

Changes in Oral Health Indicators Due to Implementation of Health Insurance Coverage for First Molar Dental Sealant for Children and Adolescents in Korea

JINSUN CHOI

Gangneung-Wonju National University College of Dentistry <https://orcid.org/0000-0002-9945-1375>

Deuk-Sang Ma (✉ mads@gwnu.ac.kr)

Research article

Keywords: Dental sealant, Health Insurance Coverage, Oral Health Indicators

Posted Date: February 21st, 2020

DOI: <https://doi.org/10.21203/rs.2.24170/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License. [Read Full License](#)

Version of Record: A version of this preprint was published on July 29th, 2020. See the published version at <https://doi.org/10.1186/s12903-020-01201-8>.

Abstract

Background: The effectiveness of a dental sealant reimbursement policy for children and adolescents was verified by comparing changes in first molar oral health indicators before and after policy implementation.

Methods: Korea National Health and Nutrition Examination Survey data were analyzed: the fourth period (2007–2009) provided data before, and sixth period (2013–2015) data after policy implementation. The proportion of individuals with first-molar sealant, decay-missing-filled first molar permanent teeth, and single crowns in the group aged 11–20 years were calculated. Data were analyzed using chi-square for complex samples and the complex samples general linear model.

Results: Compared with non-beneficiaries, among policy beneficiaries, sealant ownership increased by 7.7%, and the number of permanent teeth with sealant per capita was about double; the proportion of individuals with decay-missing-filled permanent teeth decreased 9.1%, and the average decay-missing-filled permanent teeth index per person decreased by about a quarter; the rate of single-crown holders decreased by 2.7%, and the average single-crown index decreased by 0.03 per person. The number of sealants increased with age and household income. The caries rate was higher in females and older respondents.

Conclusions: A system is needed to ensure sealant is supplied to vulnerable groups; a follow-up system is required for long-term sealant maintenance.

Background

Dental caries is the most common oral disease in childhood [1] and can lead to tooth loss if left untreated [2]. Moreover, oral care in this period is very important because it can influence oral health in adulthood. In 1983, the World Health Organization declared a strategy for promoting oral health, and by 2000, with the increased attention and efforts regarding oral health around the world, the global average decay-missing-filled permanent teeth index was reduced to less than [3]. In addition, OECD member countries also compare their decay-missing-filled permanent teeth index among 12-year-olds to understand their oral health status [4].

To reduce the prevalence of dental caries in children and adolescents in Korea, the government implemented free-sealant projects through public health centers from 2002 to 2010 [5]. These publicly based oral health projects played an important role in reducing the decay-missing-filled permanent teeth index among 12-year-olds from 3.25 in 2003 to 2.17 in 2006 [6]. Subsequently, as the effectiveness of sealant was supported, this treatment was included as a health insurance benefit for the first molar for children aged 6 to 14 years from December 2009 [7]. In October 2012, the second molar was additionally covered, and in July 2013, the age of coverage was extended to under 18 years [7]. Previous studies [8, 9] have shown that sealant treatment is increasing with the expansion of sealant health insurance. However, it has been confirmed that differences in the use of sealant treatment according to socioeconomic factors still exist [8, 9]. This may be attributed to the fact that government-led sealant projects are rapidly curtailed or abolished after the reimbursement [10], resulting in a decrease in the supply of sealant to vulnerable groups.

On the other hand, the permanent caries prevalence rate in 12-year-olds decreased slightly by 0.9% over 3 years, but the decrease observed from 7.8% in 2015 (about 5 years after sealant reimbursement) [11] to 6.9% in 2018 (about 8 years after the reimbursement) [12] was not significant.

Given these phenomena, it is necessary to evaluate the effect of sealant treatment after the implementation of the reimbursement policy for children and adolescents on the change in their oral health indicators. Sealant is also one of the first preventive services in Korea to be included in a reimbursement policy. An assessment of its usefulness is required using various indicators, given that dental prevention services are provided as health insurance benefits. Therefore, this study aimed to identify the effectiveness of the sealant reimbursement policy for children and adolescents by comparing the differences in first-molar oral health indicators between non-beneficiaries and the eligible individuals who did not receive benefits during the extended sealant coverage, as well as differences according to sociodemographic characteristics.

