

# Effects of the Dental Preventive Health Services for Children on Oral Health-Related Quality of Life

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## Abstract

The purpose of this study was to investigate the effects of public preventive dental healthcare services named the "Dental Preventive Health Services for Children" (DPHSC) on oral health-related quality of life (OHRQoL) in Korean children. Of the total 20,802 beneficiaries in 2018, 110 10-year-old elementary school students were randomly selected and were requested to complete a survey using the Korean version of Child Oral Health Impact Profile (COHIP) questionnaire before and after participating in DPHSC. Overall, 107 participants completed the pre- and post-survey. COHIP scores and clinical results such as numbers of decayed and missing teeth, malocclusion, and oral hygiene status from dental examination were statistically analyzed and the reliability and the validity of the responses were verified. There was a significant clinical increase in mean overall COHIP scores following DPHSC ( $p < 0.001$ , effect size 1.05). Children with decayed and missing teeth demonstrated poor OHRQoL. In conclusion, DPHSC can improve the OHRQoL of 10-year-old children.

**Key words :** Dental Preventive Health Services for Children, Child Oral Health Impact Profile, Oral health-related quality of life

## I. Introduction

With advances in the understanding of the causes and mechanisms of dental caries, the paradigm of dental caries treatment has shifted from the classical method of surgical intervention to the novel methods that prevent dental caries by intensive oral healthcare[1]. Prior experience of caries renders a vital indicator to predict the occurrence of dental caries in the future, and it is well established that the risk of developing permanent teeth caries is the highest at 6-12 years of age,

that is, in the first few years after permanent teeth eruption[2]. Despite its decreasing trend, the prevalence of dental caries experience and the DMFT index remain high at 56.4% and 1.84 in permanent teeth of 12-year-old children and at 68.5% and 3.43 in primary teeth of 5-year-old children, respectively, based on Korea National Children's Oral Health Survey in 2018[3].

The Korean government has provided free dental examination services for children and adolescents, but preventive dental care was not included in the public services. In this context, Seoul, the capital of the Republic of Korea, has provisioned a

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preventive dental healthcare services package named the Dental Preventive Health Services for Children (DPHSC) for kids at the age of 10 years, before the permanent dentition is fully developed. DPHSC, which was initially provided to approximately 19,000 students in 6 of 25 districts in Seoul in 2012, has been expanded annually and has been implemented for more than 46,000 students in all 25 districts since 2017. It is the first public service for preventive dental care, and includes dental examination, oral hygiene education, and preventive dental treatment. Dental examination includes visual examination, history taking, and panoramic X-ray visualization. Oral hygiene education includes proper plaque control using tooth brushing and flossing and instructions for diet and fluoride use. Preventive dental treatment includes professional oral prophylaxis, topical fluoride application, pit and fissure sealant, and scaling. The recipients of DPHSC visit designated dental clinics to avail services.

The aim of DPHSC is to establish an oral health care system that emphasizes prevention, rather than only being treatment-oriented; moreover, it is known that the participants have benefited from community-based dental care similar to DPHSC in clinical aspects such as decreased levels of dental caries and improved oral hygiene[4]. However, in view of the increasing importance of awareness on oral health or oral disease in recent years, the efficacy of DPHSC should be evaluated in more than just clinical terms[5].

Oral health-related quality of life (OHRQoL) refers to the impacts of oral health or dental diseases on daily functioning, activities and physical or psychological wellbeing and function[6]. The concepts of OHRQoL have been widely accepted in the medical or research area, especially in the case of chronic oral disease such as dental caries, which need active participation of patients themselves. It is vital to set a goal of treatment and establish the benefits of daily oral healthcare[6,7]. Approximately 20 OHRQoL scales have been developed for adults, but the scales for children are very limited[8]. Among these, the Child Oral Health Impact Profile (COHIP) questionnaire is the only instrument confirmed through validity and reliability testing for elementary school students in Korea[9]. Therefore, this study aims to examine the effects of DPHSC on the OHRQoL using COHIP.

## II. Materials and Methods

### 1. Participants

This study was performed under the review of the Seoul National University School of Dentistry Institutional Review Board (#S-D20180020).

The beneficiaries of the DPHSC were 10-year-old elementary school students living in Seoul, and DPHSC was conducted from July to December in 2018. The inclusion criteria for this study were healthy students with age-appropriate literacy. The exclusion criteria were as follows: students with intellectual and cognitive disabilities and students who underwent orthodontic treatment. The participants of this study were randomly selected from all 20,802 beneficiaries from 11 districts of urban areas in Seoul where DPHSC data could be collected using computerized system. The number of samples was targeted to 110 with an effect size of 0.8 for the overall COHIP score and 0.5 for each subscale score (critical probability  $\alpha = 0.01$ , power  $1 - \beta = 0.99$ , loss rate = 0.05, calculated with G\*Power ver.3.1.9.2.) [10]. For randomization, we used a simple random sampling method by using random number generated by a computer.

### 2. Study design

The researchers approached the selected participants individually by phone and fully explained the study design to the students and their legal guardians on the day they visited the designated dental clinics to participate in the DPHSC. The participants with written informed consent were included in this study.

