

# Impact of the COVID-19 Pandemic on Tooth Brushing and Handwashing of Adolescents: A Secondary Analysis of the Korea Youth Risk Behavior Web-Based Survey (2019~2020)

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**Background:** In this study, we investigated the changes and factors that affect daily health behaviors due to COVID-19 among adolescents. We intend to provide basic data so that a systematic and comprehensive health education program that includes physical and oral health can be made.

**Methods:** This study was a secondary data analysis of the from the 2019 and 2020 Korea Youth Risk Behavior Web-based Survey. A final sample of 112,251 participants was analyzed using chi-square test, and ordinal logistic regression.

**Results:** In the case of tooth brushing, the frequency of 'never' increased in most general characteristics compared to before COVID-19. In the case of handwashing, it was found that handwashing behavior increased (increased) after COVID-19 compared to before COVID-19. As a result of confirming the factors affecting tooth brushing behavior before and after COVID-19, it was found that girls brushed teeth 2.2 times more regularly after lunch than boys. As a result of adjusting all other factors, regular tooth brushing behavior after COVID-19 was reduced by 0.79 times compared to before COVID-19.

**Conclusion:** It is judged that it is necessary to operate a comprehensive health management program in the school so that the most basic tooth brushing for oral health and handwashing for health can become a habit. In addition, by confirming the impact of the COVID-19 pandemic on handwashing and tooth brushing behavior through this study, it is expected to be used in the development of policy data such as raising awareness of brushing and improving behaviors applicable in the current and upcoming new pandemic situations.

**Key Words:** Adolescent, COVID-19, Handwashing, Tooth brushing

## Introduction

### 1. Background

As the coronavirus infection spreads rapidly around the world, the World Health Organization (WHO) declared corona virus infectious disease-19 (hereinafter referred to as COVID-19) as a global epidemic and pandemic on March 11, 2020<sup>1)</sup>. SARS-CoV-2 is transmitted from person to person as a pathogen, and the main route of infection is through direct or indirect contact with respiratory droplets (droplets) generated through coughing, sneezing,

and speaking of an infected person<sup>2)</sup>. The main symptoms are fever, cough, shortness of breath, loss of taste and smell, etc., and the elderly, immunocompromised patients, and patients with underlying diseases such as diabetes and respiratory diseases mainly worsened to a serious condition, resulting in a high mortality rate<sup>3,4)</sup>. In order to prevent the spread of COVID-19, public health measures at the national, community and individual levels, such as social distancing, wearing a mask, and strengthening handwashing, have been taken, which have resulted in unusual changes in the home, work and social life of the global population.

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Adolescence is it is a period when life habits and risk behaviors related to chronic diseases are learned, and the health behavior factors learned during this period affect not only lifelong oral health and health, but also quality of life<sup>5)</sup>. In addition, a period of physical and mental changes, and as a period of considerable emotional instability, all parts of the body and mind are transitional<sup>6)</sup>. Adolescence is a period that requires a change in attitude and behavior beyond the acquisition of fragmentary knowledge<sup>7)</sup>.

The most effective way to keep personal hygiene is to brush your teeth properly to remove the dental plaque that causes dental caries and periodontal disease, and wash your hands to prevent the spread of various bacteria and viruses through your hands<sup>8)</sup>. Tooth brushing is the most basic way to maintain oral health. As with other diseases, if you maintain clean oral hygiene without the help of vaccinations or vaccines, you can prevent many oral diseases<sup>9,10)</sup>. In particular, the frequency of brushing is widely used as an index for predicting health behavior<sup>11)</sup>. Hands are the part of the body that comes into contact with various harmful bacteria, and 70% of most diseases can be prevented through hand washing<sup>12)</sup>.

Lifestyle habits formed in adolescence are closely related to lifestyle habits in adulthood, and it has been emphasized that forming and maintaining healthy lifestyle habits from adolescence can prevent chronic diseases, thereby reducing social and economic burden<sup>5)</sup>.

