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The association between tooth brushing during lunchtime and obesity in South Korean adolescents

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Obesity in adolescents is a global health concern associated with several diseases and complications in adulthood. Obesity has been reported to be strongly associated with oral habits. To investigate the association between tooth brushing during lunchtime and the prevalence of obesity among adolescents in a nationally representative sample of South Korean adolescents. Data from the 2018–2021 Korea Youth Risk Behavior Web-Based Survey were used in this cross-sectional study. Obesity was measured based on the body mass index. The chi-square test was used to investigate and compare tooth brushing habits during lunchtime in the study population, and multivariate logistic regression analysis was performed to analyze the relationship between tooth brushing during lunchtime and the prevalence of obesity. The odds of obesity were lower in the group that brushed their teeth during lunchtime (adjusted odd ratio: 0.90, 95% confidence interval: 0.88–0.93). Furthermore, the odds of obesity were significantly higher in high school students; boys; those with a low household income, low subjective health status awareness, medical history (asthma or atrophy), and history of sealant use; and those who responded after the coronavirus disease 2019 pandemic. A significant inverse relationship was found between tooth brushing habits during lunchtime and the prevalence of obesity. This relationship was consistent regardless of socioeconomic and lifestyle factors.

With improvements in living standards, weight gain and obesity are increasingly becoming global health concerns. Obesity, a chronic disease that affects both adults and children, is prevalent in both developed and developing nations, including South Korea[1,2]. Notably, obesity prevalence has almost surpassed traditional public health concerns such as undernutrition and infectious diseases and is one of the most significant contributors to poor health[3]. Obesity has been associated with various diseases, including cardiovascular disease and diabetes[4], and a correlation between poor oral health and obesity has been reported in previous studies[5]. Notably, individuals with obesity tend to experience periodontal disease and lose more teeth than those without obesity[6,7].

In addition to the direct adverse effects of obesity on general health, research has focused on numerous comorbidities that have common risk factors and complex health implications[8]. Previous studies have reported an association between obesity and oral diseases, including periodontal disease, dental caries, tooth erosion, xerostomia, and dentinal hypersensitivity. These oral diseases are categorized as health issues that are often accompanied by obesity and exhibit similar underlying risk factors among adolescents[9,10]. Furthermore, individuals' self-perceived oral health is associated with general health[11], and this association has crucial implications for healthcare professionals specializing in obesity management and dental practitioners who oversee the oral health of overweight individuals[5,12]. Tooth brushing is one factor in the favorable health cluster of public school children, owing to its primary role in maintaining good oral hygiene, ultimately leading to better oral health[13,14]. Oral and general health are not independent of contextual influences, as evidenced by the clustering of body

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mass index (BMI) and tooth brushing in the health and lifestyle clusters among the children, indicating their influence in a larger social environment[15,16].

The present study aimed to investigate the correlation between lunchtime tooth brushing habits and the prevalence of obesity among Korean adolescents, which is a potentially under-explored aspect of adolescent health. We specifically focused on the unique setting of schools, where adolescents are more likely to manage their oral hygiene independently, unlike at home, where parental supervision often plays a significant role. This distinction is crucial because it allows for an evaluation of how self-initiated oral hygiene practices, particularly in a school environment, impact adolescent health. The correlation between oral health and obesity in adolescents has been investigated in numerous studies; however, only a few studies have specifically targeted Korean adolescents. Therefore, our study represents a novel contribution to this field.

We primarily aimed to explore the association between consistent tooth brushing habits after lunchtime in school and the prevalence of obesity among Korean adolescents. In this study, obesity was measured based on BMI, providing an overall indicator of general obesity. In addition, we aimed to investigate whether the observed associations are influenced by various factors, such as socioeconomic status, lifestyle choices, dental anxiety, and other relevant covariates. This multifaceted approach seeks to provide a comprehensive understanding of the interplay between personal oral hygiene practices and broader health outcomes, including obesity.

