

Research Article

Association between Hand Washing and Oral Health Status and Behaviors among Korean Adolescents: The 12th Korea Youth Risk Behavior Survey (2016)

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Abstract

Background: As basic health behaviors, hand washing and oral health behaviors affect adult health status. This study investigated the relationships between hand washing and oral health status and behaviors of Korean adolescents through a nationwide study.

Methods: This cross-sectional study utilized data from the 12th Korea Youth Risk Behavior Survey (2016). From 67,983 participants, 65,528 (96.4%) adolescents were selected as the study population.

Results: At school and home, 87.8% of adolescents did not always wash their hands with soap before meals, and 53.4% of them did not always wash their hands after using the toilet. A total of 11.7% of adolescents brushed their teeth more than three times a day. Infrequent hand washing was associated with poor subjective oral health status and oral disease symptoms. Among adolescents with infrequent hand washing, more than half maintained unhealthy oral practices, and sex, grade, academic performance, household income, parents education level, drinking status, and smoking status were associated with healthy oral health practices.

Conclusion: Health care professionals should recommend adherence to basic hygiene behavior, which might be helpful in combating the risk of infectious diseases among adolescents.

Keywords: Adolescent; Health behavior; Hand hygiene; Oral health

Introduction

Korean adolescents are at a high risk of infectious diseases as they spend most of their time at school or academy and are in contact with a large number of people [1]. In addition, frequent direct contact and persistence of contact within a limited range of activities over long periods of time may result in an early spread of infectious diseases among adolescents [2]. As optimal hygiene behaviors, hand washing and oral health behaviors are recommended as the most cost-effective way to reduce the spread of infectious diseases [3]. Hand washing with soap under running water reduces the microorganisms in the hands [4], which is effective in preventing infectious diseases such as waterborne diseases [5], respiratory diseases, and gastrointestinal diseases [6]. According to a 2014 Korean hand washing project, Korean adolescents washed their hands 5.2 times a day with hand soap, and while 92.3% recognized that hand washing helped prevent infectious diseases, they did not always wash their hands when needed [7]. The

oral cavity is inhabited by many microorganisms [8]; an unhealthy oral cavity can cause respiratory infections [9] and is associated with pain and nutritional imbalances [10]. Poor oral health status and behaviors during adolescence can increase the incidence of tooth decay, worsen adult health, and lowering adolescent quality of life [11,12]. Basic hygiene behaviors, such as hand hygiene and oral health behaviors, appear to develop together [13]. Previous studies of hygiene behaviors in adolescents found positive correlations between general hygiene behaviors such as brushing teeth, showering, and cleaning [14] and an association between frequent hand washing and good oral health behaviors [15]. These results can be explained by the prediction of health-related behavior through planned behavioral theory [16,17]. Through repetitive learning that good health can be maintained as a result of healthy behavior, general basic hygiene habits, such as hand washing and oral health behaviors, are formed during adolescence [18]. Well-formed hand washing and oral health in adolescence can have a lasting impact on health during growth and adulthood [11]. Ongoing research on the relationships between hand washing and oral health status and behaviors can help develop and realize education programs on hygiene behaviors in local communities and schools for the health promotion of Korean adolescents. Therefore, this study investigated the relationships between adolescents' hand washing and oral health status and behaviors by using data from the Korea Youth Risk Behavior Survey.

Methods

This study used raw data from the 12th Korea Youth Risk Behavior Survey conducted in 2016. The survey used a multi-stage cluster sampling design to obtain samples representing middle and high school students across the country. The sampling frame used middle and high schools' nationwide data as of April 2015. The sampling

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process was performed through population stratification, sampling allocation, and sampling steps. At the population stratification stage, 44 regions (considering city sizes of 17 provinces) and school types (middle schools, general high school, and specialty high school) were divided into 132 strata. Sample schools were allocated to match the composition ratio as 400 middle schools and 400 high schools. This was performed using the stratified cluster sampling method with school as the first extraction unit and class as the second extraction unit. All students in the sampled classes were surveyed. Among them, those with long-term absences, exceptional children, and literacy students were excluded from the sample. Participants of this survey included 67,983 students from 400 middle and 400 high schools nationwide, and a total of 65,528 students (96.4% participation rate) from 798 schools finally participated in this study.

Measurements

The 12th Korea Youth Risk Behavior Survey conducted in 2016, the raw data of which was used in this study, was conducted in Korea Centers for Disease Prevention and Control. To examine 15 areas (117 questions) such as smoking, drinking, physical activity, personal hygiene, oral health, mental health, internet addiction, and equity in health, an anonymous self-written online questionnaire survey was conducted for middle and high school students nationwide. This study used extracted questions on the following areas: oral health (subjective oral health, oral disease symptoms, frequency of brushing teeth during the day, brushing teeth after lunch at school, using oral supplements, dental screening, and oral education experience at school), personal hygiene (hand washing before meals and after using the toilet at school and home and education experience of personal hygiene at school), general characteristics, smoking (monthly smoking experience), and drinking (current drinking).