Methods

Study participants

In this study, we obtained approval to analyze the raw data from the Korea National Health and Nutrition Examination Survey (KNHANES), which can be accessed through its website [13]. The KNHANES is a national survey that identifies the current state and related trends of the health and nutritional status of the population, establishes target indicators and evaluation data for the Health Plan, and calculates suitable health indicators for comparison with other countries [13]. In order to improve the representativeness of the sample and the accuracy of the estimations, the sample area was extracted using the multi-stage stratified colony probability extraction method, which is a complex-sample design method [14].

Study Variables And Measurement

Examinations for the KNHANES are conducted at Mobile Examination Center and include physical measurements, blood pressure and pulse measurements, blood and urine tests, oral examinations, pulmonary function tests, eye tests, and grip tests [13]. The oral examination is performed by dentists who have completed early and hands-on training for disease control [15].

The study was approved by the Committee on Research Ethics at the National Statistical Office and the Centers for Disease Control and Management (Approval number: 2007-02CON-04-P, 2008-04EXP-01-C, 2009-01CON-03-2C, 2013-07CON-03-4C, 2013-12EXP-03-5C) [16].

For the analysis of data in the present study, the fourth period (2007–2009) of the KNHANES was selected as the dataset before the sealant reimbursement policy, and the sixth period (2013–2015) as the dataset after the reimbursement policy was implemented. Participants' age was selected to be 11–20 years in order to compare oral health indicators after 5–6 years after policy implementation in 2010, based on an age of 6–14 of those who received reimbursement benefits.

The target tooth was selected as the first molar, which is covered by the sealant reimbursement policy. An indicator was created by converting the code of the "tooth condition" in the "oral examination" section of the KNHANES examination. The dependent variables were first molar with or without sealant, permanent caries, and single crown. Independent variables included gender (male, female), age (11–15, 16–20), region (urban, rural), household income (upper, upper-middle, lower-middle, and lower), father education (less than high school, more than college), and mother education (less than high school, more than college).

Statistical analysis

Statistical analysis was conducted using SPSS statistical package. The proportion of individuals with first-molar sealant, decay-missing-filled permanent teeth, and single-crown among individuals aged 11–20 years were calculated, and a complex-sample chi-square test was conducted to identify significant differences according to the factors under investigation. In addition, the average number of instances of sealant, decay-missing-filled permanent teeth, and single crown for the first molar in participants aged 11–20 years were calculated. In order to compare the difference between non-insured and insured households regarding sealant treatment, and to compare and analyze the differences according to the related factors, a descriptive statistical analysis considering complex samples for each independent variable was conducted using the complex samples general linear model.

The definitions of the terms are as follows:

- 1) DS rate (%): the percentage of dental sealant holders (first molars)
- 2) DS index: the number of dental sealant permanent per capita (first molars)
- 3) DMF rate (%): the percentage of decay-missing-filled permanent teeth (first molars)
- 4) DMFT index: the average decay-missing-filled permanent teeth index per person (first molars)
- 5) SC rate (%): the percentage of single-crown holders (first molars)
- 6) SC index: single-crown index per person (first molars)

Results

In the fourth period of KNHANES (2007–2009), there were 3,092 (100.0%) respondents aged 11–20 years, and 1,574 were male (50.9%) and 1,518 female (49.1%); 1,902 (61.5%) were 11–15 years old, and 1,190 (38.5%) were 16–20 years old. Regarding the region, 2,516 (81.4%) lived in the urban, and 576 (18.6%) lived in the rural. In the fourth period of KNHANES (2013–2015), there were 5,182 (100.0%) respondents aged 11–20 years, and 2,666 were male (51.4%) and 2,516 female (48.6%); 2,840 (54.8%) were 11–15 years old, and 2,342 (45.2%) were 16–20 years old. Regarding the region, 4,402 (84.9%) lived in the urban, and 780 (15.1%) lived in rural (Table 1).

