

## The Oral Health Status and Behavior of Middle School Students According to Fluoridation Area

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### **Abstract**

*This study is aimed at comparing the oral health status of middle students who lives in water fluoridation areas and those that do not in Ulju . Out of the total of 627 research subjects, 234 are from water fluoridation areas, 444 are from non-fluoridation areas, 348 are male, and 330 are female. The examination of the oral status according to fluoridation revealed 0.16 dental caries for fluoridation areas and 0.09 for non-fluoridation areas. 63.8% from fluoridation areas said that food got caught between their teeth, whereas 63.8% from non-fluoridation areas responded likewise ( $p=0.026$ ). 32.5% from fluoridation areas responded that their teeth hurt when they ate cold or hot food, while 67.5% ( $p=0.026$ ) from non-fluoridation areas responded in the same way. The study proves that the fluoridation project expects a great effect for the prevention of dental caries with a relatively small cost, making it necessary to actively educate citizens on the prevention, effect, and safety of the fluoridation projects toward dental caries.*

**Keywords:** dental caries, fluoride, water fluoridation

### **1. Introduction**

The adolescent period is a transitional period between childhood and adulthood, in which, much physical and psychological change takes place. However, adolescents in Korea tends to neglect the importance of oral health due to the burden of studying [1,2]. Oral health knowledge and attitude as well as the ability to practice it is formed during the middle school period, and this becomes the basis for oral health management for a person's entire life [3]. The prevention of dental caries through correct tooth brushing, fluoride use, dental sealing, dietary control, and periodical oral examinations must be implemented to manage oral health. The water fluoridation adjustment project alone has a 50~60% effect of preventing caries, while fluoride supplement taking, fluoride application by experts, and fluoride mouth washing can bring about the prevention of caries through continuous effort. A study targeting elementary school students proved that students living in water fluoridation adjustment areas had a six times lower rate of dental caries than the students that did not live in those areas [4]. Various kinds of oral health education and prevention project are more important for maintaining and increasing oral health during adolescence than emphasizing treatment [5]. In reference to preceding research, it is predicted that the existence of a water fluoridation project will differentiate the oral health status during adolescence. Therefore, this study aims at comparing the oral health status of middle students who lived in water fluoridation areas and those that do not in Ulju .

## 2. Subjects and Method

### 2.1. Study Population

Between December 1st and 12th, 2012, thirteen middle schools located in Ulju county in Ulsan were selected as the research school subjects. The numbers of examined subjects were 234 students from eight schools in water fluoridation areas and 444 students from eight non-fluoridation areas, with the total of 678 students undergoing oral examinations and surveys.

### 2.2. Clinical Variables

The examiners were two dentists and three public health doctors who received oral examination training in the national health survey. They conducted oral examinations based on the oral examination method recommended by the World Health Organization.

### 2.3. Statistical Analysis

Statistical analyses were performed using SPSS version 20.0 software. Statistical significance was set at  $p < 0.05$ .

## 3. Results

### 3.1. General Characteristics

Out of the 13 schools, the occurrence of dental caries was 0.41 for Chungryang middle school, a fluoridation area and 0.12 for Beomseo middle school, a non-fluoridation area. The occurrence of fillings was 2.72 for Goo-young middle school, and the number of teeth experiencing caries was highest at Gooyoung middle school with 2.74 (Table 1)(Table 2).