After the surveys were completed manually, DPHSC including dental examination, oral hygiene education, and preventive dental treatment was conducted on the same day. Prior to the implementation of DPHSC, all participating dentists have completed a national education program for oral examination. Dental examination in DPHSC yielded clinical results such as numbers of decayed and missing permanent teeth, malocclusion, and oral hygiene status, based on the contents of the program. Extent of dental caries was evaluated using the International Caries Detection and Assessment System (ICDAS) [11], and when a permanent tooth showed caries greater than ICDAS code 4, it was recorded as "decayed." If agenesis of a permanent tooth was confirmed in a panoramic radiograph, it was recorded as "missing". Malocclusion was recorded based

on the Index of Orthodontic Treatment Need (IOTN)[12,13]. If IOTN grade was greater than 3, the case was recorded as "malocclusion." Oral hygiene status was evaluated by Patient Hygiene Performance (PHP) index[14], from a 0 (excellent) to 5 (poor) scale. Professional oral prophylaxis and topical fluoride application were conducted for all participants, and sealant and scaling were conducted for those diagnosed with the need for treatment. The same survey was conducted online, using a mobile link with Google Forms within 3 months after DPHSC.

### 3. Survey

The survey used COHIP, which contains 5 subscales and 34 items[7]. The Oral Health (OH) subscale contains ten items: "Pain/toothache," "Breathing through the mouth," "Discoloration of teeth," "Crooked teeth or spaces," "Sores or sore spots," "Bad breath," "Bleeding gums," "Food sticking," "Sensitivity with hot/cold," and "Dry mouth." The Functional Limitation (FL) subscale contains six items: "Trouble with chewing firm foods," "Difficulty in eating," "Trouble with sleeping due to teeth/face," "Difficulty in pronouncing," "Difficulty in being understood," and "Difficulty in keeping teeth clean." The Social-Emotional Satisfaction (SES) subscale contains eight items: "Unhappy or sad due to teeth/face," "Felt worried or anxious due to teeth/face," "Avoided smiling," "Felt looked different," "Worried about others' thinking," "Felt shy or withdrawn due to teeth/face," "Been bullied due to teeth/face," and "Been irritated by questions about teeth/face." The School Environment (SCE) subscale contains four items: "Absent from school due to teeth/face," "Difficulty in paying attention due to teeth/face," "Unwilling to speak due to teeth or face," and "Unwilling to go to school due to teeth or face." The Self-Image (SI) subscale contains six items: "Been confident due to teeth or face," "Felt attractive with oneself due to teeth or face," "Felt positive impression on teeth of oneself," "Felt doing well on the behavior of oneself," "Anticipate fine teeth after getting old," and "Anticipate good health after getting old."

The scores to each items in the survey utilized the 5-point Likert scale, which ranged from 0, being "almost all the time," to 4, being "never" in OH, FL, SES, and SCE subscales asking negative symptoms of OHRQoL. In contrast, the scores of the items in the SI subscale asking positive perceptions about OHRQoL were "Strongly disagree" (0), "somewhat disagree" (1), "Don't agree or disagree" (2), "Somewhat agree" (3), and

"Strongly agree" (4). The subscale scores were calculated by summing up the items scores included and the overall COHIP score by summing up the subscale scores. The overall COHIP score ranged from 0 to 136, of which a higher COHIP score indicated a better OHRQoL.

In the pre-survey, the participants were asked to respond based on their experiences for the past 3 months, while their experience after DPHSC was recorded in the post-survey.

### 4. Statistical analysis

In the pre-survey, split-half reliability for Cronbach's alpha was used to validate the internal consistency. The construct validity of the questionnaire was examined with a correlation test between each subscale, and the discriminant validity was explored with a correlation test between the pre-survey and the results of the dental examination. Spearman's rank correlation coefficient was used for all correlation tests. A Wilcoxon rank-sum test was used to compare findings based on the dental examination results such as number of decayed teeth, number of missing teeth, malocclusion and PHP scores.

A Wilcoxon signed rank test was used to compare the COHIP scores between the pre- and post-surveys. Cohen's d was used to identify the effect size, which was calculated by dividing the average difference between the pre- and post-survey by pooled standard deviation.

## III. Results

A total of 110 students from urban areas in Seoul were enrolled and completed the pre-survey, and 107 students completed the post-survey (97.3%). The data from these 107 cases were analyzed (49 males and 58 females). Compared with the whole population of beneficiaries of DPHSC, the enrolled samples did not show any significant differences in gender ratio, the number of decayed permanent teeth, the number of missing permanent teeth, malocclusion, or oral hygiene status. Moreover, there were no significant differences in the number of decayed permanent teeth, missing permanent teeth, malocclusion, oral hygiene status, and pre-survey COHIP scores according to gender (Table 1).

A total of 32 students showed dental caries, having  $2.94 \pm 2.76$  decayed teeth per average. Five missing teeth were observed in two students, one had one, and another had four. Malocclusion was observed in 18 students. The average PHP

**Table 1.** Results from dental examination and overall Child Oral Health Impact Profile score according to gender (n=107)

	Number of Participants	Average Number of Decayed Teeth	Average Number of Missing Teeth	Malocclusion (presence = 1, absence = 0)	Average PHP Score (0-5)	COHIP (Pre-survey)
Male	49	0.84	0.10	0.18	2.09	101.94
Female	58	0.91	0.00	0.16	2.35	104.98
<i>p</i> value		0.845	0.229	0.698	0.210	0.268

*p* value from Wilcoxon rank-sum test

PHP = Patient Hygiene Performance, COHIP = Child Oral Health Impact Profile

score of students was 2.23 ± 1.10. All 107 participants were given dental examination, oral hygiene education, professional oral prophylaxis, and topical fluoride application. Sealant was applied on 85 teeth from 36 students. Sixty students got their teeth scaled.