From this point of view, studies related to adolescent health behaviors have been conducted in the past, but most of them are studies related to adolescent delinquency, drinking, smoking, drug use, and negative health behaviors<sup>13)</sup>. As an indicator of health behavior, comparative studies on hand washing and brushing habits, the most representative health behaviors in daily life, are scarce. It is reported that the importance of hand washing, which is a representative of daily health behaviors, is emphasized during the COVID-19 pandemic, and the awareness and practice rate of hand washing have improved<sup>14)</sup>.

## 2. Objectives

The importance of brushing is relatively less emphasized compared to hand washing, and the awareness and practice rate are also thought to have decreased compared to before

COVID-19. Based on these results, we intend to provide basic data so that a systematic and comprehensive health education program including physical health and oral health can be established, as well as policy development to raise awareness of tooth brushing and form correct tooth brushing habits in the midst of a pandemic.

## Materials and Methods

### 1. Ethics statement

This study was waived by the Institutional Review Board (IRB) of Baekseok Culture University (IRB No.2-7008132-A-N-01). This study was secondary analysis of data and data were from the Korea Youth Risk Behavior Web-based Survey (KYRBS) (<https://www.kdca.go.kr/yhs/>).

### 2. Study design

This study was analyzed using raw data from the 2019 and 2020 KYRBS. The study is an explanatory research to confirm the impact of COVID-19 on daily health behavior. This study report followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) reporting guidelines (<https://www.strobe-statement.org/>).

### 3. Participants

This study was analyzed using raw data from the 2019 and 2020 KYRBS. The study is an explanatory research to confirm the impact of COVID-19 on daily health behavior. The subjects of the study were 57,303 in 2019 and 54,948 in 2020, a total of 112,251 participants.

### 4. Study variables

The dependent variable was used to compare hand washing and toothbrushing behaviors, which are representative health behaviors, and the following items were used; "How often did you tooth brushing after lunch at school?" and "How often did you handwashing usage soap before meals at school?". The variables were classified 'never', 'sometimes', 'almost', 'always'. The explanatory variables were used six items; gender (boys, girls), school type (middle, high), academic achievement (high, middle, low), the area of residence (rural, small city, and large city),