Table 1
Characteristics of Subjects

Classification		Non-beneficiaries (2007–2009 year)		Beneficiaries (2013–2015 year)	
		N	(%)	N	(%)
Total		3,092	100.0	5,182	100.0
Gender	Male	1,574	50.9	2,666	51.4
	Female	1,518	49.1	2,516	48.6
Age	11–15 years	1,902	61.5	2,840	54.8
	16–20 years	1,190	38.5	2,342	45.2
Region	Urban	2,516	81.4	4,402	84.9
	Rural	576	18.6	780	15.1

Table 2 shows the application of sealant reimbursement among Korean children and adolescents, and the differences in sealant treatment according to sociodemographic characteristics.

Compared with the non-beneficiaries, the DS rate among the beneficiaries of the reimbursement policy increased by 7.7% (27.8–35.5%). The number of sealant permanent per capita doubled, 0.45 in non-beneficiaries and 0.83 in beneficiaries, and the difference between the two groups was significant ($p < 0.000$). Sealant retention (DS rate, DS index) was higher in women, younger age groups, for those whose father had higher education, and those with higher

household income. Age, household income, and parental status were significant factors ($p < 0.000$). Mother's education level was less different among the non-beneficiaries. In the beneficiary, the higher the mother's education level, the higher the sealant retention, and the association was significant ($p < 0.05$).

Table 2
The application of dental sealant reimbursement among Korean children and adolescents, and the differences in sealant treatment according to sociodemographic characteristics

Classification		DS rate(%) ^a		DS index ^b					
		Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries				
Total		27.8	35.5	0.45 ± 0.05	0.83 ± 0.03	*** ^c			
Gender	Male	26.7	NS	35.1	NS	0.62 ± 0.03	NS	0.87 ± 0.05	NS
	Female	29.1		35.9		0.58 ± 0.04		0.78 ± 0.05	
Age	11–15 years	34.9	***	43.3	***	0.82 ± 0.04	***	1.13 ± 0.05	***
	16–20 years	19.5		28.3		0.35 ± 0.03		0.55 ± 0.05	
Region	Urban	27.9		35.5		0.60 ± 0.03		0.84 ± 0.04	
	Rural	27.6		35.5		0.61 ± 0.08		0.76 ± 0.09	
Household income	lower	17.6	***	26.5	***	0.35 ± 0.05	***	0.60 ± 0.09	*
	Lower-middle	22.4		32.1		0.50 ± 0.06		0.78 ± 0.07	
	Upper-middle	27.7		36.3		0.57 ± 0.04		0.80 ± 0.06	
	Upper	37.0		42.2		0.83 ± 0.05		1.00 ± 0.07	
Father education	Less than high school	14.3	NS	18.8	NS	0.20 ± 0.05	NS	0.29 ± 0.06	NS
	More than college	24.7		23.2		0.39 ± 0.10		0.48 ± 0.11	
Mother education	Less than high school	18.2	NS	15.9	*	0.26 ± 0.05	NS	0.33 ± 0.06	NS
	More than college	12.8		30.5		0.24 ± 0.13		0.53 ± 0.11	
^a The data were analysed by Complex samples chi-square test									
^b The data were analysed by Complex samples general linear model.									
^c The difference between Non-beneficiaries and Beneficiaries (by Complex samples general linear model)									
*** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, NS $p > 0.05$									

Table 3 shows the application of sealant reimbursement among Korean children and adolescents, and the differences in decay-missing-filled permanent teeth index according to sociodemographic characteristics.

Compared with the non-beneficiaries, the DMFT rate among the beneficiaries decreased by 9.1% (68.4% vs. 59.3%). The DMFT index per person was 2.09 for the non-beneficiaries and 1.57 for the beneficiaries; this indicates a decrease of about a quarter, which was significant ($p < 0.000$). The decay-missing-filled permanent teeth retention (DMF rate, DMFT index) was higher in women, in the older age group, those living in the city, and those whose father's education was lower. In the non-beneficiaries, the association was significant for gender and age group, and in the beneficiaries, for father's education.

