Has the COVID-19 pandemic influenced the oral health and nutritional status of elderly patients with digestive cancer? A retrospective study in Fukui, Japan

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Abstract
The coronavirus disease 2019 (COVID-19) pandemic has affected various aspects, including socioeconomic status and health. This retrospective study aimed to investigate the influence of the COVID-19 pandemic on oral health based on the number of teeth that contribute to mastication, and the nutritional status of elderly patients with digestive cancers.

The authors defined the before and during COVID-19 periods in this study as January 2019 to December 2019 and January 2020 to December 2020, respectively. Patients with digestive cancer who underwent general, laboratory, and orthopantomograph examinations for preoperative oral health assessment before general anesthesia participated in this study. The authors investigated the following general characteristics: (1) sex, (2) age, and (3) the organ affected by disease and scheduled for surgery under general anesthesia. The authors collected information about (4) the number of teeth that could contribute to mastication as a clinical oral health parameter. The parameters: (5) body mass index, (6) serum total protein levels, and (7) serum albumin levels were used to indicate the nutritional status.

A total of 233 elderly patients with digestive cancer participated in this study. There was no significant difference between the age of the patients with digestive cancer. There was also no significant difference in the number of teeth that could contribute to mastication. Additionally, there was no significant difference in nutritional status as indicated by the body mass index, serum total protein levels, and serum albumin levels.

This study showed that the COVID-19 pandemic during 2020 did not have a significant influence on the oral health and nutritional status of elderly patients with digestive cancer. However, the influence of COVID-19 on community oral health may become apparent in the future. Thus, dental professionals should continue further research regarding the effects of COVID-19 on oral health.

Abbreviations: COVID-19 = coronavirus disease 2019, WHO = World Health Organization.
Keywords: coronavirus disease 2019, digestive cancer, nutrition status, oral health, teeth

1. Introduction
The World Health Organization (WHO) has defined coronavirus disease 2019 (COVID-19) as "a disease caused by a new coronavirus called severe acute respiratory syndrome coronavirus 2. The WHO first learned of this new virus on December 31, 2019.¹"¹ Severe acute respiratory syndrome coronavirus 2 is transmitted by respiratory droplets and contact. To control the spread of COVID-19, the movements of the general public have been restricted, and physical distancing and mask-wearing have become essential worldwide.¹¹ These changes necessitated by the COVID-19 pandemic may have affected the management of various diseases and community health. It has been approximately a year since cases of COVID-19 were first reported. The COVID-19 pandemic has since exacerbated existing racial/ethnic...
and socioeconomic disparities in health, including oral health.

Reducing health disparities and restoring social connections among community residents in the future will be challenging.

Community-based dental health promotions can play an important role in increasing interest in dental education, oral health, and oral health conditions. Dentists and dental hygienists have worked and performed research to continuously promote oral health worldwide. However, as previously mentioned, due to the COVID-19 pandemic, restrictions on social activities have been imposed to prevent the spread of infection. There are concerns that the ties between local communities and households have been affected by stay-at-home orders and/or lockdowns worldwide. Additionally, the pandemic may have led to difficulties in conducting community-based dental health promotions to maintain oral health, especially among dentists and dental hygienists involved with public social support organizations. Santos et al. reported that the COVID-19 pandemic reduced the number of oral health procedures provided by the public health system by half in almost all the Brazilian states. According to pediatric dental research in Australia, the COVID-19 pandemic had significantly influenced the provision of dental services to children of low socioeconomic backgrounds who have severe dental diseases and difficulties accessing dental care. As such, the interruption of community-based oral health activities and dental check-ups related to the COVID-19 pandemic may have affected the oral health in our communities.

A recent study of patients with esophageal cancer suggested that dental occlusal support and the number of sound teeth have a positive relationship with nutritional status. However, until now, there have been no reports on the influence of the COVID-19 pandemic on oral health and nutritional status.

This retrospective study aimed to investigate the effects of the COVID-19 pandemic on oral health based on the number of teeth that contribute to mastication, and the nutritional status of elderly patients with digestive cancer.

2. Methods

2.1. Participants

This study focused on elderly patients with digestive cancer. The authors defined “elderly patients” as patients aged greater than 65 years. Based on the WHO declaration, the “Before the COVID-19 pandemic” and “During the COVID-19 pandemic” periods were defined in this study as January 2019 to December 2019 and January 2020 to December 2020, respectively. Participants were divided into these 2 groups for data analysis. Patients with digestive cancer who underwent orthopantomograph imaging as part of their preoperative oral health assessment before general anesthesia at the Department of Dentistry and Oral Surgery of the University of Fukui Hospital participated in this study. Dentate and edentulous patients were both included in the study.

For the purpose of this study, the participants’ experience of chemotherapy, radiotherapy, other treatments, and the period after diagnosis were not considered. In addition, the authors did not consider whether the included patients had COVID-19 in this study.