Hand washing: Always hand washing before meals referred to participants who responded “always washed” to the question “How often did you wash your hands using soap before meals at home or school in the last seven days?” The responses “mostly washed,” “sometimes washed,” or “never washed” were defined as “not always.” Always hand washing after using the toilet referred to participants who responded “always washed” to the question “How often did you wash your hands with soap after using the toilet at home or school in the last seven days?” The responses “mostly washed,” “sometimes washed,” or “never washed” were defined as “not always.” Total hand washing was determined by hand washing before meals and hand washing after using the toilet at school and home.

Oral health status and behaviors: Subjective oral health status was re-categorized from “very good or good,” “normal,” and “poor or very poor” to “good,” “normal,” and “poor” according to response to the question “What do you think about your oral health, including parts such as teeth, gums and so on?” Presence of oral disease symptoms was determined by “yes” or “no” responses to the question “Have you ever experienced symptoms of ‘tooth pain when drinking or eating cold or hot drinks or food,’ ‘tooth tingling and pain,’ ‘inner cheek tingling and pain,’ or ‘unpleasant breathing’?” When one or more of the above-mentioned symptoms were experienced, it was defined as “having oral disease symptoms,” and if not experienced, it was defined as “no experience of oral disease symptoms.” Oral health behaviors included frequency of daily brushing of teeth (<3 times a day/≥3 times a day), brushing teeth after lunch at school (always/not always), dental screening (yes/no), using oral supplements (yes/no), and experience of annual oral health education (yes/no). For

frequency of daily brushing of teeth, the answers “0–2 times” and “3–9 times or more” were categorized as “<3 times/day” and “≥3 times/day” following the question “How many times did you brush your teeth yesterday?” “Always brushing teeth after lunch at school” was defined as the answer “always” to the question “How often did you brush your teeth after lunch at school in the last 7 days?” and “not always brushing teeth after lunch” was defined as answers “mostly,” “sometimes,” or “never.” Regular dental screening referred to having scaling or sealant experience annually. “Yes” to one or more of the questions “Have you been scaled in the last 12 months?” or “Have you received a sealant in the last 12 months?” was defined as “yes” for regular dental screening, and “no” to both questions was defined as “no” for regular dental screening. Using oral supplements was defined as “yes” to using one or more of “dental floss, interdental toothbrush, toothpaste solution (oral cleaning solution), or electric toothbrush.” Experience of oral health education was defined as “yes” to the question “Have you had oral health education at your school (including class time, broadcast, auditorium, etc.) in the last 12 months?”

Covariates: General characteristics included sex (boy/girl), grade (middle/high school), academic performance (low/middle/high), household income (low/middle/high), residential area (rural/small city/metropolitan), living status (with family/with others), father's education level (≤middle school/high school/≥college), mother's education level (≤middle school/high school/≥college), current drinking (yes/no), current smoking (yes/no), and annual personal hygiene education (yes/no). For current drinking, the answer “none” to the question “How many days did you drink more than one glass alcohol in the last 30 days?” was defined as “no” and any other answer was equivalent to “yes.” For current smoking, the answer “none” to the question “How many days did you smoke in the last 30 days, even one cigarette?” was defined as “no” and other answers amounted to a “yes.” Experience of annual personal hygiene education was defined as “yes” to the question “Have you received personal hygiene education on aspects such as hand washing at school (including class time, broadcasting, auditorium, etc.) in the last 12 months?”

Statistical analysis

Study data about subjects' general characteristics, hand washing, and oral health status and behaviors were presented using frequency analysis. Chi-square test was used to analyze the differences in oral health status and behaviors based on hand washing frequency. Associations of oral health status and behaviors with hand washing frequency were analyzed using a multiple logistic regression by adjusting general characteristics with $p < .05$ in univariate analysis: sex, grade, academic performance, household income, living status, father's and mother's education level, current drinking and smoking, and hygiene education. Multiple logistic regression analysis was used to analyze factors related to oral health status and behaviors of the not-always-hand washing group. The data were analyzed using a complex sample analysis module, considering the stratification variables, cluster variables, and weights. P-values less than 0.05 were considered statistically significant. IBM SPSS Statistics for Windows, version 24 (IBM Corp., Armonk, NY, USA) was used for the analyses.

Results

The general characteristics of the participants are shown in Table 1. A total of 88.7% of adolescents answered that their hands were not always washed with soap before meals and after using the toilet while 36.1% had completed personal hygiene education. In total, 87.8% reported that they did not always wash their hands with soap

Table 1: General characteristics, hand washing, and oral health behavior and status of participants.