By delving into these research areas, we hope to not only establish an association between individual health practices, such as tooth brushing after lunch, and overall well-being, particularly regarding obesity, but also to explore how this association is influenced by different demographic and lifestyle factors in Korean adolescents. Our findings may significantly contribute to the fields of health education and policy, offering new perspectives on promoting healthy lifestyle habits and understanding health status among Korean adolescents.

Methods
Source of data analyzed
Data obtained from the Korea Youth Risk Behavior Web-based Survey (KYRBS) between 2018 and 2021 were retrospectively analyzed in this study. The KYRBS is an ongoing national cross-sectional survey used to assess health-risk behaviors among middle and high school students in South Korea and monitor progress toward achieving the national health objectives outlined in Korea's National Health Plan in 2020. Furthermore, it provides data essential for the development and evaluation of school health policies and programs in South Korea. The target population for this survey was nationally representative middle and high school students aged 12–18 years in South Korea. Approximately 75,000 students from 400 middle and 400 high schools participated in the survey, which was conducted between June and July of each year. Students anonymously completed a self-administered questionnaire in the computer laboratory at each sampled school. A steering committee representing the Office of Education from 17 provinces in South Korea managed the survey[17]. All procedures contributing to this study comply with the ethical standards of the relevant national and institutional committees on human experimentation and with the Helsinki Declaration of 1975, revised in 2008. The KYRBS was approved by the Institutional Review Board (IRB) of the Korea Centers for Disease Control and Prevention (KCDC; approval number: 2014-06EXP-02-P-A) in 2014. From 2015 onward, the requirement for ethical approval for the KYRBS was waived by the IRB of the KCDC under the Bioethics and Safety Act and opened to the public for academic use. All participants signed an informed consent form before participating in the KYRBS.

Variable definitions
In this study, BMI was calculated using participants' self-reported height and weight and classified according to the age- and sex-specific equations from the 2017 Korean National Growth Charts for Children and Adolescents. BMI was classified as follows: underweight (BMI < 5th percentile), normal weight (5th ≤ BMI < 85th percentile), overweight (85th ≤ BMI < 95th percentile), obesity (95th ≤ BMI < 99th percentile), and severe obesity (BMI ≥ 99th percentile). This classification reflects the nationally recognized standards, ensuring a robust and contextually relevant assessment of weight status among Korean adolescents. Regarding our primary variable of interest, "tooth brushing after lunch," we first investigated the student's engagement in this habit based on a "yes" or "no" response. To provide deeper insights using a subgroup analysis, we expanded this variable by introducing a more detailed classification based on the frequency of tooth brushing. This classification was based on the number of times students brushed their teeth after lunch in the last 7 days. The frequency of tooth brushing was categorized as follows: (a) Always: if the participant brushed their teeth after lunch seven times (daily) in the last 7 days; (b) Mostly: if the participant brushed their teeth after lunch 4–6 times in the last 7 days; and (c) Sometimes: if the participant brushed their teeth after lunch 1–3 times in the last 7 days.

Covariates
Common possible confounders associated with body weight, including socioeconomic and lifestyle factors[18] and oral health[9], should be considered in studies on oral health and obesity. Grade level (middle or high school) was considered to reflect the academic characteristics of the students. Sex (boys and girls) was recorded as a significant variable. Economic status was determined using the variable "household income," categorized as "high," "middle," or "low." Similarly, the variable "living companions" reflected the living arrangements of the students, categorized as "with family," "live alone," or "in a childcare facility." The students' perceived stress levels were evaluated using the variable "perceived stress level," categorized as "high," "middle," or "low." In addition, students' subjective assessment of their overall health was measured using the variable "subjective health status," categorized as "high," "middle," or "low." The variable "physical activity" was used to assess the level of physical activity among students and was categorized as "high," "middle," or "low." Students with 0 days of physical activity of ≥ 60 min weekly were classified as having a "low" physical activity level, those with 7 days of intense physical