**Table 1.** Comparison Before and After COVID-19 of Tooth Brushing

Variable	Before COVID-19				$\chi^2$	After COVID-19				$\chi^2$
	Never	Sometimes	Almost	Always		Never	Sometimes	Almost	Always	
Gender					3,000.00 <sup>a</sup>					2,100.00 <sup>a</sup>
Boys	13,807 (46.27)	7,042 (23.60)	4,490 (15.05)	4,502 (15.09)		14,709 (51.88)	6,182 (21.80)	3,497 (12.33)	3,965 (13.98)	
Girls	8,211 (29.90)	5,639 (20.53)	4,572 (16.65)	9,040 (32.92)		10,035 (37.73)	5,058 (19.02)	3,884 (14.60)	7,618 (28.64)	
School type					3,000.00 <sup>a</sup>					3,600.00 <sup>a</sup>
Middle school	13,824 (47.05)	7,018 (23.88)	3,868 (13.16)	4,674 (15.91)		15,747 (54.37)	6,226 (21.50)	3,429 (11.84)	3,559 (12.29)	
High school	8,194 (29.35)	5,663 (20.28)	5,194 (18.60)	8,868 (31.76)		8,997 (34.62)	5,014 (19.29)	3,952 (15.21)	8,024 (30.88)	
Academic achievement					90.00 <sup>a</sup>					76.60 <sup>a</sup>
Low	7,271 (40.11)	4,107 (22.66)	2,745 (15.14)	4,003 (22.08)		8,412 (46.18)	3,756 (20.62)	2,409 (13.22)	3,640 (19.98)	
Middle	6,228 (36.14)	3,930 (22.80)	2,815 (16.33)	4,261 (24.72)		7,060 (42.57)	3,579 (21.58)	2,329 (14.04)	3,617 (21.81)	
High	8,519 (38.82)	4,644 (21.16)	3,502 (15.96)	5,278 (24.05)		9,272 (46.02)	3,905 (19.38)	2,643 (13.12)	4,326 (21.47)	
The areas of residence					1,200.00 <sup>a</sup>					2,200.00 <sup>a</sup>
Rural	927 (20.61)	1,010 (22.46)	984 (21.88)	1,576 (35.05)		894 (20.57)	815 (18.75)	914 (21.03)	1,723 (39.65)	
Small city	9,966 (36.28)	6,058 (22.05)	4,496 (16.37)	6,951 (25.30)		11,508 (42.65)	5,648 (20.93)	3,718 (13.78)	6,107 (22.63)	
Large city	11,125 (43.91)	5,613 (22.16)	3,582 (14.14)	5,015 (19.79)		12,342 (52.25)	4,777 (20.22)	2,749 (11.64)	3,753 (15.89)	
Residential type					408.42 <sup>a</sup>					846.74 <sup>a</sup>
With family	21,308 (39.27)	12,048 (22.20)	8,367 (15.42)	12,544 (23.12)		24,196 (46.24)	10,723 (20.49)	6,805 (13.00)	10,608 (20.27)	
Without family	710 (23.39)	633 (20.85)	695 (22.89)	998 (32.87)		548 (20.95)	517 (19.76)	576 (22.02)	975 (37.27)	
Family economic status					55.04 <sup>a</sup>					74.53 <sup>a</sup>
Low	2,843 (38.73)	1,591 (21.67)	1,195 (16.28)	1,712 (23.32)		3,314 (45.95)	1,374 (19.05)	954 (13.23)	1,570 (21.77)	
Middle	10,494 (38.22)	5,882 (21.42)	4,265 (15.53)	6,816 (24.82)		11,882 (45.01)	5,173 (19.60)	3,535 (13.39)	5,807 (22.00)	
High	8,681 (38.57)	5,208 (23.14)	3,602 (16.01)	5,014 (22.28)		9,548 (44.74)	4,693 (21.99)	2,892 (13.55)	4,206 (19.71)	

<sup>a</sup>Data was analysed by chi-square test.