Table 2 shows the reliability and validity test results from the pre-survey. With Cronbach's alpha above 0.75 (*p* < 0.01), high reliability was confirmed for the overall COHIP and the subscale scores. In terms of construct validity, the correlations

between each subscales were less than 0.5 and significant (*p* < 0.05) except for the SI subscale, and all correlations between each subscales and overall COHIP were significant (*p* < 0.01). On the discriminant validity, the participants with missing teeth showed lower overall COHIP score, OH score, SES score, and SI score than those without missing teeth (*p* < 0.05). The subjects with decayed teeth showed lower FL score than those without decayed teeth (*p* < 0.01). With regard to malocclusion and PHP scores, there were no statistically significant results.

**Table 2.** Results of reliability, construct validity, and discriminant validity test based on the results from the pre-survey (n=107)

		OH	FL	SES	SCE	SI	COHIP	
Reliability	Cronbach's Alpha	0.795	0.757	0.911	0.818	0.860	0.887	
	<i>p</i> value	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Construct Validity <sup>1)</sup>	OH	<i>ρ</i>	0.430	0.460	0.126	0.111	0.750	
		<i>p</i> value	0.002	0.006	0.195	0.256	<0.001	
	FL	<i>ρ</i>		0.270	0.173	0.119	0.622	
		<i>p</i> value		<0.009	0.074	0.223	<0.001	
	SES	<i>ρ</i>			0.233	0.160	0.565	
		<i>p</i> value			0.016	0.100	<0.001	
	SCE	<i>ρ</i>				0.069	0.253	
		<i>p</i> value				0.482	0.008	
	SI	<i>ρ</i>					0.600	
		<i>p</i> value					<0.001	
Discriminant Validity <sup>2)</sup>	Decayed teeth <sup>#</sup>	<i>ρ</i>	-0.034	-0.295	-0.060	0.014	-0.032	-0.121
		<i>p</i> value	0.725	0.002	0.538	0.883	0.743	0.214
	Missing teeth <sup>#</sup>	<i>ρ</i>	-0.223	-0.106	-0.210	0.047	-0.191	-0.217
		<i>p</i> value	0.021	0.279	0.030	0.633	0.048	0.025
	Malocclusion <sup>#</sup>	<i>ρ</i>	0.001	0.145	0.093	0.073	0.140	0.147
		<i>p</i> value	0.993	0.136	0.343	0.455	0.150	0.131
	PHP score (0-5)	<i>ρ</i>	0.008	-0.016	-0.050	-0.099	-0.121	-0.070
		<i>p</i> value	0.938	0.870	0.609	0.311	0.213	0.474

<sup>1)</sup>Spearman's rank correlation coefficient between each subscales.

<sup>2)</sup>Spearman's rank correlation coefficient between the COHIP scores and dental examination results.

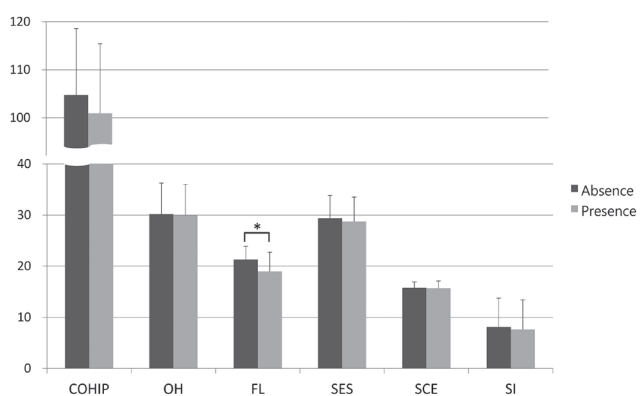
<sup>#</sup>Categorized as presence or absence.

COHIP = Child Oral Health Impact Profile, OH = Oral Health subscale, FL = Functional Limitation subscale, SES = Social-Emotional Satisfaction subscale, SCE = School Environment subscale, SI = Self-Image subscale, PHP = Patient Hygiene Performance

Similar results were obtained using the Wilcoxon rank-sum test according to the presence or absence of decayed and missing teeth, as shown in Fig. 1 and Fig. 2.

The overall COHIP score, each subscale scores, and item scores in the pre- and post-survey are shown in Table 3. It was found that the average overall COHIP score was significantly increased after DPHSC ( $p < 0.001$ ), as well as OH, FL, SES, and SI subscales; however, SCE subscale did not show any significant difference. Overall COHIP, OH and FL subscales showed

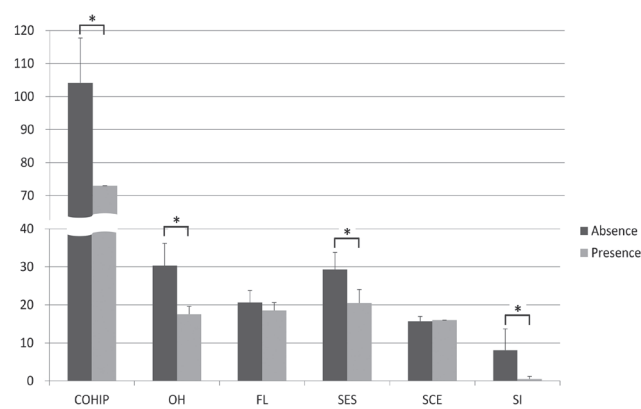
large effect sizes. The distribution of the response frequencies before and after DPHSC is shown in Table 4. The majority of respondents reported "Almost never" or "Never" at the negative items (OH 58.0%, FL 82.2%, SES 86.0%, SCE 98.1%) while "strongly disagree" or "somewhat disagree" at the positive items (SI 42.0%). The most frequently reported symptoms were "Bad breath" and "Food sticking" in OH and "Difficulty in keeping teeth clean" in FL, and these items also showed the greatest improvement after DPHSC.