Characteristics		Total (N=65,528)		Boys (n=33,803, 52.2%)		Girls (n=31,725, 47.8%)		p
		n	%	n	%	n	%	
Grade								.983
	High school	33,309	54.6%	17,061	54.6%	16,248	54.6%	
	Middle school	32,219	45.4%	16,742	45.4%	15,477	45.4%	
Academic performance								<.001
	High	8,689	13.0%	5,029	14.7%	3,660	11.1%	
	Middle	50,252	76.8%	25,070	74.3%	25,182	79.6%	
	Low	6,587	10.2%	3,704	11.0%	2,883	9.3%	
Household income								<.001
	High	6,247	9.6%	3,874	11.5%	2,373	7.5%	
	Middle	57,377	87.5%	28,867	85.4%	28,510	89.8%	
	Low	1,904	2.9%	1,062	3.1%	842	2.7%	
Residential area								.975
	Metropolitan area	29,046	43.3%	14,806	43.3%	14,240	43.3%	
	Small city	31,626	50.8%	16,484	50.7%	15,142	51.0%	
	Rural area	4,856	5.8%	2,513	6.0%	2,343	5.7%	
Living status								.180
	With family	62,263	95.5%	32,044	95.2%	30,219	95.8%	
	With others	3,265	4.5%	1,759	4.8%	1,506	4.2%	
Father's education								.069
	≥College	31,977	63.4%	16,417	64.1%	15,560	62.7%	
	High school	18,153	33.9%	9,033	33.1%	9,120	34.8%	
	≤Middle school	1,457	2.6%	771	2.7%	686	2.5%	
Mother's education								<.001
	≥College	28,860	56.0%	14,833	57.7%	14,027	54.2%	
	High school	22,272	41.8%	10,625	40.1%	11,647	43.6%	
	≤Middle school	1,225	2.2%	609	2.2%	616	2.2%	
Current drinking								<.001
	No	56,099	85.0%	28,255	82.8%	27,844	87.5%	
	Yes	9,429	15.0%	5,548	17.2%	3,881	12.5%	
Current smoking								<.001
	No	61,516	93.7%	30,645	90.4%	30,871	97.3%	
	Yes	4,012	6.3%	3,158	9.6%	854	2.7%	
Hygiene education (annually)								<.001
	Yes	24,214	36.1%	13,481	38.7%	10,733	33.2%	
	No	41,314	63.9%	20,322	61.3%	20,992	66.8%	
Hand hygiene								<.001
	Total hand washing							<.001
	Always	7,468	11.3%	5,044	14.7%	2,424	7.6%	

	Not always	58,060	88.7%	28,759	85.3%	29,301	92.4%	
	Hand washing before meals							<.001
	Always	8,101	12.2%	5,470	15.9%	2,631	8.2%	
	Not always	57,427	87.8%	28,333	84.1%	29,094	91.8%	
	Hand washing after toilet							<.001
	Always	30,440	46.6%	14,877	44.0%	15,563	49.5%	
	Not always	35,088	53.4%	18,926	56.0%	16,162	50.5%	
Oral health status								
	Subjective oral health status							<.001
	Good	27,923	42.3%	15,106	44.3%	12,817	40.2%	
	Normal	26,762	41.0%	13,426	39.9%	13,336	42.2%	
	Poor	10,843	16.7%	5,271	15.8%	5,572	17.6%	
	Oral disease symptoms							<.001
	No	28,955	43.9%	16,444	48.4%	12,511	39.1%	
	Yes	36,573	56.1%	17,359	51.6%	19,214	60.9%	
Oral health behaviors								
	Frequency of daily brushing of teeth							<.001
	≥3 times/day	7,786	11.7%	3,629	10.6%	4,157	13.0%	
	<3 times/day	57,742	88.3%	30,174	89.4%	27,568	87.0%	
	Brushing teeth after lunch							<.001
	Always	16,204	24.2%	5,184	15.0%	11,020	34.2%	
	Not always	49,324	75.8%	28,619	85.0%	20,705	65.8%	
	Regular dental screening(annually)							<.001
	Yes	25,249	38.9%	11,597	34.6%	13,652	43.4%	
	No	40,279	61.1%	22,206	65.4%	18,073	56.6%	
	Using oral supplements							.681
	Yes	28,331	43.8%	14,639	43.7%	13,692	43.9%	
	No	37,197	56.2%	19,164	56.3%	18,033	56.1%	
	Oral health education(annually)							<.001
	Yes	19,004	27.6%	10,469	29.3%	8,535	25.8%	
	No	46,524	72.4%	23,334	70.7%	23,190	74.2%	

