren improved after the pandemic. This could mean that our work organization, with a goal of increasing children's responsibility for oral health, was successful during the pandemic. Based on the results, we can examine whether there was a fear of the inability to get professional help during the pandemic. It is possible that patients were afraid of the new conditions (new ways to protect people from infection, restriction of movement and social contacts) or that the complicated access to health services prompted them to take responsibility for maintaining their health and improved their awareness of its overall importance. This was applicable to children and parents in the context of oral health maintenance. It is possible that the lockdown and limited access to medical services led to increased self-care and awareness of the importance of preventive measures.

Modern generations (children and young parents) favor the use of digital technology (internet, applications for video conferences or virtual meetings). Modern preventive healthcare approaches for children have raised both children's and parent's awareness about the importance of maintaining oral health. Therefore, new trends in the implementation of preventive healthcare approaches in dentistry must keep pace with the development of modern technologies. Adaptation to new working conditions through approaches conducive to children will be highly beneficial. We will use all resources, both in-person and online, to communicate and spread oral health knowledge to children.

To conclude, limited access to dental services does not necessarily imply poor oral health.

References

1. **Makiyama K, Kawashima T, Nomura S, Eguchi A, Yoneoka D, Tanoue Y et al.** Trends in Healthcare Access in Japan during the First Wave of the COVID-19 Pandemic, up to June 2020. *Int J Environ Res Public Health* 2021; 18 (6): 3271.
2. **Jeng Y, Chen FH, Jen GH, Chen HC, Yen AM, Chen CD et al.** Impact of COVID-19 pandemic on accessibility of Taiwanese medical care. *Am J Manag Care* 2021; 27 (9): e330–e335.
3. **Aktas P.** Chronic and rare disease patients' access to healthcare services during a health crisis: The example of the COVID-19 pandemic in Turkey. *Health Expect* 2021; 24 (5): 1812–1820.
4. **Núñez A, Sreeganga SD, Ramaprasad A.** Access to Healthcare during COVID-19. *Int J Environ Res Public Health* 2021; 18 (6): 2980.
5. **Tuczynska M, Matthews-Kozanecka M, Baum E.** Accessibility to Non-COVID Health Services in the World During the COVID-19 Pandemic: Review. *Front Public Health* 2021; 9: 760795.
6. **Moynihan R, Sanders S, Michaleff ZA, Scott AM, Clark J, To EJ et al.** Impact of COVID-19 pandemic on utilisation of healthcare services: a systematic review. *BMJ Open* 2021; 11 (3): e045343.
7. **Hussein J.** COVID-19: What implications for sexual and reproductive health and rights globally? *Sex Reprod Health Matters* 2020; 28: 1746065.
8. **Linn L, Oliel S, Baldwin A.** La COVID-19 afectó el Funcionamiento de los Servicios de Salud para Enfermedades no Transmisibles en las Américas – OPS/OMS|Organización Panamericana de la Salud. [(accessed on 26 December 2022)]. <https://www.paho.org/es/noticias/17-6-2020-covid-19-afecto-funcionamiento-servicios-salud-para-enfermedades-no> [Ref list].
9. **World Health Organization.** Pulse Survey on Continuity of Essential Health Services during the COVID-19 Pandemic: Interim Report 2020. World Health Organization; Geneva, Switzerland.
10. **Roy A, Singh AK, Mishra S, Chinnadurai A, Mitra A, Bakshi O.** Mental health implications of COVID-19 pandemic and its response in India. *Int J Soc Psychiatry* 2021; 67 (5): 587–600.
11. **Mac Giolla Phadraig C, van Harten MT, Diniz-Freitas M, Limeres Posse J, Faulks D, Dougall A et al.** The impact of COVID-19 on access to dental care for people with disabilities: a global survey during the COVID-19 first wave lockdown. *Med Oral Patol Oral Cir Bucal* 2021; 26 (6): e770–e777.
12. **Ettinger R, Marchini L, Zwetckhenbaum S.** The Impact of COVID-19 on the Oral Health of Patients with Special Needs. *Dent Clin North Am* 2022; 66 (2): 181–194.
13. **Stennett M, Tsakos G.** The impact of the COVID-19 pandemic on oral health inequalities and access to oral healthcare in England. *Br Dent J* 2022; 232: 109–114.
14. **Colbert GB, Venegas-Vera AV, Lerma EV.** Utility of telemedicine in the COVID-19 era. *Rev Cardiovasc Med* 2020; 21 (4): 583–587.
15. **Wang H, Yuan X, Wang J, Sun C, Wang G.** Telemedicine maybe an effective solution for management of chronic disease during the COVID-19 epidemic. *Prim Health Care Res Dev* 2021; 22: e48.
16. **Nanda M, Sharma R.** A Review of Patient Satisfaction and Experience with Telemedicine: A Virtual Solution During and Beyond COVID-19 Pandemic. *Telemed J E Health* 2021; 27 (12): 1325–1331.
17. **Mubaraki AA, Alrabie AD, Sibyani AK, Aljuaid RS, Bajaber AS, Mubaraki MA.** Advantages and disadvantages of telemedicine during the COVID-19 pandemic era among physicians in Taif, Saudi Arabia. *Saudi Med J* 2021; 42 (1): 110–115.
18. **Mills EC, Savage E, Lieder J, Chiu ES.** Telemedicine and the COVID-19 Pandemic: Are We Ready to Go Live? *Adv Skin Wound Care* 2020; 33 (8): 410–417.
19. **Klein H, Palmer C.** Studies on dental caries vs. familial resemblance in the caries experience of siblings. *Public Health Rep* 1938; 53: 1353–1364.
20. **Rules on carrying out preventive health care at the primary level.** <http://www.pisrs.si/Pis.web/pregledPredpisa?id=NAVO59>. Accessed 05.01.2023.
21. **Jianhui D, Xuehui S, Rashid M, Xia X, Sumaira K, Sajid M et al.** The Influence of COVID-19 Pandemic on Physical Health–Psychological Health, Physical Activity, and Overall Well-Being: The Mediating Role of Emotional Regulation. *Front. Psychol* 2021 (16).
22. **Ismail H, Marshall VD, Patel M, Tariq M, Mohammad RA.** The impact of the COVID-19 pandemic on medical conditions and medication adherence in people with chronic diseases. *J Am Pharm Assoc* 2022; 62 (3): 834–839.e1.
23. **Komori A, Mori H, Naito T.** The impact of the COVID-19 pandemic on other infections differs by their route of transmission: A retrospective, observational study in Japan. *J Infect Chemother* 2022; 28 (12): 1700–1703.
24. **American Dental Association.** ADA recommending dentists postpone elective procedures. <https://www.ada.org/en/publications/ada-news/2020-archive/march/ada-recommending-dentists-postpone-elective-procedures>.
25. **Persoon IF, Volgenant CMC, van der Veen MH, Opdam NJM, Manton DJ, Bruers JJM.** Impact of the Coronavirus on Providing Oral Health Care in the Netherlands. *Int Dent J* 2022; 72 (4): 545–551.

Received June 6, 2023.
Accepted August 18, 2023.