activity or who underwent strength training for ≥ 3 days weekly were classified as having a "high" physical activity, and the remaining students were classified as having a "middle" physical activity[19,20]. Furthermore, students' sleep duration was examined using the variable "sleep duration" and classified into "sleep deprivation," "appropriate sleep," or "excessive sleep." Specific classification criteria were applied, and sleep duration was classified as "insufficient" (0–480 min), "sufficient" (480–720 min), and "excessive" (720–1200 min). Inappropriate values of > 1200 min were excluded from the analysis[21]. The variable "asthma/atopic dermatitis" was used to investigate whether students had previously been diagnosed with asthma, atopic dermatitis, or both based on a "yes" or "no" response. Students' body shape perception compared with what is considered normal or below normal and overweight was measured using the variable "body shape perception," categorized as "below normal," "normal," or "overweight." The variable "nutrition education" was used to determine the impact of nutrition education based on a "yes" or "no" response. The variable "carbonated drinks" was used to assess students' consumption of such beverages based on a "yes" or "no" response. Students' self-reported oral health status was examined using the variable "oral health status," categorized as "high" or "low." Furthermore, the variable "sealant history" was used to determine whether students had a history of dental sealant application based on a "yes" or "no" response. Finally, the variable "corona period" was used to distinguish between the pre-coronavirus 2019 disease (COVID-19) and post-COVID-19 pandemic periods, categorized as "pre-corona" or "post-corona."

Statistical analysis

Chi-square tests were used to analyze and compare variables. To examine the relationship between tooth brushing after lunch and obesity in adolescents, we performed a survey logistic regression analysis using strata, weight, and clusters after adjusting for covariates. Subgroup analyses were performed to investigate the combined association of tooth brushing and other covariates with obesity. Participants with obesity were divided into three groups according to the severity of obesity, and the difference in the relationship between tooth brushing after lunchtime and obesity was analyzed in each of these groups. The results were presented as odds ratios (ORs) and 95% confidence intervals (CIs) to compare the prevalence of obesity. The analyses were performed using stratified sampling variables (strata) and weighted variables as suggested by the KYRBS. All analyses were performed using SAS software (version 9.4; SAS Institute, Cary, NC, USA), and statistical significance was set at p < 0.05.

Results

This study included 137,734 participants (71,080 boys and 66,654 girls) from the KYRBS survey conducted between 2018 and 2021. Table 1 presents the distribution of the participants' responses, with 24% of respondents classified as having obesity and 76% as having normal weight. Among them, 58.9% brushed their teeth during lunchtime (22.7% had obesity), whereas 41.1% did not (25.8% had obesity).

Table 2 presents the results of the multivariate logistic regression analysis of the association between each variable and obesity. The hypothesis testing for the coefficients was implemented using a chi-squared test based on the Wald statistic. The odds of obesity were lower in the group that brushed their teeth during lunchtime than in the group that did not (adjusted odds ratio [OR] 0.90, 95% confidence interval [CI] 0.88–0.93). Furthermore, the odds of obesity were significantly higher in high school students; boys; those with a low household income, low subjective health status awareness, medical history (asthma or atrophy), and history of sealant use; and those who responded post-corona.

Table 3 presents the results of the subgroup analysis. The hypothesis testing for the coefficients was implemented using a chi-squared test based on the Wald statistic. For all subgroups of all variables, the odds of obesity were lower in the group that brushed their teeth during lunchtime than in the group that did not. This difference was significant for all subgroups except for middle school students, those with low household income, those who lived alone, and those with low physical activity.

Figure 1 shows the results of the multinomial multivariate logistic regression analysis between tooth brushing during lunchtime and obesity subgroups. In cases of tooth brushing, the ORs generally decreased as the prevalence of obesity increased. Figure 2 shows the results of the multivariate logistic regression analysis between the subgroups regarding the frequency of tooth brushing during lunchtime and obesity. The ORs decreased as the frequency of tooth brushing increased. As shown in Figs. 1, 2, tooth brushing, sex, age, residential type, living standard, exercise, stress, subjective health status, asthma or atopy, sleep, soda consumption, self-reported oral health, sealant status, nutrition education at school, and pre- and post-corona were all considered variables.