2.2. Data extraction

The patients’ data were collected based on the preoperative examination before digestive cancer surgery under general anesthesia, including general findings, laboratory results, and orthopantomograph imaging. The authors analyzed the following general characteristics of the patients: (1) sex, (2) age, and (3) the organ affected by the disease and scheduled for surgery under general anesthesia. The authors collected information about (4) the number of teeth that could contribute to mastication as a clinical oral health parameter. The parameters: (5) body mass index, (6) serum total protein levels, and (7) serum albumin levels, were used to indicate nutritional status.

In this study, the authors defined “a tooth that could contribute to mastication” as a tooth with remaining dentin and prosthetic material that reached approximately the occlusal plane. In other words, residual root teeth and impacted teeth were excluded.

2.3. Statistical analyzes

Statistical analyzes were performed using SPSS version 26 (IBM, Tokyo, Japan). The Mann–Whitney U test was used for statistical analyzes, and P < .05 was considered statistically significant.

2.4. Ethical approval

This retrospective study was approved by the Institutional Research Board (Ethical Committee of the University of Fukui, Faculty of Medical Sciences, No. 20190082). There were no ethical issues in conducting this study because it was a retrospective study targeting examination findings and images from existing clinical records. The authors declared that all methods were performed as per relevant guidelines and regulations (including the Declaration of Helsinki). Verbal informed consent was obtained from all participants at the time of dental examination at the Department of Dentistry and Oral Surgery at the University of Fukui Hospital. The Ethical Committee of the University of Fukui, Faculty of Medical Sciences, approved this procedure because the information of this retrospective study has been released to the public.

3. Results

A total of 233 elderly patients with digestive cancer participated in this study.

3.1. General characteristics

The “Before the COVID-19 pandemic” group comprised 70 male (67.3%) and 34 female (32.7%) individuals (Table 1). The mean age and standard deviation of these patients were 75.2 ± 6.6 (65–91) years. The most common organ affected by disease and scheduled for surgery under general anesthesia was the colon (43 patients, 41.3%), followed by the stomach (25 patients, 24.0%).

The “During the COVID-19 pandemic” group comprised 79 male (61.2%) and 50 female (38.8%) individuals. The mean age and standard deviation of these patients were 75.7 ± 6.4 (65–91). The most common organ affected by disease and scheduled for surgery under general anesthesia was the colon (58 patients, 45.0%), followed by the stomach (27 patients, 20.9%).

The age of patients with digestive cancer in the “Before the COVID-19 pandemic” and “During the COVID-19 pandemic” groups were not significantly different (P = .52, Mann–Whitney U test).

3.2. The number of teeth that contribute to mastication

Regarding the number of teeth in patients in the “Before the COVID-19 pandemic” group, the mean ± standard deviation was
Table 1
Patient characteristics in 2019 versus 2020.

|                | 2019 (n) (%) | 2020 (n) (%) |
|----------------|-------------|-------------|
| **Sex**        |             |             |
| Male           | 70 (67.3)   | 79 (61.2)   |
| Female         | 34 (32.7)   | 50 (38.8)   |
| **Total**      | 104 (100)   | 129 (100)   |
| **Age (yr)**   |             |             |
| 65–69          | 28 (26.9)   | 29 (22.5)   |
| 70–79          | 48 (46.2)   | 62 (48.1)   |
| 80≤            | 28 (26.9)   | 38 (29.4)   |
| **Affected organ** |         |             |
| Colon          | 43 (41.3)   | 58 (45.0)   |
| Stomach        | 25 (24.0)   | 27 (20.9)   |
| Pancreas       | 17 (16.4)   | 15 (11.6)   |
| Other          | 19 (18.3)   | 29 (22.5)   |

Table 2
The mean number of teeth and nutritional status.

|                | 2019 (n) | 2020 (n) | \(P\) |
|----------------|----------|----------|-------|
| **Number of teeth** | 15.4 ± 10.2 | 15.1 ± 9.6 | .67   |
| **Body mass index** | 22.2 ± 3.3 | 23.0 ± 3.3 | .09   |
| **Total protein level** | 7.0 ± 0.7 | 6.9 ± 0.6 | .55   |
| **Albumin level** | 3.9 ± 0.5 | 3.9 ± 0.4 | .64   |

4. Discussion

A retrospective single-institution study in Fukui, Japan clarified that the COVID-19 pandemic did not significantly influence the oral health and nutritional status of elderly patients during 2020. There was no significant difference in the number of teeth between the "Before the COVID-19 pandemic" and "During the COVID-19 pandemic" groups (\(P=.64\), Mann–Whitney \(U\) test).

Regarding the body mass index of the patients in the "Before the COVID-19 pandemic" group, the mean ± standard deviation was 15.1 ± 9.6 (0–29) (Fig. 2). There was no significant difference in the number of teeth that could contribute to mastication in patients between the “Before the COVID-19 pandemic” and “During the COVID-19 pandemic” groups (\(P=.67\), Mann–Whitney \(U\) test).