**Table 2.** Comparison Before and After COVID-19 of Handwashing

Variable	Before COVID-19				After COVID-19				$\chi^2$
	Never	Sometimes	Almost	Always	Never	Sometimes	Almost	Always	
Gender									184.67 <sup>a</sup>
Boys	3,698 (12.39)	9,432 (31.61)	9,730 (32.61)	6,981 (23.39)	3,034 (10.70)	7,102 (25.05)	8,557 (30.18)	9,660 (34.07)	
Girls	5,188 (18.89)	10,941 (39.84)	7,495 (27.29)	3,838 (13.98)	3,384 (12.73)	7,598 (28.57)	7,514 (28.25)	8,099 (30.45)	
School type									1,600.00 <sup>a</sup>
Middle school	3,818 (12.99)	9,838 (33.48)	9,419 (32.05)	6,309 (21.47)	2,562 (8.85)	6,552 (22.62)	8,612 (29.74)	11,235 (38.79)	
High school	5,068 (18.15)	10,535 (37.73)	7,806 (27.96)	4,510 (16.15)	3,856 (14.84)	8,148 (31.35)	7,459 (28.70)	6,524 (25.10)	
Academic achievement									167.10 <sup>a</sup>
Low	2,892 (15.95)	6,687 (36.89)	5,382 (29.69)	3,165 (17.46)	2,205 (12.10)	5,271 (28.93)	5,370 (29.48)	5,371 (29.48)	
Middle	2,444 (14.18)	6,198 (35.96)	5,414 (31.41)	3,178 (18.44)	1,754 (10.58)	4,431 (26.72)	4,954 (29.87)	5,446 (32.84)	
High	3,550 (16.18)	7,488 (34.12)	6,429 (29.30)	4,476 (20.40)	2,459 (12.21)	4,998 (24.81)	5,747 (28.53)	6,942 (34.46)	
The areas of residence									28.79 <sup>a</sup>
Rural	574 (12.76)	1,454 (32.33)	1,432 (31.84)	1,037 (23.06)	418 (9.62)	1,166 (26.83)	1,345 (30.95)	1,417 (32.60)	
Small city	4,361 (15.87)	9,847 (35.85)	8,277 (30.13)	4,986 (18.15)	3,193 (11.83)	7,215 (26.74)	7,741 (28.69)	8,832 (32.73)	
Large city	3,951 (15.60)	9,072 (35.81)	7,516 (29.67)	4,796 (18.93)	2,807 (11.88)	6,319 (26.75)	6,985 (29.57)	7,510 (31.79)	
Residential type									13.10 <sup>a</sup>
With family	8,382 (15.45)	19,268 (35.51)	16,359 (30.15)	10,258 (18.90)	6,118 (11.69)	13,939 (26.64)	15,287 (29.21)	16,988 (32.46)	
Without family	504 (16.60)	1,105 (36.40)	866 (28.52)	561 (18.48)	300 (11.47)	761 (29.09)	784 (29.97)	771 (29.47)	
Family economic status									285.21 <sup>a</sup>
Low	1,407 (19.17)	2,715 (36.98)	2,047 (27.88)	1,172 (15.97)	939 (13.02)	2,076 (28.79)	2,021 (28.02)	2,176 (30.17)	
Middle	4,476 (16.30)	10,371 (37.77)	8,190 (29.83)	4,420 (16.10)	3,259 (12.35)	7,422 (28.12)	7,836 (29.69)	7,880 (29.85)	
High	3,003 (13.34)	7,287 (32.38)	6,988 (31.05)	5,227 (23.23)	2,220 (10.40)	5,202 (24.38)	6,214 (29.12)	7,703 (36.10)	

<sup>a</sup>Data was analysed by chi-square test.

residential type (with family, without family), family economic status (high, middle, low). For comparison COVID-19, 2019 was divided into before- and 2020 was analyzed after-COVID-19.

## 5. Statistical methods

In this study, descriptive analysis using chi-squared test was performed to confirm the differences in handwashing and tooth brushing according to general characteristics before and after COVID-19. In addition, ordinal logistic regression analysis was performed to confirm the correlation between COVID-19 and handwashing and tooth brushing behavior. STATA software version 14.0 (Stata Corp, College Station, TX, USA) was used to perform the statistical analyses. The p-value of 0.05 was set for statistical significance.

## Results

### 1. Comparison before and after COVID-19 of tooth brushing after lunch at school

The differences in tooth brushing behavior after lunch before and after COVID-19 are shown Table 1. When comparing before and after COVID-19, both boys and girls showed a negative trend after COVID-19, in particular, the frequency of 'never' was relatively worse for girls (+18%p) than for boys (+15%p) ( $p < 0.05$ ). According to academic achievement, after COVID-19, the frequency of 'never tooth brushing' showed an increase in all groups ( $p < 0.05$ ). It was found that the frequency of never tooth brushing increased more in the high group than in the low group ( $p < 0.05$ ). There was also a difference in tooth brushing behavior according to the area of residence and the family economic status ( $p < 0.05$ ).

### 2. Comparison before and after COVID-19 of handwashing

The differences in handwashing behavior before lunch before and after COVID-19 are shown Table 2. When comparing before and after COVID-19, it was found that hand washing behavior was upward sloping in all groups after COVID-19. In terms of gender, boys were found to handwashing better than girls ( $p < 0.05$ ). Compared to

school type, middle school students tended to hand-washing better than high school, and according to academic achievement, the frequency of handwashing tended to increase as achievement increased ( $p < 0.05$ ).