Discussion

The present study, with its large sample size of 137,734 participants, presents substantial evidence of a novel inverse association between oral hygiene practices, particularly tooth brushing during lunchtime, and the prevalence of obesity among adolescents. This association remained even after adjusting for covariates and subgrouping according to sociodemographic variables and general health status, including physical activity and sleep duration. To our knowledge, the present study is the first to investigate the relationship between tooth brushing during lunchtime and obesity in the Korean adolescent population. Our results, supported by multivariate logistic regression and subgroup analyses, suggest a potential causal relationship; however, further research is required to verify this relationship. This could be either a direct effect of oral hygiene on metabolic processes or an indication that tooth brushing during lunchtime is a marker of a more health-conscious lifestyle, encompassing better dietary choices and increased physical activity.

Regarding the analysis of the primary variables and covariates, the detailed findings and implications derived from our data are presented as follows: The primary variable of interest, "tooth brushing during lunchtime," was inversely associated with obesity. Participants who brushed their teeth during lunchtime had an adjusted OR of 0.90 for obesity, indicating a 10% lower odds compared with the adjusted OR of those who did not brush.

Variables		Obesity		Normal		Total
		N	(%)	N	(%)	N
Toothbrushing during lunch time						
	Always	6,764	(19.9)	27,147	(80.1)	33,911
	Mostly	4,735	(24.0)	15,033	(76.0)	19,768
	Sometimes	6,919	(25.3)	20,481	(74.7)	27,400
	No	14,643	(25.8)	42,012	(74.2)	56,655
Age						
	Middle school	11,078	(22.0)	39,366	(78.0)	50,444
	High school	21,983	(25.2)	65,307	(74.8)	87,290
Gender						
	Male	20,278	(28.5)	50,802	(71.5)	71,080
	Female	12,783	(19.2)	53,871	(80.8)	66,654
Household income						
	High	11,925	(23.3)	39,313	(76.7)	51,238
	Middle	15,887	(23.4)	52,110	(76.6)	67,997
	Low	5,249	(28.4)	13,250	(71.6)	18,499
Living companion						
	With family	31,252	(24.0)	98,914	(76.0)	130,166
	Live oneself	1,730	(24.0)	471	(76.0)	7,201
	Childcare facility	79	(21.5)	288	(78.5)	367
Perceived stress level						
	High	6,052	(24.0)	19,133	(76.0)	25,185
	Middle	13,590	(23.1)	45,195	(76.9)	58,785
	Low	13,419	(25.0)	40,345	(75.0)	53,764
Subjective health status						
	High	21,049	(22.1)	74,293	(77.9)	95,342
	Middle	8,594	(27.1)	23,076	(72.9)	31,670
	Low	3,418	(31.9)	7,304	(68.1)	10,722
Physical activity						
	High	11,057	(22.2)	38,663	(77.8)	49,720
	Middle	20,775	(25.3)	61,338	(74.7)	82,113
	Low	1,229	(20.8)	4,672	(79.2)	5,901
Sleep duration						
	Sleep deprivation	27,713	(24.1)	87,428	(75.9)	115,141
	Appropriate sleep	4,666	(23.5)	15,208	(76.5)	19,874
	Excessive sleep	682	(25.1)	2,037	(74.9)	2,719
Past medical history(asthma, atopy)						
	Yes	23,424	(23.7)	75,253	(76.3)	98,677
	No	9,637	(24.7)	29,420	(75.3)	39,057
Nutrition education						
	Yes	19,066	(24.1)	60,072	(75.9)	79,138
	No	13,995	(23.9)	44,601	(76.1)	58,596
Carbonated drinks						
	Yes	26,327	(24.2)	82,364	(75.8)	108,691
	No	6,734	(23.2)	22,309	(76.8)	29,043
Oral health status (self-reported)						
	High	15,784	(24.1)	49,689	(75.9)	65,473
	Low	17,277	(23.9)	54,984	(76.1)	72,261
Sealant history						
	Yes	25,019	(24.9)	75,358	(75.1)	100,377
	No	8,042	(21.5)	29,315	(78.5)	37,357
Corona period						
	Pre-corona	16,164	(22.6)	55,443	(77.4)	71,607
	Post-corona	16,897	(25.6)	49,230	(74.4)	66,127
Year						
	2018	7,990	(21.9)	28,444	(78.1)	36,434
Continued						

Variables	Obesity		Normal		Total
	N	(%)	N	(%)	N
2019	8,174	(23.2)	26,999	(76.8)	35,173
2020	8,020	(25.0)	24,008	(75.0)	32,028
2021	8,877	(26.0)	25,222	(74.0)	34,099

Table 1. Socioeconomic and health-related characteristics of the study participants according to obesity status.