**Fig. 1.** Differences in the overall Child Oral Health Impact Profile and subscales scores according to presence or absence of decayed teeth in the pre-survey.

$p$  value from Wilcoxon rank-sum test (\* :  $p < 0.05$ )

COHIP = Child Oral Health Impact Profile, OH = Oral Health subscale, FL = Functional Limitation subscale, SES = Social-Emotional Satisfaction subscale, SCE = School Environment subscale, SI = Self-Image subscale



**Fig. 2.** Differences in the overall Child Oral Health Impact Profile and subscales scores according to presence or absence of missing teeth in the pre-survey.

$p$  value from Wilcoxon rank-sum test (\* :  $p < 0.05$ )

COHIP = Child Oral Health Impact Profile, OH = Oral Health subscale, FL = Functional Limitation subscale, SES = Social-Emotional Satisfaction subscale, SCE = School Environment subscale, SI = Self-Image subscale

**Table 3.** Overall Child Oral Health Impact Profile scores before and after Dental Preventive Health Services for Children (n = 107)

	COHIP score		Mean Difference	Effect Size <sup>§</sup>	$p$ value <sup>†</sup>
	Pre-survey	Post-survey			
	Mean (SD)				
COHIP (0-136)	103.59 (14.1)	116.83 (10.9)	13.24	1.05	<0.001
OH (0-40)	30.12 (6.0)	37.07 (4.0)	6.95	1.36	<0.001
FL (0-24)	20.62 (3.1)	23.23 (2.0)	2.62	1.00	<0.001
SES (0-32)	29.18 (4.6)	30.65 (2.7)	1.48	0.39	0.003
SCE (0-16)	15.72 (1.2)	15.88 (0.6)	0.16	0.17	0.200
SI (0-24)	7.95 (5.6)	9.99 (7.0)	2.04	0.32	0.034

<sup>†</sup> $p$  value from Wilcoxon signed rank test

<sup>§</sup>Calculated using Cohen's d

COHIP = Child Oral Health Impact Profile, OH = Oral Health subscale, FL = Functional Limitation subscale, SES = Social-Emotional Satisfaction subscale, SCE = School Environment subscale, SI = Self-Image subscale

**Table 4.** The distribution of the response frequencies before and after Dental Preventive Health Services for Children (n = 107)

	Pre-survey			Post-survey			
	N (%)						
	All time / often	Sometimes	Almost never / never	All time / often	Sometimes	Almost never / never	
<i>OH</i>	Pain/toothache	2 (1.9)	28 (26.2)	77 (71.9)	0 (0.0)	3 (2.8)	104 (97.2)
	Mouth Breathing	14 (13.1)	24 (22.4)	69 (64.5)	3 (2.8)	9 (8.4)	95 (88.8)
	Teeth Discoloration	4 (3.7)	10 (9.3)	93 (86.9)	1 (0.9)	3 (2.8)	103 (96.3)
	Crooked teeth or spaces	7 (6.5)	18 (16.8)	82 (76.6)	1 (0.9)	4 (3.7)	102 (95.3)
	Sores or sore spots	9 (8.4)	13 (12.1)	85 (79.4)	0 (0.0)	0 (0.0)	107 (100)
	Bad breath	29 (27.1)	37 (34.6)	41 (38.3)	3 (2.8)	11 (10.3)	93 (86.9)
	Bleeding gums	7 (6.5)	13 (12.1)	87 (81.3)	0 (0.0)	1 (0.9)	106 (99.1)
	Food sticking	25 (23.4)	43 (40.2)	39 (36.4)	3 (2.8)	23 (21.5)	81 (75.7)
	Sensitivity with hot/cold	14 (13.1)	14 (13.1)	79 (73.8)	2 (1.9)	5 (4.7)	100 (93.5)
	Dry mouth	5 (4.7)	18 (16.8)	84 (78.5)	0 (0.0)	5 (4.7)	102 (95.3)
<i>FL</i>	Trouble with chewing firm foods	3 (2.8)	27 (25.2)	77 (72.0)	1 (0.9)	6 (5.6)	100 (93.5)
	Difficulty in eating	2 (1.9)	29 (27.1)	76 (71.0)	0 (0.0)	3 (2.8)	104 (97.2)
	Trouble with sleeping	0 (0.0)	9 (8.4)	98 (91.6)	0 (0.0)	2 (1.9)	105 (98.1)
	Difficulty in pronouncing	1 (0.9)	3 (2.8)	103 (96.3)	0 (0.0)	1 (0.9)	106 (99.1)
	Difficulty in being understood	1 (0.9)	4 (3.7)	102 (95.4)	1 (0.9)	3 (2.8)	103 (96.3)
	Difficulty in keeping teeth clean	5 (4.7)	36 (33.6)	66 (61.7)	1 (0.9)	5 (4.7)	101 (94.4)
<i>SES</i>	Unhappy or sad	2 (1.9)	5 (4.7)	100 (93.5)	0 (0.0)	4 (3.7)	103 (96.3)
	Felt worried or anxious	4 (3.7)	13 (12.1)	90 (84.1)	1 (0.9)	4 (3.7)	102 (95.3)
	Avoided smiling	2 (1.9)	8 (7.4)	97 (90.7)	0 (0.0)	2 (1.9)	105 (98.1)
	Felt looked different	1 (0.9)	9 (8.4)	97 (90.7)	0 (0.0)	2 (1.9)	105 (98.1)
	Worried about others' thinking	2 (1.9)	16 (14.9)	89 (83.2)	0 (0.0)	2 (1.9)	105 (98.1)
	Felt shy or withdrawn	3 (2.8)	11 (10.3)	93 (86.9)	1 (0.9)	1 (0.9)	105 (98.1)
	Been bullied	1 (0.9)	2 (1.9)	104 (97.2)	1 (0.9)	0 (0.0)	106 (99.1)
	Been irritated	3 (2.8)	2 (1.9)	102 (95.3)	1 (0.9)	0 (0.0)	106 (99.1)
<i>SCE</i>	Absent from school	0 (0.0)	2 (1.9)	105 (98.1)	1 (0.9)	0 (0.0)	106 (99.1)
	Difficulty in attention	1 (0.9)	1 (0.9)	105 (98.1)	0 (0.0)	0 (0.0)	107 (100)
	Unwilling to speak	0 (0.0)	3 (2.8)	104 (97.2)	0 (0.0)	1 (0.9)	106 (99.1)
	Unwilling to go to school	1 (0.9)	2 (1.9)	104 (97.2)	0 (0.0)	0 (0.0)	107 (100)
	Strongly / somewhat disagree	Don't agree or disagree	Somewhat / strongly agree	Strongly / somewhat disagree	Don't agree or disagree	Somewhat / strongly agree	
<i>SI</i>	Been confident	72 (67.3)	18 (16.8)	17 (15.9)	58 (54.2)	19 (17.8)	30 (28.0)
	Felt attractive	81 (75.7)	18 (16.8)	8 (7.5)	56 (52.3)	20 (18.7)	31 (29.0)
	Felt positive impression	56 (52.3)	31 (29.0)	20 (18.7)	48 (44.9)	26 (24.3)	33 (30.8)
	Felt doing well	40 (37.4)	40 (37.4)	27 (25.2)	45 (42.1)	22 (20.6)	40 (37.4)
	Anticipate fine teeth	54 (50.5)	41 (38.3)	12 (11.2)	44 (41.1)	29 (27.1)	34 (31.8)
	Anticipate a good health	43 (40.2)	30 (28.0)	34 (31.8)	33 (30.8)	31 (29.0)	43 (40.2)