before eating at school and home, and 53.4% reported they did not always wash their hands with soap after using the toilet at school and home. Poor subjective oral health was reported by 16.7%, and 56.1% experienced oral disease symptoms. The frequency of brushing teeth <3 times/day and frequency of brushing teeth after lunch were 88.3% and 75.8%, respectively. Additionally, 38.9% of the participants had regular dental screening and 27.6% had completed oral health education. Oral health status and behaviors among the always-hand washing group compared to the not-always-hand washing group are shown in Table 2. Among the not-always-hand washing adolescents, 17.4% reported poor subjective oral health and 58.1% experienced oral disease symptoms. In addition, 89.4% of adolescents who did not always wash their hands brushed their teeth <3 times/day, and 76.1% of them did not always brush their teeth after lunch. However,

42.1% of not-always-hand washing adolescents used oral supplements and 27.1% had completed oral health education. Poor subjective oral health status (adjusted odds ratio (aOR) = 1.89, 95% Confidence Interval (CI) = 1.71–2.09, Oral Disease symptoms (aOR = 1.76, 95% CI = 1.66–1.88), brushing teeth <3 times/day (aOR = 2.13, 95% CI = 1.98–2.30), not always brushing teeth after lunch (aOR = 1.58, 95% CI = 1.47–1.70), and non-use of oral supplements (aOR = 1.70, 95% CI = 1.60–1.80) were significantly high in the not-always-hand washing group compared to the always-hand washing group. Factors associated with oral health status and behaviors among the not-always-hand washing group are shown in Table 3. Being a girl (aOR = 3.35, 95% CI = 3.03–3.71) and belonging to higher grade (aOR = 3.27, 95% CI = 2.89–3.69) were associated with always brushing teeth after lunch. High academic performance (aOR = 2.44, 95% CI = 2.15–2.76)

Table 2: Oral health status and behaviors among the not-always-hand washing group compared to always-hand washing group of participants.

Variables	Hand washing		p*
	Always	Not always	
Oral health status			
Subjective oral health status			<.001
Good	55.4%	40.7%	
Normal	33.7%	42.0%	
Poor	10.9%	17.4%	
aOR (95% CI) ^a for poor subjective oral health status	1.00	1.89 (1.71–2.09) **	
Oral disease symptoms^b			
No	59.6%	41.9%	<.001
Yes	40.4%	58.1%	
AOR (95% CI) ^a for experience of oral disease symptoms	1.00	1.76 (1.66–1.88) **	
Oral health behaviors			
Frequency of daily brushing of teeth			<.001
≥3 times	20.4%	10.6%	
<3 times	79.6%	89.4%	
AOR (95% CI) ^a for <3 times/day brushing of teeth	1.00	2.13 (1.98–2.30) **	
Brushing teeth after lunch			
Always	26.0%	23.9%	.001
Not always	74.0%	76.1%	
AOR (95% CI) ^a for not always brushing teeth after lunch	1.00	1.58 (1.47–1.70) **	
Regular dental screening			
Yes	38.0%	39.0%	.124
No	62.0%	61.0%	
AOR (95% CI) ^a for no dental check-ups	1.00	0.98 (0.92–1.04)	
Using oral supplements			
Yes	57.4%	42.1%	<.001
No	42.6%	57.9%	
AOR (95% CI) ^a for no using oral supplements	1.00	1.70 (1.60–1.80) **	
Oral health education(annually)			
Yes	31.8%	27.1%	<.001
No	68.2%	72.9%	
AOR (95% CI) ^a for no oral health education	1.00	1.03 (0.95–1.11)	

aOR: Adjusted Odds Ratio; CI: Confidence Interval.

*p value: by chi-square test **p value <.001 by multiple logistic regression

^aAdjusted for sex, grade, academic performance, household income, living status, father's education, mother's education, current drinking, current

smoking, and hygiene education

^bExperience of oral disease symptoms included one or more of toothache, gum disease, oral soft tissue disease, and bad breath.

and high household income (aOR = 4.73, 95% CI = 3.80–5.89) were associated with good subjective oral health. High household income was associated with no oral disease symptoms, brushing teeth ≥3 times/day, always brushing teeth after lunch, regular dental screening, and use of oral supplements. Parents' high level of education was associated with good subjective oral health, regular dental screening, and use of oral supplements. Current drinking and smoking were associated with good subjective oral health (aOR = 0.87, 95% CI = 0.80–0.95; aOR = 0.79, 95% CI = 0.70–0.78). Hygiene education had significantly higher OR for regular dental screening (aOR = 1.40, 95% CI = 1.35–1.46) and use of oral supplements (aOR = 1.17, 95% CI = 1.12–1.22).