Regarding demographic variables such as sex, age, and household income, boys and high school students exhibited higher odds of obesity. This disparity might reflect developmental and hormonal differences that influence body composition and lifestyle choices during adolescence. Furthermore, lower household income was associated with higher odds of obesity, possibly due to limited access to healthier food options and recreational activities. For health and lifestyle variables, participants with lower subjective health status and a history of asthma or atopy had increased odds of obesity, highlighting the intricate relationship between chronic health conditions and weight management. Notably, a history of dental sealant application was associated with higher odds of obesity, which may reflect broader patterns of health behavior. Regarding societal and environmental factors, we observed that respondents in the post-corona era had higher odds of obesity, indicating the impact of the pandemic on lifestyles, possibly due to reduced physical activity and altered dietary habits during lockdowns. Finally, the results of our subgroup analysis further supported the primary findings. The reduced odds of obesity among those who brushed their teeth at lunchtime were consistent across most subgroups. However, the finding was not significant among middle school students, those with low household income, those living alone, and those with low physical activity levels. This suggests that the relationship between tooth brushing and obesity might be influenced by age, socioeconomic status, and lifestyle factors.

The results of the present study are consistent with those of previous studies, which reported an association between tooth brushing and obesity. In a study in which the association between oral health behavior and obesity was confirmed based on the 2008–2010 National Health and Nutrition Examination Survey, the frequency of tooth brushing was lower in individuals with obesity[22]. In a cross-sectional study based on data from 21 public schools in Ichikawa City, Chiba, Japan, the frequency of tooth brushing daily, as a secondary factor in addition to physical activity, influenced obesity in adolescents[23]. In a cohort study of 1,619 workers in Tokyo, individuals who brushed their teeth three or more times daily had considerably lower ORs for obesity than those who brushed their teeth once or less daily[24].

Unlike previous studies, in the present study, we limited our age group to teenagers and focused on tooth brushing behaviors during adolescence, when oral health habits are developed. We also examined tooth brushing behaviors during weekday school lunchtime rather than focusing on the number of times children brushed their teeth, as in previous studies. As caregivers strongly influence health habits, such as tooth brushing during adolescence, investigating tooth brushing habits at school in the absence of caregivers, which is associated with autonomy, is imperative. Furthermore, unlike previous studies limited to a specific region, our study represented adolescents in South Korea as a whole and covered the post-corona period.

The exact mechanism underlying the relationship between tooth brushing during lunchtime and obesity remains unclear; however, based on previous studies and biological data, the following hypotheses may explain the mechanism: First, inflammation may contribute to the association between tooth brushing and obesity[25,26]. Unhealthy tooth brushing behavior can cause inflammation, increasing the concentration of inflammatory markers such as C-reactive protein and fibrinogen[27,28]. A negative correlation between fibrinogen levels and weight reduction has been reported in previous studies[29], and the relevance between C-reactive protein and an increase in the prevalence of obesity[30] may strengthen our explanation. Second, tooth brushing may reinforce the overall health-enhancing behaviors of adolescents, such as safety, sleep, diet, exercise, low sedentary behavior, and dental care[31,32], causing a significant decrease in the prevalence of obesity[33]. Furthermore, insufficient tooth brushing during lunchtime implies a lack of willingness to maintain health, possibly due to a decreased awareness of the importance of weight management. Notably, individuals with obesity often lack self-awareness regarding the importance of weight management and have distorted and unhealthy perceptions regarding their health. In a study, students who failed to maintain or manage a healthy oral condition tended to neglect weight management[34,35]. Nevertheless, further research is required to understand the reasons for these correlations.