OH = Oral Health subscale, FL = Functional Limitation subscale, SES = Social-Emotional Satisfaction subscale, SCE = School Environment subscale, SI = Self-Image subscale

Among the participants with decayed teeth, the overall COHIP score and subscale scores did not change significantly after the implementation of DPHSC. In those with missing teeth, the overall COHIP, OH subscale and SES subscale scores increased significantly after the implementation of DPHSC ( $p = 0.009, 0.007$  and  $0.015$ , respectively).

#### IV. Discussion

Socioeconomic inequalities are known to affect physical and mental health of children, which means that children living in socioeconomically deficient environments are in poor health[15]. These health inequalities are associated with material deficiencies, psychosocial factors, health related behavioral factor and socio-structural factors, and begin early in life and continue through childhood and adolescent to adulthood[15]. The same pattern occurs with oral health[16,17], and which is influenced by structural factors such as socioeconomic position, social capital, and social and economic policies and behavioral ones such as oral hygiene care, dietary regulation, and dental clinic visits[17-20]. Therefore, public oral care for all children is essential to ensure equity of oral health and to reduce the prevalence of dental caries[21-23].

The Korean government provides a total of three infant oral examinations for preschoolers and parent education services free of charge according to the Child Welfare Act, as well as oral examination services for 7, 10, 13, and 16 years of age according to the School Health Law. However, there has been little public preventive management intended for school-age children. Hence, DPHSC began to be implemented for some elementary schools in Seoul in 2012, being the first project in Seoul where public preventive program was targeted at school age. Expanding subjects every year, it is being conducted for all students in the fourth grade of elementary schools since 2017.

In the study that analyzed the effectiveness of community-based dental care 2 years later in Korea[4], the participants showed decreased dental caries prevalence by 0.3% during 2 years, but the prevalence of dental caries in students not participating in the case increased by 11.4%. The occurrence of permanent teeth with caries experience increased by 0.09 in participating students but increased by 0.88 in nonparticipating students. In addition, the participants showed increased brushing frequency after lunch and decreased snack consumption rate[4]. The results mentioned above confirmed the ef-

fectiveness of the prevention and are consistent with other studies about public oral health care[21-23]. However, oral health does not simply mean absence of oral disease such as dental caries or good oral hygiene practice itself but refers to the state of the oral cavity and its related tissues that enable a person to eat, talk, and socialize without feeling ill or discomfort. Hence, multidimensional evaluation is required for proper evaluation[24]. Assessing OHRQoL is vital for multidisciplinary assessment of chronic diseases such as dental caries and can be used for public health policies[25,26]. In this study, we used COHIP, one of the questionnaires utilized for OHRQoL for children, to evaluate the effectiveness of DPHSC.

In this study, a high reliability based on  $>0.75$  Cronbach's alpha coefficient was verified in the five subscales as well as overall COHIP ( $p < 0.001$ ). In the case of construct validity, there was a statistically significant relationship, not as high as 0.5 or less between inter-category correlation. It means that the questionnaire was useful to analyze the students' OHRQoL in various perspectives. However, the correlations between SI subscale and other subscales were not significant, and this may be related to the finding that the responses on the SI subscale showed a relatively even distribution compared with the responses on the other subscales (Table 4). Likewise, discriminant validity was also verified in that carious or missing tooth reduced COHIP score, and similar results are shown in the comparison of COHIP scores by Wilcoxon rank sum test (Figs 1 and 2). This is consistent with previous studies[27-31]. Overall, the COHIP questionnaire used in this study is thought to have adequate reliability and validity.