Discussion

The Korean education system provides adolescents with information on how to wash their hands and maintain oral health through school health education [19]; however, the results of this study showed that approximately 90% of Korean adolescents did not wash their hands with soap when needed and frequency of brushing teeth was lower than the recommended three times a day. In addition, nearly 90% of students did not always wash hands with soap before meals at school or home, and less than 50% washed their hands after using the toilet. These results are in stark contrast to the 60.8% respondents washing hands before eating and 86.2% washing hands after using the toilet at public places according to a previous study in 2014 [7]. Washing hands with soap before eating prevents infectious diseases such as cholera and intestinal parasites [20,21], and washing hands with soap after using the toilet helps prevent diarrhea-related diseases [22]. Low frequency of brushing is associated with the development of dental caries and periodontitis [23,24]. Therefore, hand washing and brushing teeth are primary personal hygiene behaviors that should be habituated in adolescence because these behaviors are linked to adult health, and it should be more frequently emphasized by school health education programs [11]. This study revealed that only 38.9% of adolescents underwent regular dental screening. In previous studies, adolescents did not participate in regular oral health check-ups, which reported lack of awareness regarding the need for personal hygiene and socioeconomic inequalities in dental services [25–27]. In this study, regular dental screening was shown to be associated with household income and personal hygiene education among the not-always-hand washing adolescents. Adolescents with low dental screening may belong to households with poor financial status and face a lack of awareness regarding the need for oral health through health education. The results showed that not always hand washing was associated with poor subjective oral health status, experience of oral disease symptoms, low frequency of brushing teeth, and non-use of oral supplements. Among infrequently hand washing adolescents, high household income and high education level of parents were positively related to frequent brushing of teeth, regular dental screening, and use of oral supplements. The lack of financial support, low parental knowledge, and unhealthy behaviors in adolescents' families can contribute to poor oral health behaviors among adolescents [28,29]. Therefore, education programs to spread awareness regarding the importance of preventive personal hygiene and behaviors should be recommended for parents as well as adolescents. Although boys and girls had similar oral health education completion rates, girls brushed teeth, underwent regular

Table 3: Factors associated with oral health status and behaviors among the not-always-hand washing group of participants.

Characteristics	Subjective oral health status: Good		Oral disease Symptoms: No		Frequency of daily brushing of teeth: ≥3 times		Brushing teeth after lunch: always		Regular dental screening: Yes		Using oral supplements: Yes		Oral health education: Yes		
	aOR	(95% CI)	aOR	(95% CI)	aOR	(95% CI)	aOR	(95% CI)	aOR	(95% CI)	aOR	(95% CI)	aOR	(95% CI)	
Sex (/boys)															
	Girls	0.86	(0.81–0.91)**	0.70	(0.67–0.73)**	1.51	(1.40–1.63)**	3.35	(3.03–3.71)**	1.51	(1.45–1.58)**	1.08	(1.03–1.13)*	0.93	(0.86–1.00)*
Grade (/middle school)															
	High school	0.77	(0.72–0.82)**	0.90	(0.87–0.94)**	1.44	(1.33–1.56)**	3.27	(2.89–3.69)**	1.05	(1.00–1.10)	0.66	(0.63–0.70)**	0.56	(0.51–0.61)**
Academic performance (/low)															
	Middle	1.92	(1.74–2.11)**	1.09	(1.01–1.17)*	1.19	(1.05–1.35)*	1.28	(1.16–1.42)**	1.17	(1.09–1.25)**	1.06	(0.99–1.13)	1.19	(1.07–1.31)*
	High	2.44	(2.15–2.76)**	0.96	(0.87–1.05)	1.41	(1.22–1.62)**	1.58	(1.40–1.79)**	1.33	(1.22–1.45)**	0.93	(0.85–1.01)	1.32	(1.18–1.48)**
Household income (/low)															
	Middle	2.30	(1.90–2.78)**	1.49	(1.29–1.73)**	0.91	(0.74–1.13)	1.20	(1.00–1.44)*	1.02	(0.88–1.19)	1.17	(1.00–1.36)*	1.09	(0.89–1.34)
	High	4.73	(3.80–5.89)**	2.04	(1.74–2.39)**	1.33	(1.06–1.67)*	1.31	(1.07–1.61)*	1.19	(1.01–1.40)*	1.62	(1.38–1.89)**	1.09	(0.87–1.36)
Residential area (/rural area)															
	Small city	1.04	(0.88–1.24)	0.98	(0.91–1.07)	0.82	(0.68–0.99)*	0.59	(0.46–0.75)**	1.02	(0.91–1.15)	1.24	(1.10–1.40)**	0.50	(0.41–0.61)**
	Metropolitan area	1.12	(0.94–1.33)	0.97	(0.89–1.05)	0.68	(0.57–0.82)**	0.37	(0.29–0.47)**	1.10	(0.98–1.23)	1.29	(1.15–1.45)**	0.50	(0.42–0.61)**
Living status (/with others)															
	With family	1.00	(0.87–1.15)	1.15	(1.05–1.27)*	0.65	(0.58–0.73)**	0.78	(0.69–0.89)**	0.95	(0.86–1.05)	1.13	(1.02–1.24)*	0.86	(0.72–1.02)
Father's education (/≤Middle school)															
	High school	1.25	(1.02–1.53)*	1.17	(1.03–1.33)*	1.01	(0.81–1.27)	1.03	(0.87–1.20)	1.16	(1.00–1.34)	1.14	(1.00–1.31)	1.01	(0.86–1.20)
	≥College	1.52	(1.24–1.86)**	1.14	(1.00–1.31)*	1.15	(0.92–1.44)	1.02	(0.86–1.20)	1.26	(1.09–1.45)*	1.40	(1.22–1.61)**	1.06	(0.90–1.24)
Mother's education (/≤Middle school)															
	High school	1.44	(1.19–1.75)**	1.13	(0.97–1.30)	1.04	(0.83–1.31)	1.14	(0.96–1.34)	1.10	(0.95–1.28)	1.16	(1.00–1.35)*	0.79	(0.66–0.95)*
	≥College	1.54	(1.27–1.88)**	1.10	(0.95–1.28)	1.12	(0.89–1.42)	1.11	(0.94–1.32)	1.33	(1.14–1.55)**	1.27	(1.09–1.49)*	0.7	(0.64–0.94)*
Current drinking (/no)															
	Yes	0.87	(0.80–0.95)*	0.83	(0.78–0.88)**	1.03	(0.93–1.14)	0.97	(0.90–1.05)	1.14	(1.08–1.21)**	1.14	(1.07–1.21)**	0.99	(0.91–1.08)
Current smoking (/no)															
	Yes	0.79	(0.70–0.78)**	0.92	(0.84–1.02)	1.13	(0.98–1.31)	0.74	(0.65–0.85)**	0.94	(0.86–1.03)	1.05	(0.96–1.15)	1.08	(0.95–1.21)
Hygiene education (/no)															
	Yes	1.09	(1.03–1.16)*	0.96	(0.92–1.00)	0.94	(0.89–1.00)	0.91	(0.86–0.96)*	1.40	(1.35–1.46)**	1.17	(1.12–1.22)**	13.07	(12.29–13.89)**