Table 3

The application of dental sealant reimbursement among Korean children and adolescents, and the differences in decay-missing-filled permanent teeth retention according to sociodemographic characteristics

Classification	DMF rate (%) ^a		DMFT index ^b		
	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	
Total	68.4	59.3	2.09 ± 0.10	1.57 ± 0.04	***
Gender	Male	62.2 ***	54.9 ***	1.74 ± 0.05 ***	1.38 ± 0.05 ***
	Female	75.1	64.0	2.19 ± 0.05	1.77 ± 0.06
Age	11–15 years	60.3 ***	50.1 ***	1.64 ± 0.04 ***	1.26 ± 0.05 ***
	16–20 years	77.9	67.5	2.32 ± 0.05	1.84 ± 0.06
Region	Urban	68.5 NS	59.6 NS	1.97 ± 0.04 NS	1.57 ± 0.05 NS
	Rural	67.6	57.3	1.88 ± 0.08	1.53 ± 0.11
Household income	lower	68.4 NS	62.3 NS	2.47 ± 0.11 NS	1.95 ± 0.12 NS
	Lower-middle	69.7	60.3	2.28 ± 0.17	1.93 ± 0.15
	Upper-middle	69.2	61.4	2.39 ± 0.10	1.95 ± 0.12
	Upper	66.8	54.8	2.70 ± 0.26	1.98 ± 0.16
Father education	Less than high school	81.9 NS	73.3 NS	2.03 ± 0.10 NS	1.70 ± 0.12 *
	More than college	79.8	68.6	2.01 ± 0.07	1.63 ± 0.09
Mother education	Less than high school	81.6 NS	72.0 NS	1.98 ± 0.07 NS	1.63 ± 0.07 NS
	More than college	83.4	71.3	1.85 ± 0.06	1.38 ± 0.07
^a The data were analysed by Complex samples chi-square test					
^b The data were analysed by Complex samples general linear model.					
^c The difference between Non-beneficiaries and Beneficiaries (by Complex samples general linear model)					
***p < 0.001, **p < 0.01, *p < 0.05, NSp > 0.05					

Table 4 shows the application of sealant reimbursement among Korean children and adolescents, and the differences in single-crown treatment according to sociodemographic characteristics.

Compared with the non-beneficiaries, the SC rate fell by 2.7% (8.7% vs 6.0%). The SC index per person decreased by 0.03, with 0.11 for the non-beneficiaries and 0.08 for the beneficiaries, but the difference was not significant. Single-crown holdings were higher in females, those in the higher age group, and those with a higher level of father's education.

Table 4

The application of dental sealant reimbursement among Korean children and adolescents, and the differences in Single-crown permanent teeth retention according to sociodemographic characteristics

Classification	SC rate(%): ^a		SC index ^b		
	Non-beneficiaries	Beneficiaries	Non-beneficiaries	Beneficiaries	
Total	8.7	6.0	0.11 ± 0.02	0.08 ± 0.00	NS
Gender	Male	7.5 NS	5.7 NS	0.10 ± 0.01 *	0.07 ± 0.01 NS
	Female	9.9	6.3	0.14 ± 0.01	0.09 ± 0.01
Age Group	11–15 years	4.5 ***	3.2 ***	0.06 ± 0.00 ***	0.04 ± 0.00 ***
	16–20 years	13.6	8.5	0.19 ± 0.01	0.12 ± 0.01
Region	Urban	9.0 NS	5.8 NS	0.12 ± 0.01 NS	0.08 ± 0.01 NS
	Rural	7.1	7.0	0.10 ± 0.02	0.10 ± 0.02
Household income	lower	7.0 NS	6.4 NS	0.18 ± 0.04 NS	0.17 ± 0.04 NS
	Lower-middle	11.1	6.7	0.18 ± 0.57	0.21 ± 0.05
	Upper-middle	8.2	6.5	0.20 ± 0.03	0.21 ± 0.04
	Upper	8.5	4.9	0.09 ± 0.06	0.21 ± 0.05
Father education	Less than high school	11.5 NS	11.8 NS	0.11 ± 0.02 NS	0.08 ± 0.02 *
	More than college	15.0	16.7	0.17 ± 0.02	0.10 ± 0.02
Mother education	Less than high school	12.4 NS	14.6 NS	0.10 ± 0.01 NS	0.09 ± 0.01 NS
	More than college	9.3	16.6	0.11 ± 0.01	0.05 ± 0.01
^a The data were analysed by Complex samples chi-square test					
^b The data were analysed by Complex samples general linear model.					
^c The difference between Non-beneficiaries and Beneficiaries (by Complex samples general linear model)					
***p < 0.001, **p < 0.01, *p < 0.05, NSp > 0.05					