The mean score of overall COHIP was 103.59, and it was very similar to the results of a previous Korean study ( $103.3 \pm 13.3$ ), which targeted 2236 school-aged students in Gyeonggi province[9]. Seoul and Gyeonggi province are close to each other, with similar living standards and environment. So OHRQoL of students in these two regions was expected to be similar, and the result confirmed this, which enables us to conclude that the randomization process used in this study was valid.

In addition, this study confirmed that DPHSC improves the OHRQoL of children. The overall score of COHIP increased statistically after DPHSC and the effect size was very high (1.05). In the subscales, all but the SCE subscale showed a statistically significant improvement. Especially, OH and FL subscales showed very high effect sizes of 1.36 and 1.00. This result is meaningful, considering that DPHSC was aimed at all fourth

grade elementary school children in Seoul, regardless of presence of oral diseases and oral education and preventive dental treatment being the main contents rather than dental restorative treatment. In fact, among 107 subjects, 32 students had dental caries, and the average number of carious teeth was only 0.88, <1 per patient, and only 2 students had missing teeth. In other words, these results came from the situation where there is not a great deal of discomfort from oral health status, and these results showed the possibility that DPHSC promoted participants' awareness of oral health[5]. The effect size of SES, SCE, and SI was as low as <0.4, and the percentage of respondents with no or little in FL, SES, and SCE was >80%. This is also related to the fact that the oral health status of the participants was not so poor and the influence on these subscales was not significant. Also, the most frequent items reported by participants before DPHSC were "Bad breath", "Food sticking" and "Difficulty in keeping teeth clean", and these three items showed the greatest improvement after DPHSC. This may be because the participants have acquired and practiced knowledge about oral hygiene management through DPHSC.

The participants with decayed teeth did not show any significant changes after DPHSC; this could be because the number of decayed teeth was small, and dental restorative treatment was not included in DPHSC. Participants with missing teeth showed improvement in OHRQoL; probably because dentists provided thorough consultation about how to manage missing teeth and long-term treatment plan. However, because of the small number of participants with missing teeth, the results should be generalized with caution.

The limitations of this study are as follows. It is difficult to tell which factors have had the greatest impact on the OHRQoL because DPHSC is ongoing with dental examination, oral hygiene education, and preventive dental treatment. In addition, since the analysis included only the questionnaire within 3 months after DPHSC based on the results of previous study[32], there is a limitation to evaluate the long-term effect of the project. Moreover, we analyzed the data only from the students who participated in DPHSC; no control group was available to confirm the effects of confounders other than DPHSC because all 10-year-olds in Seoul are beneficiaries of DPHSC. Another limitation is that the dental examination results are based on the data from multiple dentists participating in DPHSC, despite the national education program before DPHSC. Also, the fact that the ways to fill out the OHRQoL

questionnaire are different before and after DPHSC can be another confounder. The validity and reliability of OHRQoL using a mobile link with Google Forms should be verified.

In 2018, the DPHSC was performed only for 10-year-olds and limited in a one-time project. It is clear that prevention and oral health education are more effective than traditional dental treatment both clinically and cost-effectively[33] and a continuing preventive approach adhered causes changes in oral health behavior and cognition and in turn reduces oral disease[21,34]. But the long-term effect of a one-time project still needs clarification[35]. Hence, the researchers express that more sustained preventive health services and studies are needed to maintain oral health of children.

## V. Conclusion

The DPHSC can improve the OHRQoL of 10-year-old students. Students with decayed and missing teeth demonstrated reduced OHRQoL.

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## References

1. Hurlbutt M, Young DA : A best practices approach to caries management. *J Evid Based Dent Pract*, 14:77-86, 2014.
2. Mejàre I, Axelsson S, Twetman S, *et al.* : Caries risk assessment. A systematic review. *Acta Odontol Scand*, 72:81-91, 2014.
3. Ministry of Health and Welfare : The report of Korea National Children's Oral Health Survey in 2018. Available from URL: [http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR\\_MENU\\_ID=04&MENU\\_ID=0403&CONT\\_SEQ=349638](http://www.mohw.go.kr/react/al/sal0301vw.jsp?PAR_MENU_ID=04&MENU_ID=0403&CONT_SEQ=349638) (Accessed on July 2, 2020).