This study has some limitations. First, this was a cross-sectional study, and only the correlation between tooth brushing and the prevalence of obesity could be determined; however, a causal relationship could not be established. Second, a risk of false responses persists in this study because the KYRBS, which forms the basis of this study, contains self-reported online data. Furthermore, our data may have consistency and reliability issues, as some variables in this study were based on the subjective judgment of adolescents. Third, in this study, only the data obtained using the KYRBS were used as independent variables; therefore, other factors that could influence obesity, such as the onset of adult disease, were not considered. Finally, we focused on the presence or absence of tooth brushing for most analyses in this study, except that shown in Fig. 2. As Fig. 2 shows a large difference even among teenagers who indicated brushing their teeth after lunch, the dichotomous interpretation can be regarded as a limitation of this study. Therefore, further research may suggest a better analysis using levels.

Despite these limitations, this study has several strengths. Although the KYRBS is limited by cross-sectional data, it provides nationally representative data, enabling us to generalize our findings to the entire adolescent

Variables	Obesity	
	Adjusted OR	95% CI
Toothbrushing during lunch time		
No	1.00	
Yes	0.90	(0.88–0.93)
Age		
Middle school	1.00	
High school	1.25	(1.21–1.29)
Gender		
Male	1.00	
Female	0.57	(0.55–0.59)
Household income		
High	1.00	
Middle	0.99	(0.96–1.02)
Low	1.20	(1.15–1.26)
Living companion		
With family	1.00	
Live oneself	0.97	(0.91–1.04)
Childcare facility	0.81	(0.61–1.09)
Perceived stress level		
High	1.00	
Middle	0.97	(0.94–1.01)
Low	1.06	(1.02–1.11)
Subjective health status		
High	1.00	
Middle	1.39	(1.34–1.43)
Low	1.73	(1.65–1.83)
Physical activity		
Middle	1.00	
High	0.90	(0.87–0.92)
Low	0.74	(0.68–0.80)
Sleep duration		
Appropriate sleep	1.00	
Sleep deprivation	0.98	(0.94–1.02)
Excessive sleep	1.05	(0.81–1.35)
Past medical history(asthma, atopy)		
Yes	1.00	
No	1.07	(1.04–1.10)
Nutrition education		
Yes	1.00	
No	1.02	(1.00–1.05)
Carbonated drinks		
Yes	1.00	
No	1.01	(0.98–1.05)
Oral health status (self-reported)		
High	1.00	
Low	0.99	(0.97–1.02)
Sealant history		
Yes	1.00	
No	0.87	(0.84–0.90)
Corona period		
Pre-corona	1.00	
Post-corona	1.16	(1.12–1.19)

Table 2. Results of the multiple logistic regression analysis for the association between lunchtime tooth brushing and obesity. The hypothesis testing for the coefficients was conducted using a chi-squared test based on the Wald statistic.

		Obesity		
		No brushing	Toothbrushing during lunch time	
		Adjusted OR	Adjusted OR	95% CI
Age				
	Middle school	1.00	0.95	(0.91–1.00)
	High school	1.00	0.88	(0.85–0.91)
Gender				
	Male	1.00	0.91	(0.87–0.94)
	Female	1.00	0.89	(0.85–0.94)
Household income				
	High	1.00	0.88	(0.84–0.93)
	Middle	1.00	0.91	(0.87–0.95)
	Low	1.00	0.95	(0.88–1.03)
Living companion				
	With family	1.00	0.91	(0.88–0.93)
	Live oneself	1.00	0.93	(0.80–1.09)
	Childcare facility	1.00	0.52	(0.29–0.94)
Perceived stress level				
	High	1.00	0.91	0.85–0.97)
	Middle	1.00	0.91	(0.87–0.95)
	Low	1.00	0.91	(0.87–0.95)
Subjective health status				
	High	1.00	0.93	(0.90–0.96)
	Middle	1.00	0.89	(0.84–0.95)
	Low	1.00	0.81	(0.74–0.90)
Physical activity				
	Middle	1.00	0.88	(0.84–0.92)
	High	1.00	0.91	(0.88–0.95)
	Low	1.00	1.00	(0.86–1.16)
Sleep duration				
	Appropriate sleep	1.00	1.10	(1.06–1.14)
	Sleep deprivation	1.00	1.14	(1.06–1.22)
	Excessive sleep	1.00	1.03	(0.61–1.74)
Past medical history(asthma, atopy)				
	Yes	1.00	0.91	(0.88–0.94)
	No	1.00	0.90	(0.85–0.95)
Nutrition education				
	Yes	1.00	0.90	(0.87–0.94)
	No	1.00	0.91	(0.87–0.95)
Carbonated drinks				
	Yes	1.00	0.90	(0.87–0.93)
	No	1.00	0.91	(0.85–0.97)
Oral health status (self-reported)				
	High	1.00	0.89	(0.86–0.93)
	Low	1.00	0.92	(0.88–0.95)
Sealant history				
	Yes	1.00	0.91	(0.88–0.94)
	No	1.00	0.89	(0.84–0.94)
Corona period				
	Pre-corona	1.00	0.89	(0.86–0.93)
	Post-corona	1.00	0.91	(0.87–0.95)