Discussion

Sealant reimbursement for the first molar began in 2009 for individuals aged 6–14 in December 2009. Through two revisions, the second molar was added to the coverage in October 2012. In July 2013, the age range was expanded to those under 18 years of age. We aimed to identify the effectiveness of the sealant reimbursement policy for the first molar for those aged 11–20 years (who benefited from the beginning of reimbursement following the implementation of the sealant coverage in Korea) by identifying differences in oral health indices between beneficiaries and non-beneficiaries as well as associations with sociodemographic characteristics.

First, the sealant holder rate increased by 7.7% (27.8% for the non-beneficiaries and 35.5% for the beneficiaries) and the mean number of first molars with sealant per capita doubled (from 0.45 for non-beneficiaries to 0.83 for beneficiaries). This increase is estimated to be affected by the sealant reimbursement policy. However, this is low compared with the two-thirds of Danish 15-year-olds who have at least one sealant [17], as Korea has not yet reached one sealant per person. The main reason for the increase in the sealant holding rate not meeting the expectations was the low-income groups, as there was a relatively high cost-sharing ratio of 30–60% for the first 7 years (from December 2009 to September 2017), which may have raised the threshold for dental access. Before reimbursement, the cost of one sealant is approximately \$34, of which 30–60% is approximately \$10–20. It can be estimated that the cost will be about \$40 to \$80 per person, provided that all four first molars are treated per person. These costs are considered to be very expensive for the vulnerable groups.

Prior studies have shown that high partial copayments will be particularly burdensome for low-income individuals [18]. The relationship between socioeconomic factors and sealant has weakened after the reimbursement policy, but still existed [6]. In this study, there was a significant difference in sealant retention according to parental education and household income. Similar studies have reported that household income is associated with a higher sealant experience. [19].

Meanwhile, some developed countries provide free preventive dental services for children and adolescents. In the French dental system, children and adults are eligible for free preventive dental services every 3 years from 3 to 24 years of age [20]. In addition, Sweden regards children's dental care as part of the nation's universal welfare, and services for dental health for children and adolescents up to 19 years of age are provided free of charge [21].

In 2012, Korea piloted the family dentist system for vulnerable children under 18 years of age living in Seoul for the first time [22]. Since then, this system has been introduced and implemented in some areas. The family dentist system in Korea is a scheme that provides dental medical services such as oral examination, preventive care, and treatment in connection with the public health center and local dental clinic for low-income children [23]. This system has shown positive effects in terms of oral health awareness and behavior, and it is also very positive that students who have low access to dental healthcare and who do not receive dental services can be beneficiaries of the system [24]. Since 2020, the family dentist system for children has been piloted as a government-led project. In addition, since October 2017, deductibles have been reduced from 30–10% because of sealant reimbursement [25]. Nevertheless, in order to provide dental preventive services to vulnerable groups who do not benefit from the reimbursement system, schemes such as the family dentist system for children should be promoted, and measures to supplement the limitations and minimize problems between the systems should be implemented.

The proportion individuals with decay-missing-filled permanent teeth decreased by about quarter-fold in the beneficiaries compared with the non-beneficiaries, 2.09 in the non-beneficiaries and 1.57 in the beneficiaries. In addition, the single-crown retention rate decreased 2.7% (8.7% for the non-beneficiaries to 6.0% for the beneficiaries). The number of single crowns per person decreased by 0.03 (from 0.11 to 0.08), but this was not statistically significant. In other words, both the occurrence of caries and fixed dentures decreased, but these were not significant changes when compared to values before the reimbursement policy. In addition, according to the outpatient ranking of multi-frequency diseases in Korea, dental caries in 2010–2018 ranked 6-7th, which indicates no significant change over 8 years [26]. It is supposed that dental caries are decreasing in children and adolescents, but the caries that have advanced to adulthood and need treatment have not been reduced.