aOR: Adjusted Odds Ratio; CI: Confidence Interval.

*p value<.05 **p value <.001

dental screening, and used oral supplements more frequently than boys. In previous studies, the rate of oral health-related behaviors was higher among girls than boys [14,30,31]. Awareness regarding the importance of oral health and positive attitude toward oral health

have been shown to have a positive effect on the performance of oral health behaviors by girls [30]; this may be because motivation from fear or aversion to infection can lead to personal hygiene-related self-management [13]. High school adolescents had more frequency of

brushing teeth daily and after lunch than middle school adolescents. In addition, good academic performance was associated with good subjective oral health and frequent brushing of teeth. These results are consistent with previous results that brushing of teeth was more frequent in high school students than middle school students [32] or in higher grade [33]. As learning opportunities about health behaviors increase, the perceived importance of personal hygiene habits increases, and a higher knowledge of health habits can lead to health behavior practices [34]. Although education on adolescent health care has been regularly imparted at school or in the community, the reality is that this has a short-term effect on improving oral health knowledge and attitudes, and the effect on preventing oral disease is insufficient in the long term [35-37]. This reduced effectiveness may be due to the provision of a comprehensive health education program that ignores individual characteristics of adolescents [35,36]. Therefore, it is suggested that development and application of customized school education programs considering gender, individual level of perception and knowledge of health habits, and socio-economic level can be helpful for the oral health of adolescents. Alcohol drinking and smoking status in adolescents who did not always wash their hands were inversely related to good subjective oral health status and no oral disease symptoms. Drinking alcohol and smoking are well known risk factors for the development of oral disease in adolescents [38], and these health risk behaviors are correlated with personal hygiene [39-41]. Therefore, drinking alcohol and smoking are modifiable risk factors for adolescents' personal hygiene and oral health; adolescents should be aware of the dangers of these behaviors and be encouraged to choose lifestyles that are beneficial to oral health. This study has some limitations. First, hand washing and oral health status and behavior measurements were collected by self-report. Social desirability prejudice may have influenced adolescents to report excessive health behaviors. Second, the education method for personal hygiene and oral health was not controlled. Educational programs can be influenced by adolescents' health behavior as there are several variables involved such as time, place, instructor, and medium (e.g., online). Third, hand washing and oral health status was not confirmed through a reliable assessment by a health teacher or dentist. Despite these limitations, this study has several advantages. This study used government-approved statistical data for a nationwide survey of adolescent population in Korea, which is meaningful in that it simultaneously investigated hand washing behavior and oral health status and behaviors. Another considerable advantage is that these results can be generalized to Korean adolescents.