Table 3. Subgroup analysis of the association between lunchtime tooth brushing and obesity stratified by demographic variables. The hypothesis testing for the coefficients was conducted using a chi-squared test based on the Wald statistic.
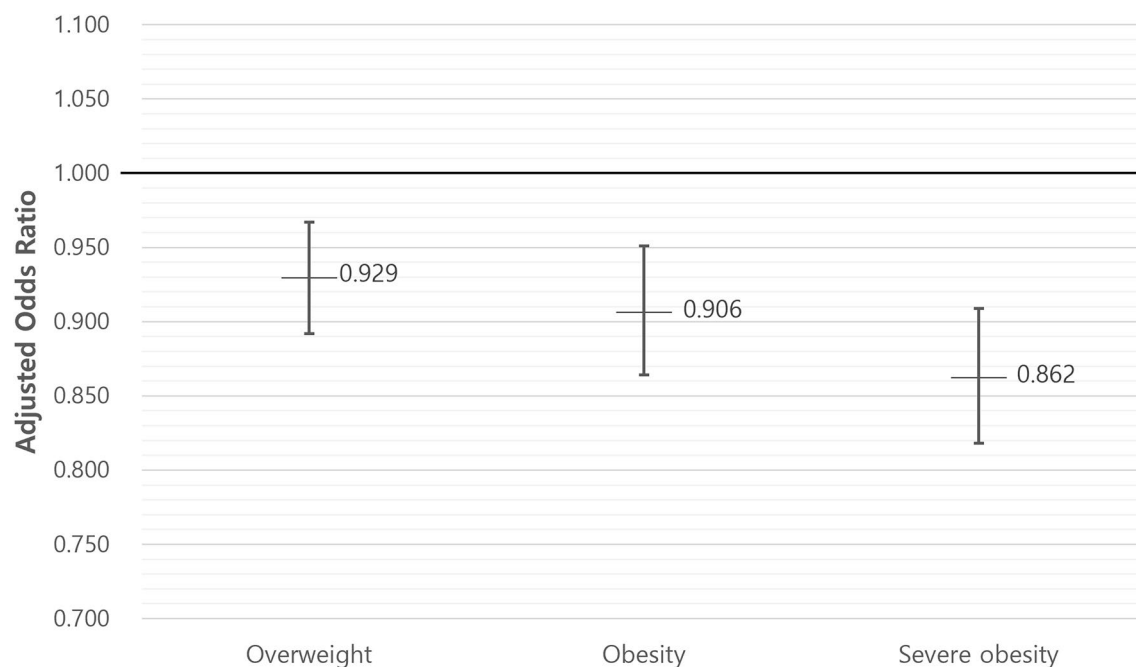
Figure 1. Results of multivariate logistic regression analysis between tooth brushing during lunchtime and obesity severity subgroups.
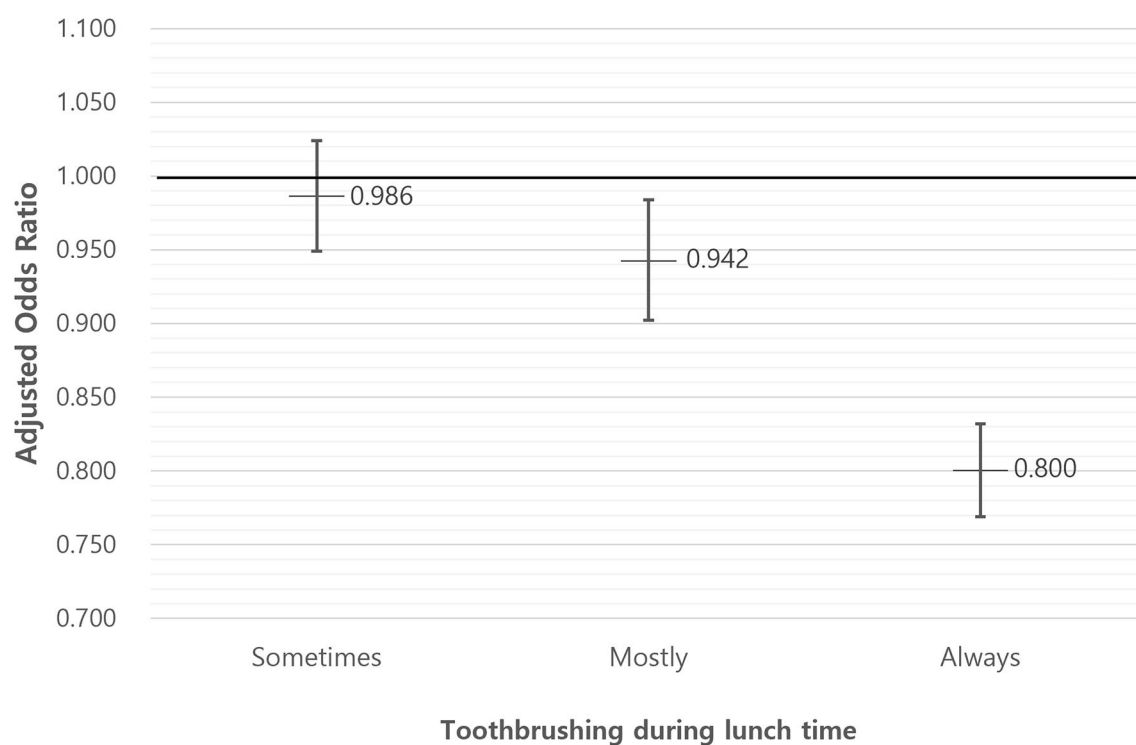