### 3. Affecting factors of tooth brushing before and after COVID-19

As a result of confirming the affecting factors of tooth brushing before and after COVID-19, Table 3 shows. Compared to boys, girls were found to tooth brushing 2.22 times more, and high school students compared to middle school students were 2.54 times more likely to tooth brushing ( $p < 0.05$ ). According to the residential type, the probability of tooth brushing increased by 1.53 times in without living compared to with family living ( $p < 0.05$ ). It was found that the higher the academic achievement and the socio-economic status increased, the more tooth brushing ( $p < 0.05$ ). When the other factors were adjusted, the tooth brushing behavior after COVID-19 showed a tendency to decrease 0.79 times compared to before COVID-19 ( $p < 0.05$ , Table 3).

## Discussion

### 1. Interpretation

Health risk behaviors formed in adolescence become habits or lifestyles in the process of socialization and are difficult to modify. In addition, adolescence is an important period in determining lifelong health as it affects the morbidity of chronic diseases in adulthood<sup>15)</sup>. Unhealthy adolescence is emerging as a social problem as well as an individual problem as it acts as an obstacle to performing normal tasks after becoming an adult<sup>16)</sup>.

### 2. Comparison with previous studies

Based on this point of view, this study was conducted to compare the changes in toothbrushing and hand washing among adolescents before and after COVID-19. Therefore, I would like to describe the confirmed results of this study in three areas.

First, in the case of brushing, the frequency of 'never' tooth brushing increased in most general characteristics compared to before COVID-19. Among them, the variables

**Table 3.** Affecting Factors of Tooth Brushing Before and After COVID-19

Variable	Odds ratio	Standard error	z <sup>a</sup>	95% confidence interval
Gender				
Boys (Ref.)				
Girls	2.221	0.025	70.620	2.172 ~ 2.271
School type				
Middle school (Ref.)				
High school	2.542	0.029	80.440	2.485 ~ 2.600
Academic achievement				
Low (Ref.)				
Middle	1.211	0.017	13.460	1.178 ~ 1.245
High	1.246	0.017	15.700	1.213 ~ 1.281
The area of residence				
Rural (Ref.)				
Small city	0.468	0.010	-36.020	0.449 ~ 0.488
Large city	0.316	0.007	-53.620	0.303 ~ 0.329
Residential type				
With family (Ref.)				
Without family	1.529	0.039	16.660	1.455 ~ 1.608
Family economic status				
Low (Ref.)				
Middle	1.101	0.019	5.430	1.063 ~ 1.140
High	1.174	0.022	8.680	1.133 ~ 1.218
COVID-19				
Before (Ref.)				
After	0.792	0.009	-20.820	0.775 ~ 0.810
/cut1	-468.3095	22.566		-512.537 to -424.082
/cut2	-467.3404	22.565		-511.568 to -423.113
/cut3	-466.5448	22.565		-510.772 to -422.318

<sup>a</sup>Data was analysed by ordinal logistic regression.

that showed a major change were gender and residential area. In the case of girls, the frequency of 'never' after COVID-19 increased markedly in the case of girls and living in a large city. According to a study by Park et al.<sup>17)</sup>, compared with before the COVID-19 epidemic, 2.7% of men and 6.0% of women responded that the number of brushing was reduced. In the Bruna et al.<sup>18)</sup> study, when compared before and after COVID-19, the number of daily brushing increased by 8.7% for less than 3 times, but decreased by 8.7% for more than 3 times, which is consistent with the results of this study. In the case of brushing, the mask must be removed, and the aerosol generated during brushing is thought to have caused anxiety and discomfort to the youth living in groups at school. In addition, compared to the quarantine rules emphasized by the government, such as wearing a mask, washing hands, and social distancing, brushing is considered

to have resulted in negative results because it is not a rule that is actively recommended after COVID-19. In the case of women, the psychological concerns and risk perception due to COVID-19 are higher in women than in men<sup>19,20)</sup>. Even in large cities, the population density is higher than in small areas, so there is a clear difference in the COVID-19 outbreak rate, so it will not be easy for girls living in large cities to take off their masks and brush their teeth at school. However, wearing a mask for a long time can cause bad breath and periodontal disease. It is thought that it is necessary to instill awareness of proper brushing through education and promotion.