Conclusions

Korean adolescents generally did not wash their hands when needed and had poor oral health behaviors. In addition, infrequent hand washing was associated with poor oral health status and behaviors. Adolescents should be educated about the association between hand hygiene practices and oral health and disease, and be made aware of preventive health behaviors. Health care professionals should recommend adherence to basic hygiene behavior, which might be helpful in combating the high risk of infectious diseases.

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References

1. Epidemiological investigation of infectious diseases in Korea annual report 2017. In: Control KCFD, editor. Korean Centers for Disease Control: Korean Centers for Disease Control. 2018.
2. Mossong J, Hens N, Jit M, Beutels P, Auranen K, Mikolajczyk R, et al. Social contacts and mixing patterns relevant to the spread of infectious diseases. *PLoS Med*. 2008;5(3):e74.
3. Luangsanatip N, Hongsuwan M, Lubell Y, Limmathurotsakul D, Srisamang P, Day NPJ, et al. Cost-effectiveness of interventions to improve hand hygiene in healthcare workers in middle-income hospital settings: a model-based analysis. *J Hosp Infect*. 2018;100(2):165-75.
4. Jain S, Clezy K, McLaws ML. Safe removal of gloves from contact precautions: The role of hand hygiene. *Am J Infect Control*. 2018;46(7):764-7.
5. Hashi A, Kumie A, Gasana J. Hand washing with soap and WASH educational intervention reduces under-five childhood diarrhoea incidence in Jijiga District, Eastern Ethiopia: A community-based cluster randomized controlled trial. *Prev Med Rep*. 2017;6:361-8.
6. Azor-Martínez E, Gonzalez-Jimenez Y, Seijas-Vazquez ML, Cobos-Carrascosa E, Santisteban-Martínez J, Martínez-López JM, et al. The impact of common infections on school absenteeism during an academic year. *Am J Infect Control*. 2014;42(6):632-7.
7. Moo Sik L, Su Jin H, Young Taek K. Handwashing with soap and national handwashing projects in Korea : focus on the National Handwashing Survey, 2006-2014. *Epidemiol Health*. 2015;37:1-9.
8. Marsh PD. Dental plaque as a biofilm and a microbial community--implications for health and disease. *BMC Oral health*. 2006.
9. Zhou Y, Jiang S, Li KY, Lo ECM, Gao X. Association between oral health and upper respiratory tract infection among children. *Int Dent J*. 2018;68(2):122-8.
10. Petersen PE. World Health Organization global policy for improvement of oral health--World Health Assembly 2007. *Int Dent J*. 2008;58(3):115-21.
11. Zaborskis A, Milciuviene S, Narbutaite J, Bendoraitiene E, Kavaliauskiene A. Caries experience and oral health behaviour among 11 -13-year-olds: an ecological study of data from 27 European countries, Israel, Canada and USA. *Community Dent Health*. 2010;27(2):102-8.
12. Petersen PE, Bourgeois D, Ogawa H, Estupinan-Day S, Ndiaye C. The global burden of oral diseases and risks to oral health. *Bull World Health Organ*. 2005;83(9):661-9.
13. Curtis VA. Dirt, disgust and disease: a natural history of hygiene. *J Epidemiol Community Health*. 2007;61(8):660-4.
14. Dorri M, Sheiham A, Watt RG. Relationship between general hygiene behaviours and oral hygiene behaviours in Iranian adolescents. *Eur J Oral Sci*. 2009;117(4):407-12.
15. McKittrick TR, Jacobsen KH. Oral hygiene and handwashing practices among middle school students in 15 Latin American and Caribbean countries. *West Indian Med J*. 2015;64(3):2668.
16. McEachan RRC, Conner M, Taylor NJ, Lawton RJ. Prospective prediction of health-related behaviours with the Theory of Planned Behaviour: a meta-analysis. *Health Psychol Rev*. 2011;5(2):97-144.
17. Curtis VA, Danquah LO, Aunger RV. Planned, motivated and habitual hygiene behaviour: an eleven country review. *Health Educ Res*. 2009;24(4):655-73.
18. Aunger R. Tooth brushing as routine behaviour. *Int Dent J*. 2007;57(5S):364-76.
19. Lee GY. The relationship between school health education experience and health risk behaviors in adolescents: Results of the 2013 Korea Youth Risk Behavior Web-based Survey. *J Korean Public Health Nurs*. 2015;29(2):257-71.
20. Hutin Y, Luby S, Paquet C. A large cholera outbreak in Kano city, Nigeria: the importance of hand washing with soap and the danger of street-vended water. *J Water Health*. 2003;1(1):45-52.