**Table 1. Oral Health Status of Subjects**

		N	D	M	F
Fluoridation area	Ungchon	18	0.11±0.32	.	1.78±2.26
	Chungryang	17	0.41±1.00	.	1.29±1.69
	Onsan	77	0.18±0.72	.	1.39±2.31
	Namchang	110	0.13±0.47	0.02±0.13	1.65±1.58
	SeoSang	12	.	.	1.00±1.60
Non-fluoridation area	Sangbok	33	0.02±0.65	.	2.24±2.32.
	SamNam	32	0.03±0.18	0	1.47±1.90
	Chensang	100	0.09±0.35	0.01±0.10	1.63±2.48
	Beomseo	65	0.11±0.36	0.12±0.70	2.37±2.85
	Gooyoung	78	0.03±0.16	.	2.72±3.13
	Shinen	51	0.04±0.28	0.06±0.31	1.08±1.55
	Enyang	77	0.18±0.51	0.06±0.34	0.61±2.24
	Dokawng	8	.	.	1.00±1.51

**Table 2. DMFT index of subjects**

	N	DMFT
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Fluoridation area	Ungchon	18	1.89±2.22
	Chungryang	17	1.71±1.99
	Onsan	77	1.57±2.46
	Namchang	110	1.80±1.62
	SeoSang	12	1.00±1.60
Non-fluoridation area	Sangbok	33	2.46±2.33
	SamNam	32	1.50±1.90
	Chensang	100	1.73±2.47
	Beomseo	65	2.60±2.98
	Gooyoung	78	2.74±3.12
	Shinen	51	1.18±1.66
	Enyang	77	1.86±2.40
	Dokawng	8	1.00±1.51

### 3.2. Oral Health Status According to Fluoridation Area

The examination of the oral status according to fluoridation revealed 0.16 dental caries for fluoridation areas and 0.09 for non-fluoridation areas( $p=0.140$ ), while teeth loss was 0.01 in fluoridation areas, and 0.04 in non-fluoridation areas( $p=0.072$ ). Fillings were 1.52 in fluoridation areas, and 1.89 in non-fluoridation areas, displaying a statistically significant difference ( $p=0.033$ ), whereas the number of teeth experiencing caries were 1.68 in fluoridation areas, and 2.02 in non-fluoridation areas( $p=0.062$ )(Table 3).

Oral status according to gender revealed 0.11 dental caries for male students and 0.13 for female students( $p=0.557$ ), while tooth loss was 0.01 for male students and 0.04 for female students( $p=0.176$ ). Fillings were 1.48 for male students and 2.05 for female students( $p=0.001$ ), while the number of teeth experiencing caries were 1.60 for male students, and 2.22 for female students( $p=0.001$ )(Table 4).

**Table 3. Oral Health Status According to Fluoridation Area**

	Water fluoridated area (n=234)	Water non-fluoridated area (n=444)	p-value
D	0.16±0.60	0.09±0.37	0.140
M	0.01±0.09	0.04±0.32	0.072
F	1.52±1.91	1.89±2.52	0.033
DMFT	1.68±2.00	2.02±2.57	0.062

**Table 4. Oral Health Status According to Gender**

	Boys (n=348)	Girls (n=338)	p-value
D	0.11±0.48	0.13±0.44	0.557
M	0.01±0.22	0.04±0.31	0.176
F	1.48±2.33	2.05±2.30	0.001
DMFT	1.60±2.38	2.22±2.37	0.001

### 3.3. Oral Symptoms According to Fluoridation Area and Gender

On the question regarding oral symptoms in the past month, 36.1% of subjects from the fluoridation area responded that there was pain, while those responding yes was 63.9% in non-fluoridation areas( $p=0.324$ ). 33.3% from fluoridation areas responded that they suffered from canker sores, while 66.7% responded likewise in non-fluoridation areas( $p=0.402$ ). 37.1% from fluoridation areas responded yes to bad breath, while it was 62.9% in non-fluoridation areas( $p=0.069$ ). 63.8% from fluoridation areas said that food got caught between their teeth, whereas 63.8% from non-fluoridation areas responded likewise( $p=0.026$ ). 32.5% from fluoridation areas responded that their teeth hurt when they ate cold or hot food, while 67.5% ( $p=0.026$ ) from non-fluoridation areas responded in the same way. 38.5% from fluoridation areas said that they worried what other people thought about their oral status, while 61.5% ( $p=0.100$ ) responded likewise in non-fluoridation areas. 34.4% from the fluoridation areas perceived that their oral status was worse than other people, while the same was for 65.6% ( $p=0.514$ ) from non-fluoridation areas. 44.8% from fluoridation areas responded that they had asked other people about their oral status, while it was 55.2% ( $p=0.022$ ) for non-fluoridation area subjects. 26.3% of subjects from fluoridation areas responded that they had been absent from school to go to the dentist, while the same was the case for 73.7% from the non-fluoridation areas( $p=0.309$ )(Table 5)(Table 6).