4. Jung SH, Shin BM, Park DY, Ma DS : One-year outcomes and reasons for dropout in participants of the continuous dental care program of the Community Child Center in Gangneung city. *J Korean Acad Oral Health*, 37:110-116, 2013.
5. Amalia R, Schaub RM, Groothoff JW, *et al.* : Impact of school-based dental program performance on the oral health-related quality of life in children. *J Invest Clin Dent*, 8:12179, 2017.
6. Sischo L, Broder HL : Oral health-related quality of life: what, why, how, and future implications. *J Dent Res*, 90:1264-1270, 2011.
7. Broder HL, Wilson-Genderson M : Reliability and convergent and discriminant validity of the Child Oral Health Impact Profile (COHIP Child's version). *Community Dent Oral Epidemiol*, 35:20-31, 2007.
8. Hebling E, Pereira AC : Oral health-related quality of life: a critical appraisal of assessment tools used in elderly people. *Gerodontology*, 24:151-161, 2007.
9. Ahn YS, Kim HY, Noh HJ, *et al.* : Validation of a Korean version of the Child Oral Health Impact Profile (COHIP) among 8- to 15-year-old school children. *Int J Paediatr Dent*, 22:292-301, 2012.
10. Tsakos G, Allen PF, Steele JG, Locker D : Interpreting oral health-related quality of life data. *Community Dent Oral Epidemiol*, 40:193-200, 2011.
11. Ismail AI, Sohn W, Pitts NB, *et al.* : The International Caries Detection and Assessment System (ICDAS): an integrated system for measuring dental caries. *Community Dent Oral Epidemiol*, 35:170-178, 2007.
12. Brook PH, Shaw WC : The development of an index of orthodontic treatment priority. *Eur J Orthod*, 11:309-320, 1989.
13. Shaw WC, Richmond S, Stephens CD, *et al.* : Quality control in orthodontics: indices of treatment need and treatment standards. *Br Dent J*, 170:107-112, 1991.
14. Podshadley AG, Haley JV : A method for evaluating oral hygiene performance. *Public Health Rep*, 83:259-264, 1968.
15. Pearce A, Dundas R, Whitehead M, Taylor-Robinson D : Pathways in inequalities in child health. *Arch Dis Child*, 104:998-1003, 2019.
16. Fisher-Owens SA, Gansky SA, Newacheck PW, *et al.* : Influences on children's oral health: a conceptual model. *Pediatrics*, 120:510-520, 2007.
17. Broadbent JM, Zeng J, Thomson WM, *et al.* : Oral health-related beliefs, behaviors, and outcomes through the life course. *J Dent Res*, 95:808-813, 2016.
18. Alhabdan YA, Albeshr AG, Yenugadhathi N, Jradi H : Prevalence of dental caries and associated factors among primary school children: a population-based cross-sectional study in Riyadh, Saudi Arabia. *Environ Health Prev Med*, 23:60, 2018.
19. Nishide R, Mizutani M, Hatashita H, *et al.* : Homecare protective and risk factors for early childhood caries in Japan. *Environ Health Prev Med*, 23:57, 2018.
20. Ha DH, Do LG, Roberts-Thomson K, Jamieson L : Risk indicators for untreated dental decay among Indigenous Australian children. *Community Dent Oral Epidemiol*, 47:316-323, 2019.
21. Macpherson LMD, Anopa Y, Conway DI, McMahon AD : National supervised tooth brushing program and dental decay in Scotland. *J Dent Res*, 92:109-113, 2018.
22. Mbawalla H, Masalu JR, Masatu M, Åström AN : Changes in adolescents' oral health status following oral health promotion activities in Tanzania. *Acta Odontol Scand*, 71:333-342, 2013.
23. de Silva AM, Hegde S, Yousefi-Nooraie R, *et al.* : Community-based population-level interventions for promoting child oral health. *Cochrane Database Syst Rev*, 9:CD009837, 2016.
24. Locker D : Measuring oral health: a conceptual framework. *Community Dent Health*, 5:3-18, 1988.
25. Weintraub JA : Uses of oral health related quality of life measures in Public Health. *Community Dent Health*, 15:8-12, 1998.
26. Antunes LA, Andrade MR, Luiz RR, *et al.* : Change in the quality of life of children and adolescents younger than 14 years old after oral health interventions: a systematic review. *Pediatr Dent*, 35:37-42, 2013.
27. Abanto J, Paiva SM, Bonecker M, *et al.* : The impact of dental caries and trauma in children on family quality of life. *Community Dent Oral Epidemiol*, 40:323-331, 2012.
28. de Paula JS, Sarracini KL, Mialhe FL, *et al.* : Longitudinal evaluation of the impact of dental caries treatment on oral health-related quality of life among schoolchildren. *Eur J Oral Sci*, 123:173-178, 2015.
29. Pakpour AH, Lin CY, Jansson H, *et al.* : Predictors of oral health-related quality of life in Iranian adolescents: A prospective study. *J Invest Clin Dent*, 9:12264, 2018.
30. Schuch HS, Costa Fdos S, Goettems ML, *et al.* : Oral health-

related quality of life of schoolchildren: impact of clinical and psychosocial variables. *Int J Paediatr Dent*, 25:358-365, 2015.

31. Severo Alves L, Dam-Teixeira N, Susin C, Maltz M : Association among quality of life, dental caries treatment and intraoral distribution in 12-year-old South Brazilian schoolchildren. *Community Dent Oral Epidemiol*, 41:22-29, 2013.

32. Knapp R, Gilchrist F, Rodd HD, Marshman Z : Change in children's oral health-related quality of life following dental treatment under general anaesthesia for the management of dental caries: a systematic review. *Int J Paediatr Dent*, 27: 302-312, 2017.

33. Slade GD, Bailie RS, Morris P, *et al.* : Effect of health promotion and fluoride varnish on dental caries among Australian Aboriginal children: results from a community-randomized controlled trial. *Community Dent Oral Epidemiol*, 39:29-43, 2011.

34. Wennhall I, Matsson L, Schröder U, Twetman S : Outcome of an oral health outreach programme for preschool children in a low socioeconomic multicultural area. *Int J Paediatr Dent*, 18:84-90, 2008.

35. Jaime RA, Carvalho TS, Mendes FM, *et al.* : Oral health education program on dental caries incidence for school children. *J Clin Pediatr Dent*, 39:277-283, 2015.