3.3. Nutritional status

Regarding the body mass index of the patients in the “Before the COVID-19 pandemic” group, the mean ± standard deviation was 22.2 ± 3.3 (15.3–33.2) (Fig. 3). In contrast, the mean ± standard deviation in the “During the COVID-19 pandemic” group was 23.0 ± 3.3 (16.6–32.4). There was no significant difference in the body mass index between patients in the “Before the COVID-19 pandemic” group and those in the “During the COVID-19 pandemic” group (\(P=.09\), Mann–Whitney \(U\) test).

Regarding the serum total protein levels of patients in the “Before the COVID-19 pandemic” group, the mean ± standard deviation was 7.0 ± 0.7 (5.2–9.0). In contrast, the mean ± standard deviation in the “During the COVID-19 pandemic” group was 6.9 ± 0.6 (5.4–9.0). There was no significant difference in the serum total protein levels between the “Before the COVID-19 pandemic” and “During the COVID-19 pandemic” groups (\(P=.55\), Mann–Whitney \(U\) test).

Regarding the serum albumin levels of patients in the “Before the COVID-19 pandemic” group, the mean ± standard deviation was 3.9 ± 0.5 (2.2–4.7). In contrast, the mean ± standard deviation in the “During the COVID-19 pandemic” group was 3.9 ± 0.4 (2.6–4.6). There was no significant difference in the serum albumin levels between patients in the “Before the COVID-19 pandemic” group and those in the “During the COVID-19 pandemic” group (\(P=.64\), Mann–Whitney \(U\) test).

These reports support the methodology of this study. A retrospective analysis conducted before the COVID-19 pandemic and dental health activities may continue to be limited during the pandemic. Studies similar to this one should be continued, and dental professionals should consider appropriate strategies for maintaining oral health and nutritional status during and after the COVID-19 pandemic. Community-based oral health promotions, large-scale dental check-ups, and research activities should be initiated by dental experts after the COVID-19 pandemic.

The authors’ previous questionnaire survey on tongue cleaning in the same area revealed that members of the general public across a wide age range, who were not hospitalized, were interested in oral hygiene. The authors also reported on spontaneous intraoral hemorrhage associated with dental calculus and poor oral hygiene in the same community. Furthermore, in a study conducted before December 2019, when COVID-19 was first reported by the WHO, the authors reported on the status of periodontal disease in patients with digestive cancer at the same institution as the present study. These reports suggest a growing interest in oral health. However, community-based dental promotions need to continue. Based on these results and dental research worldwide, the authors were concerned that COVID-19 would disrupt community-based oral health activities and dental check-ups, and these may have had a significantly negative influence on oral health in our community before conducting this study. Interestingly, the results of this study refuted the authors’ concerns.

In 2015, the United Nations adopted and announced Sustainable Development Goals in 17 targets of health, poverty, and communities. The United Nations mentioned, “End hunger, achieve food security and improved nutrition, and promote sustainable agriculture” and “Ensure healthy lives and promote well-being for all at all ages” as the second and third items, respectively, on their list. Therefore, dentists should promote and improve oral health and nutritional status in coordination with these goals. The WHO definition of “oral health” includes various conditions, such as dental caries, periodontitis, tooth loss, oral cancer, oral manifestations of human immunodeficiency virus infection, trauma, and so on.
Figure 1. Age and number of teeth in patients in the "Before the COVID-19 pandemic" group.

Figure 2. Age and number of teeth in patients in the "During the COVID-19 pandemic" group.
birth defects. These conditions have become key indicators of health and quality of life.\textsuperscript{[16]} Oral health not only includes dental and orofacial problems but also the prevention and treatment of diseases, including appropriate rehabilitation services, thereby maintaining general health and quality of life.\textsuperscript{[16]} New areas of work, new policies, and clinical challenges as noted by politicians and medical experts, including the development and administration of vaccines, have been instituted to maintain global public health due to the COVID-19 pandemic.\textsuperscript{[17]} These are the most urgent global issues related to the achievement of sustainable development goals, and therefore, dental professionals should be involved.

The COVID-19 pandemic was not anticipated. As a result, the authors collected our data retrospectively in this study from the preoperative examinations. Therefore, the results of this study should be interpreted with this methodological limitation in mind. Moreover, the clinical oral health status was assessed by only the number of teeth that could contribute to mastication, and the nutritional status was assessed only by body mass index, serum total protein levels, and serum albumin levels. Therefore, the study did not consider other factors that may influence nutrition and function such as dental prosthetic appliances, including dentures and bridges. Furthermore, participant selection was limited to 2 periods: January 2019 to December 2019 (“Before the COVID-19 pandemic”) and January 2020 to December 2020 (“During the COVID-19 pandemic”) the period covered by this study, from January 2020 to December 2020, may have been the beginning of the pandemic. Therefore, the impact of the COVID-19 pandemic on community oral health may become apparent in the future.

5. Conclusion
This retrospective single-institution study in Fukui, Japan clarified that the COVID-19 pandemic during 2020 did not significantly influence oral health and nutritional status. The effects of the COVID-19 pandemic on community oral health may become apparent in the future. Therefore, further research is needed.

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