Figure 2. Results of the logistic regression analysis between subgroups regarding the frequency of tooth brushing during lunchtime weekly and obesity.

population in South Korea. Our study distinguishes itself from previous studies based on the statistical results that encompass the entire adolescent population of South Korea. Furthermore, we focused on lunchtime meals in schools in South Korea, where factors such as mealtime duration and meal amount tend to remain relatively constant compared with other settings. Notably, as tooth brushing during lunchtime is not compulsory at school, it is more directly associated with students' healthcare as a measure reflecting students' autonomy. This approach allowed us to effectively control for confounding variables, ensuring the reliability of our statistical analysis.

In conclusion, a significant negative correlation was observed between tooth brushing during lunchtime and the prevalence of obesity, particularly among the student population with the highest BMI. This correlation was consistent regardless of socioeconomic and lifestyle factors.

Data availability

Publicly available datasets, obtained from the 2018–2021 KYRBS, were analyzed in this study. All data can be found and downloaded from the KYRBS official website: https://www.kdca.go.kr/yhs/home.jsp.

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Author contributions

Y.C., H.S., and S.L. had full access to all the data in the study and take responsibility for the integrity of data and accuracy of data analysis. Concept and design: Y.C., H.S., and H.K. Acquisition, analysis, and interpretation of data: Y.C., H.S., and S.L. Drafting of the manuscript: Y.C. and H.S. Critical revision of the manuscript for important intellectual content: J.K., J.S., and H.K. Statistical analysis: H.S. and H.K. Supervision: J.K., J.S., and H.K. All authors reviewed the manuscript.

Competing interests

The authors declare no competing interests.

Additional information

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