**Table 5. Oral Symptoms According to Fluoridation Area**

	Water fluoridated area (n=234)	Water non-fluoridated area (n=444)	p-value
Pain			
Yes	70(36.1)	124(63.9)	0.324
No	164(33.9)	320(66.1)	
Canker sores			
Yes	51(33.3)	102(66.7)	0.402
No	183(34.9)	342(65.1)	
Bad breath			
Yes	137(37.1)	232(62.9)	0.069
No	97(31.4)	323(68.6)	
Food got caught between their teeth			
Yes	180(63.8)	309(63.2)	0.026
No	54(28.6)	135(71.4)	
Teeth hurt when they ate cold or hot food			
Yes	83(32.5)	172(67.5)	0.026
No	151(35.7)	272(64.3)	
Worried what other people thought about their oral status			
Yes	75(38.5)	120(61.5)	0.100
No	159(32.9)	324(67.1)	
Oral status was worse than other people			
Yes	77(34.4)	147(65.6)	0.514
No	157(34.6)	297(65.4)	
Asked other people about their oral status			
Yes	39(44.8)	48(55.2)	0.022
No	195(33.0)	396(67.0)	
Absent from school to go to the dentist			
Yes	5(26.3)	14(73.7)	0.309
No	229(34.7)	430(65.3)	

### 3.4. Oral Hygiene Behaviors According to Fluoridation Area and Gender

Regarding the question on oral hygiene behavior, 37.1% of fluoridation area respondents said that they brush their teeth before breakfast, while the same was for

62.9% in non-fluoridation areas( $p=0.262$ ). 32.5% from fluoridation areas responded that they brush their teeth after breakfast, while the same was for 67.5% from the non-fluoridation areas ( $p=0.042$ ). 40.7% from the fluoridation areas said that they brush after lunch, while 59.3% from non-fluoridation areas responded likewise, displaying a statistically significant difference( $p=0.018$ ). 33.9% of respondents from fluoridation areas said they brushed their teeth before sleeping, while the same was for 66.1% from non-fluoridation areas( $p=0.365$ ). 41.0% of respondents from fluoridation areas said they brushed their teeth after snack, while the same was the case for 59.0% from non-fluoridation areas( $p=0.116$ )(Table 7)(Table 8).

**Table 6. Oral Symptoms According to Gender**

	Boys (n=348)	Girls (n=338)	p-value
Pain			
Yes	92(47.4)	102(52.6)	0.115
No	256(52.9)	228(47.1)	
Canker sores			
Yes	70(45.8)	83(52.2)	0.070
No	278(53.0)	247(47.0)	
Bad breath			
Yes	195(52.8)	174(47.2)	0.216
No	153(49.5)	156(50.5)	
Food got caught between their teeth			
Yes	255(52.1)	234(47.9)	0.274
No	93(49.2)	96(50.8)	
Teeth hurt when they ate cold or hot food			
Yes	135(52.9)	120(47.1)	0.283
No	213(50.4)	210(49.6)	
Worried what other people thought about their oral status			
Yes	92(47.2)	103(52.8)	0.099
No	256(53.0)	227(47.0)	
Oral status was worse than other people			
Yes	117(52.2)	107(47.8)	0.402
No	231(50.9)	223(49.1)	
Asked other people about their oral status			
Yes	42(48.3)	45(51.7)	0.310
No	306(51.8)	285(48.2)	
Absent from school to go to the dentist			
Yes	10(52.6)	9(47.4)	0.547
No	338(51.3)	321(48.7)	