Second, in the case of hand washing, it was found that hand washing behavior in all groups after COVID-19 was upward compared to before COVID-19. Comparing the frequency of the groups who answered 'always' to whether or not to wash their hands according to general character-

istics, it was found that middle school students wash their hands better than high school students and boys by gender. According to the study results of Han and Lee<sup>20)</sup>, males performed more preventive behaviors than females, and there were many previous studies<sup>21-23)</sup> in which male students showed higher rates of hand washing before meals as in this study. The results of Kim et al.<sup>23)</sup> and Hong and Ye<sup>24)</sup> also showed that middle school students had higher hand washing practices than high school students, which was consistent with the results of this study. According to a study by Burt<sup>25)</sup> and Kim et al.<sup>26)</sup>, men had poor hygiene habits and less interest in health than women. However, the results of this study provided evidence to refute these facts. Handwashing is an important means of maintaining personal hygiene, and a basis for making it a habit should be prepared through professional and continuous management and education, rather than a one-time occurrence.

Third, as a result of Adujusting for all other factors, the regular brushing behavior after COVID-19 showed a tendency to decrease 0.79 times compared to before COVID-19. According to a study by Park et al.<sup>17)</sup> targeting university students, 87.0% of the respondents answered that the frequency of brushing after COVID-19 was 'similar', showing a different result from this study. In a study by Bruna et al.<sup>18)</sup> targeting adolescents, the frequency of brushing decreased after COVID-19. Conversely, if we interpret these results, it can be seen as a positive effect of active prevention action such as wearing a mask and implementation of quarantine rules. However, as adolescence is an intermediate stage of growth as an independent individual, it may be difficult to form new health habits and maintain existing habits because they face stressful situations in various fields as well as academics<sup>27)</sup>. Therefore, it is judged that it is necessary to operate an oral health management program in the school so that the most basic toothbrushing for oral health can become a habit.

### 3. Limitations

The limitations were that the data of the adolescent health behavior survey surveyed in the self-report format was used and that there were limitations in setting variables through the cross-sectional survey design. Also,

the main variable of this study was measured based on the school lifestyle, but there may be a limitation in that the restricted distance due to the COVID-19 pandemic.

### 4. Generalizability

It is worthwhile in that it confirmed the changes in the tooth brushing and handwashing behaviors of adolescents before and after COVID-19 based on the reliability and representativeness of the adolescent health behavior survey data. It can also be meaningful as it is the first study to evaluate changes in behavior regarding health and oral health before and after COVID-19. In addition, by confirming the impact of the COVID-19 pandemic on handwashing and brushing behavior through this study, it is expected to be used in the development of policy data such as raising awareness of brushing and improving behaviors applicable in the current and upcoming new pandemic situations.

### 5. Suggestions

Based on this study, it is thought that additional investigation and analysis on the behavioral changes of adolescents using more diverse variables will be necessary in the future.

## Notes

### Conflict of interest

Eunsuk Ahn has been managing editor of the Journal of Journal of Dental Hygiene Science since September 2019. She was not involved in the review process of this editorial. Otherwise, there was no conflict of interest.

### Ethical approval

This study was waived by the Institutional Review Board of Baekseok Culture University (IRB No.2-7008132-A-N-01).

### Author contributions

Conceptualization: Eunsuk Ahn and Ji-Min Hwang. Data acquisition: Eunsuk Ahn. Formal analysis: Eunsuk Ahn. Supervision: Ji-Min Hwang. Writing-original draft: Eunsuk Ahn and Ji-Min Hwang. Writing-review & editing:



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## Data availability

Please contact the corresponding author for data availability.

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