21. Ayalew A, Debebe T, Worku A. Prevalence and risk factors of intestinal parasites among Delgi school children, North Gondar, Ethiopia. *Parasit Vectors*. 2011;3(5):75-81.
22. Luby SP, Agboatwalla M, Painter J, Altaf A, Billhimer WL, Hoekstra RM. Effect of intensive handwashing promotion on childhood diarrhea in high-risk communities in Pakistan: a randomized controlled trial. *JAMA*. 2004;291(21):2547-54.
23. Han K, Park JB. Association between oral health behavior and periodontal disease among Korean adults: The Korea national health and nutrition examination survey. *Medicine (Baltimore)*. 2017;96(7):e6176-e.
24. Zimmermann H, Zimmermann N, Hagenfeld D, Veile A, Kim TS, Becher H. Is frequency of tooth brushing a risk factor for periodontitis? A systematic review and meta-analysis. *Community Dent Oral Epidemiol*. 2015;43(2):116-27.
25. Zhu L, Petersen PE, Wang HY, Bian JY, Zhang BX. Oral health knowledge, attitudes and behaviour of children and adolescents in China. *Int Dent J*. 2003;53(5):289-98.
26. Polk D, Polk D, Weyant R, Manz MC. Socioeconomic factors in adolescents' oral health: are they mediated by oral hygiene behaviors or preventive interventions? *Community Dent Oral Epidemiol*. 2010;38(1):1-9.
27. da Fonseca EP, Frias AC, Mialhe FL, Pereira AC, Meneghim MC. Factors associated with last dental visit or not to visit the dentist by Brazilian adolescents: A population-based study. *PloS One*. 2017;12(8):e0183310.
28. Maes L, Vereecken C, Vanobbergen J, Honkala S. Tooth brushing and social characteristics of families in 32 countries. *Int Dent J*. 2006;56(3):159-67.
29. Bombert F, Manso AC, Sousa Ferreira C, Nogueira P, Nunes C. Sociodemographic factors associated with oral health in 12-year-old adolescents: hygiene behaviours and health appointments. A cross-sectional national study in Portugal. *Int Dent J*. 2018;68(5):327-35.
30. Ericsson JS, Östberg AL, Wennström JL, Abrahamsson KH. Oral health-related perceptions, attitudes, and behavior in relation to oral hygiene conditions in an adolescent population. *Eur J Oral Sci*. 2012;120(4):335-41.
31. Kim JA, Choi HM, Seo YH, Kang DR. Relations among obesity, family socioeconomic status, oral health behaviors, and dental caries in adolescents: the 2010–2012 Korea National Health and Nutrition Examination Survey. *BMC Oral Health*. 2018;18(1):114.
32. Kim HY, Kim YS, Hwang JM, Park YD. Oral health behaviours according to demographic characteristics in Korean adolescents: a national representative sample. *Int Dent J*. 2011;61(3):168-73.
33. Pengpid S, Peltzer K. Hygiene behaviour and associated factors among in-school adolescents in nine African countries. *Int J Behav Med*. 2011;18(2):150-9.
34. Tolvanen M, Lahti S, Miettunen J, Hausen H. Relationship between oral health-related knowledge, attitudes and behavior among 15–16 year-old adolescents—A structural equation modeling approach. *Acta Odontol Scand*. 2012;70(2):169-76.
35. Östberg AL. Adolescents' views of oral health education. A qualitative study. *Acta Odontol Scand*. 2005;63(5):300-7.
36. Watt R, Fuller S, Harnett R, Treasure E, Stillman-Lowe C. Oral health promotion evaluation—time for development. *Community Dent Oral Epidemiol*. 2001;29(3):161-6.
37. Ghaffari M, Rakhshanderou S, Ramezankhani A, Noroozi M, Armoon B. Oral health education and promotion programmes: Meta-analysis of 17-year intervention. *Int J Dent Hyg*. 2017(00):1-9.
38. Sheiham A, Watt RG. The common risk factor approach: a rational basis for promoting oral health. *Community Dent Oral Epidemiol*. 2000;28(6):399-406.
39. Jessor R. Risk behavior in adolescence: a psychosocial framework for understanding and action. *J Adolesc Health*. 1991;12(8):597-605.
40. Tada A, Matsukubo T. Relationship between oral health behaviors and general health behaviors in a Japanese adult population. *J Public Health Dent*. 2003;63(4):250-4.
41. Peltzer K, Pengpid S. Oral and hand hygiene behaviour and risk factors among in-school adolescents in four Southeast Asian countries. *Int J Environ Res Public Health*. 2014;11(3):2780-92.