**Table 7. Oral Hygiene Behaviors According to Fluoridation Area**

	Water fluoridated area (n=234)	Water non-fluoridated area (n=444)	p-value
Before breakfast			
Yes	52(37.1)	88(62.9)	0.262
No	182(33.8)	356(66.2)	
After breakfast			
Yes	163(32.5)	338(67.5)	0.042
No	71(40.1)	106(59.9)	
After lunch			
Yes	81(40.7)	118(59.3)	0.018
No	153(31.9)	326(68.1)	
After dinner			

Yes	130(34.1)	251(65.9)	0.435
No	104(35.0)	193(65.0)	
<b>Before sleeping</b>			
Yes	141(33.9)	275(66.1)	0.365
No	93(35.5)	169(64.5)	
<b>After snack</b>			
Yes	34(41.0)	49(59.0)	0.116
No	200(33.6)	395(66.4)	
<b>Frequency snack (week)</b>			
More than once a day	34(33.0)	69(67.0)	0.871
2-5 days	126(35.4)	230(64.6)	
6-7 days	74(33.80)	145(66.2)	
<b>Carbonated soft drink(week)</b>			
More than once a day	16(35.6)	29(64.4)	0.350
2-5 days	114(37.3)	192(62.7)	
6-7 days	104(31.8)	223(68.2)	
<b>Fruit(week)</b>			
More than once a day	81(30.5)	185(69.5)	0.202
2-5 days	115(37.1)	195(62.9)	
6-7 days	38(37.3)	64(62.7)	

**Table 8. Oral Hygiene Behaviors According to Gender**

	Boys (n=348)	Girls (n=338)	p-value
<b>Before breakfast</b>			
Yes	66(47.1)	74(52.9)	0.155
No	282(52.4)	256(47.6)	
<b>After breakfast</b>			
Yes	246(49.1)	255(50.9)	0.031
No	102(57.6)	75(42.4)	
<b>After lunch</b>			
Yes	66(33.2)	133(66.8)	0.001
No	282(58.9)	197(41.1)	
<b>After dinner</b>			
Yes	181(47.5)	200(52.5)	0.015
No	167(56.2)	130(43.8)	
<b>Before sleeping</b>			
Yes	210(50.5)	206(49.5)	0.317
No	138(52.7)	124(47.3)	
<b>After snack</b>			
Yes	50(60.2)	33(39.8)	0.053
No	298(50.1)	297(49.9)	
<b>Frequency snack (week)</b>			
More than once a day	37(35.9)	94(42.9)	0.002
2-5 days	186(52.2)	170(47.8)	
6-7 days	125(57.1)	66(64.1)	
<b>Carbonated soft drink(week)</b>			
More than once a day	21(46.7)	24(53.3)	0.774
2-5 days	160(52.3)	146(47.7)	
6-7 days	167(51.1)	160(48.9)	
<b>Fruit(week)</b>			
More than once a day	125(47.0)	141(53.0)	0.133
2-5 days	164(52.9)	146(47.1)	
6-7 days	59(57.8)	43(42.2)	

#### 4. Discussion

Water fluoridation projects have long been verified for its effect, safety, and economic feasibility in several advanced nations. The addition of a faint amount of fluoride has no side effects for the human body and does not affect the environment[6-8]. To the extent of choosing cavity prevention projects by means of water fluoridation as one of the 10 greatest accomplishments in the field of public health in the 20<sup>th</sup> century, water fluoridation has experienced excellent effect for preventing caries[9- 12]. The comparison of the number of teeth experiencing caries according to fluoridation area has revealed 1.68 for fluoridation areas, and 2.02 for non-fluoridation areas, which coincides with preceding research[13-14]. The number of teeth experiencing caries according to gender was 1.60 for male students, and 2.22 for female students, which shows a significantly higher number for females than males. This is due to the fact that generally females erupt their permanent teeth earlier than males, and therefore, the time exposed to an environment conducive to caries is longer for females than males.