< Appendix >

구강검진 문진표

이 설문조사는 구강검진을 하기 전 구강상태를 참고하기 위하여 실시하는 것으로, 솔직하고 성실한 답변을 해야 본인의 구강진료에 도움이 됩니다. 비밀은 절대 보장되므로 잘 모르는 사항은 부모님께 여쭙어 정확하게 답변해 주시기 바랍니다.			
아 동	( )	지역아동센터	
학 생	( )	초등학교 4학년	반 번
성 명		성 별	남 · 여
생년월일			
연락처			
최근 1년 동안 느낀 증상에 모두 표시해주세요.			
구강 증상	문항	질문사항	
1		치아가 깨지거나 부러짐	①있다 ②없다
2		차갑고 뜨거운 음식을 마시거나 음식을 먹을 때 이가 아픔	①있다 ②없다
3		치아가 쏘시고 욱신거리고 아픔	①있다 ②없다
4		잇몸이 아프거나 피가 남	①있다 ②없다
5		혀 또는 입 안쪽 뺨이 욱신거리며 아픔	①있다 ②없다
6		불쾌한 입 냄새가 남	①있다 ②없다
본인의 구강건강 상태에 해당하는 번호를 표시해 주세요.			
구강건강상태	7	지난 1년간 치과에 간 적이 있습니까?	① 있다 ② 없다 ③ 모르겠다
	8	어제 하루동안 이를 닦은 때를 모두 표시 해 주세요	①아침식사 전 ②아침식사 후 ③점심식사 후 ④저녁식사 후 ⑤잠자기 직전 ⑥간식 후
	9	과자 등 단음식, 콜라 등 청량음료를 즐겨 먹습니까?	① 그렇다 ② 보통이다 ③ 아니다
	10	현재 사용하는 치약에 불소가 들어 있습니까?	① 예 ② 아니오 ③ 모르겠다
	11	담배로 입냄새, 잇몸손상, 구강암 등이 발생 될 수 있다고 들었거나 배운 적이 있습니까?	① 있다 ② 없다 ③ 모르겠다
12	술이 입냄새, 잇몸손상, 염증을 일으킬 수 있다는 것을 들었거나 배운 적이 있습니까?	① 있다 ② 없다 ③ 모르겠다	
* 치과의사 선생님께서 하고 싶은 말을 쓰세요.			

Appendix 1. Questionnaire for dental examination completed by the participants in Dental Preventive Health Services for Children.

구강검진결과 통보서

소 속	( ) 지역아동센터				
성 명	( ) 초등학교 4학년 반 번				
	성 별 남 · 여 생년월일				
구강검사 결과 및 판정					
충전된 치아	① 없음 ② 있음	학생 치과주치의 상 ( )개 하 ( )개	아동 치과주치의 유치 ( )개 영구치 ( )개	그 밖의 치아 상태	① 과잉치 ② 유치 잔존 ③ 그 밖의 치아 상태:
현재 우식치아	① 없음 ② 있음	학생 치과주치의 상 ( )개 하 ( )개	아동 치과주치의 유치 ( )개 영구치 ( )개	치주 질환	① 없음 ② 있음
우식발생 위험치아	① 없음 ② 있음	상 ( )개 하 ( )개	유치 ( )개 영구치 ( )개	아관절 이상	① 없음 ② 있음
결손치아 (영구치)	① 없음 ② 있음	상 ( )개 하 ( )개		구내염 및 연조직질환	① 없음 ② 있음
구내염 및 연조직질환	① 없음 ② 있음			교등학교 추가항목	
부정교합	① 없음 ② 있음	③ 교정중		치아마모증	① 없음 ② 있음
구강위생 상태	① 우수 ② 보통	③ 개선요망		제3대구치 (사랑니)	① 정상 ② 이상
소 건					
보건교육 (필수)	<input checked="" type="checkbox"/> 구강위생관리 <input checked="" type="checkbox"/> 바른 식습관 <input checked="" type="checkbox"/> 불소이용법 <input checked="" type="checkbox"/> 금연/금주 <input checked="" type="checkbox"/> 칫솔질실질				
* 아래	<input checked="" type="checkbox"/> 표기된 항목은 서울시 치과주치의사업에서 제공되는 서비스로 무료 제공됩니다.				
예방진료	<input type="checkbox"/> 전문가 구강위생관리 <input type="checkbox"/> 불소도포 <input type="checkbox"/> 치아홈메우기 <input type="checkbox"/> 치석제거				
(아동치과주치의 사업 대상자만 해당)	* 아래 <input checked="" type="checkbox"/> 표기된 항목은 위 아동에게 필요한 전문적 치료이며, 치료비는 일부만 지원됩니다.				
치료	<input type="checkbox"/> 충전 <input type="checkbox"/> 발치 <input type="checkbox"/> 치수/치근단 치료 <input type="checkbox"/> 기타				
종합소견					
별도검사	검사일자	검사명	검사기관	검사결과	
판 정	면허번호		검진일 및 검진기관	검진일	
치과의사	의 사 명	(인)	검진기관	명	

Appendix 2. Result notification of dental examination in Dental Preventive Health Services for Children.

국문초록

## 서울시 학생치과주치의 사업이 구강 건강과 관련된 삶의 질에 미치는 영향

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이 연구의 목적은 서울시 학생치과주치의 사업이 구강 건강과 관련된 삶의 질에 미치는 영향을 확인하는 것이다. 2018년 사업의 전체 대상자인 20,802명 중 무작위로 선정된 110명의 10세 초등학생들을 대상으로 하였으며, 사업 시행 전과 후에 Child Oral Health Impact Profile (COHIP) 설문 문항을 작성하도록 하였다. 사업 전후 설문을 모두 작성한 107명의 어린이들을 대상으로, COHIP 점수와 우식 치아의 수, 결손 치아의 수, 부정교합, 구강위생상태와 같은 임상검사 결과들이 분석되었으며, 응답의 신뢰도와 타당도가 확인되었다. COHIP 점수는 사업 시행 후 증가되었으며( $p < 0.001$ , effect size 1.05), 우식 치아와 결손 치아가 있는 어린이들은 낮은 COHIP 점수를 보였다. 결론적으로, 서울시 학생치과주치의 사업은 10세 초등학생들의 구강 건강과 관련된 삶의 질에 긍정적으로 기여할 수 있다.