Recently it has been revealed that fluoride application as well as intake was excellent for the prevention of dental caries, and therefore, it is actively recommended to prevent caries in adults and the elderly [12, 15, 16]. The study proves that the fluoridation project expects a great effect for the prevention of dental caries with a relatively small cost, making it necessary to actively educate citizens on the prevention, effect, and safety of the fluoridation projects toward dental caries.

#### References

- [1] SH. Hong, "A Research on Recognition of Oral Health Based on Oral Health Education for Adolescents in Some Reformatories", *Journal of Dental Hygiene Science*. vol. 7, no.3, (2007), pp. 187-191.
- [2] S.H. Kim, "A Survey of the Health Risk Behaviors of Some High School Students in Taegu", *The Koreanpublic health association*, vol. 26, no 1, (2000), pp. 38-45.
- [3] J.B. Kim, "Pubic Health Dentistry", *Komoonsa Medicacal Science*, (2009), pp. 429-441.
- [4] K.W. Jang, "Oral Health Education", *Komoonsa Medicacal Science*, (2010), pp. 184-185.
- [5] American Dental Association, *Fluoridation facts*. Chicago:American Dental Association, (2005), pp. 22-39.
- [6] D.B. Ast, B. Fitzgerald, "Effectiveness of water fluoridation". *J Am Dent Assoc*, vol. 65, (1962), pp. 581-7.
- [7] Department of Health and Human Services Public HealthService, "Review of fluoride benefits and risks. Report of the AD HOC sub committee on fluoride of the committee and related programs public health service", <http://health.gov/environment/ReviewofFluoride/>.
- [8] Centers for Disease Control and Prevention, "Ten great public health achievements-United States", 1900-1999'. *Morb Morta l Wkly Rep* 1999, vol. 48, (1999), pp. 241-3.
- [9] I.J. Chin, D.H. Kim, S.M. Lee, S.W. Lee, K.H. Bae, J.B. Kim, "Caries preventive effect on primary teeth by community water fluoridation program in metropolitan city", *J Korean Acad Dent Health*, (2007), vol. 31, pp. 224-34. <http://dx.doi.org/10.11149/jkaoh.2012.36.4.289>.
- [10] H.J. Shin, D.K. Yang, Han DH, Lee SM, Bae KH, Kim JB. "The effect of 5-year community water fluoridation program on dental caries prevention of permanent teeth in the western area of Jeju, Korea", *Journal of Korean Acad Dent Health*, vol. 32, (2008), pp. 504-16.
- [11] B. Burt, S. Eklund, "Dentistry, dental practice, and the community. 4th ed. Philadelphia: WB Saunders", (1992), pp. 150-151.
- [12] M.J. Kim, "Evaluation of community water fluoridation program on dental caries prevention in Ulsan". *JKSDH*, vol. 15, no. 2, (2015), pp. 271-278.
- [13] B.J. Kim, "A comparison of dental caries status in cities with or without fluoridation", *Journal of Korean Acad Dent Health*, vol. 34, no. 2, (2010), pp. 198-205.
- [14] H.J. Shin, "The effect of 5-year community water fluoridation program on dental caries prevention of permanent teeth in the western area of Jeju, Korea", *Journal of Korean Acad Dent Health*, (2008), vol. 32, no. 4, pp. 504-516.
- [15] S.J. Moon, "A survey on the awareness of water fluoridation of the primary school teachers by the education career periods in Jinju." *J Korean Acad Dent Health*, vol. 29, no. 4, (2005), pp. 463-473.
- [16] H.J. Jin, M.K. Lee, J.H. Lee, "The Oral Health Status and Behavior of Middle School Students according to Fluoridation Area", *Advanced Science and Technology Letters*, vol.116, (2015), pp.196-198.

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