As a result, there seems to be a need to determine how long sealant treatment in children and adolescents can last into adulthood. Some previous studies have shown that the retention and lifespan of sealants act as a beneficial factor in the prevention of tooth decay [27, 28]. That is, after sealant treatment, if left out partially, the risk of caries seems inevitable. Choi et al. insisted on the factors that can improve retention of sealant treatment and asserted the importance of follow-up management to institutionalize and manage return visits after treatment [29]. Although sealant is less costly and more effective as a preventive policy than the expensive post-treatment of caries, the caries prevention effect of sealant will not last into adulthood without considering the loss and maintenance of sealant. In the future, a follow-up system that can ensure sealant retention will need to be implemented.

This study was meaningful as it confirmed the change in oral health indicators and the difference of sociodemographic factors after the sealant reimbursement policy was implemented. However, there were some limitations. First, we could not track the age of the participants limited to cross-sectional studies; moreover, there were restrictions in identifying causal relationships, although associations between oral health indicators and sociodemographic characteristics were identified. In the future, cohort studies are needed to track the experience with sealant treatment to confirm changes in oral health indices and promote sealant maintenance.

Conclusions

Sealant treatment for the first molar in children and adolescents aged 11–20 years was significantly higher in reimbursement policy beneficiaries compared with non-beneficiaries, and caries was significantly lower. In addition, differences in sealant and caries indicators according to sociodemographic characteristics were also identified. Therefore, a system to prevent and treat dental caries based on universal health coverage should be established, and a follow-up system is needed to monitor the retention of sealant.

Abbreviations

DMF rate (%): the percentage of decay-missing-filled permanent teeth (first molars)

DMFT index: the average decay-missing-filled permanent teeth index per person (first molars)

DS rate (%): the percentage of dental sealant holders (first molars)

DS index: the number of dental sealant permanent per capita (first molars)

SC rate (%): the percentage of single-crown holders (first molars)

SC index: single-crown index per person (first molars)

KNHNES: Korea National Health and Nutrition Examination Survey

Declarations

Ethics approval and consent to participate

This study used data from the fourth period (2007–2009) and fifth period (2013–2015) KNHANES conducted by the Korea Centers for Disease Control and Prevention. and the study was approved by the Committee on Research Ethics at the National Statistical Office and the Centers for Disease Control and Management.

Consent for publication

"Not applicable"

Availability of data and materials

The datasets generated and/or analysed during the current study are available in the [Korea National Health and Nutrition Examination Survey] repository, [https://knhanes.cdc.go.kr/knhanes/sub03/sub03_01.do]

Competing interests

The authors declare that they have no competing interests.

Funding

The authors report no external funding source for this study.

Authors' contributions

All authors gravely contributed to the study presented in this article. JS was involved in acquiring, analyzing, and interpreting data and writing the first draft of the manuscript, and DS contributed to study planning and designing, data interpretation, and revision of the final draft.

Acknowledgements

We express gratitude to the Korea Centers for Disease Control and Prevention for providing us with the raw Korea National Health and Nutrition Examination Survey data.

References

1. Kassebaum NJ, Smith AGC, Bernabé E, Fleming TD, Reynolds AE2, Vos T, Murray CJL, Marcenes W GBD 2015 Oral Health Collaborators. Global, Regional, and National Prevalence, Incidence, and Disability-Adjusted Life Years for Oral Conditions for 195 Countries, 1990-2015: A Systematic Analysis for the Global Burden of Diseases, Injuries, and Risk Factors. *J Dent Res.* 2017;96(4):380-7.
2. Müller, A, Hussein K, Meta-analysis of teeth from European populations before and after the 18th century reveals a shift towards increased prevalence of caries and tooth loss. *Arch Oral Biol* 2017; 73:7–15.
3. Petersen, PE. The World Oral Health Report 2003: continuous improvement of oral health in the 21st century—the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol.*2003;1:3-23.
4. Dental health among children. In *Health at a Glance 2009: OECD Indicators*. Paris, France:OECD Publishing; 2009:34–35.
5. Korean Dental Association, Health Policy Institute. Oral health status and determinants. In *2014 Yearbook of the Korean Dentistry*. Seoul, South Korea: Korean Dental Association, Health Policy Institute; 2015:
6. Korean Dental Association, Health Policy Institute. Oral health status and determinants. In *2018 Yearbook of the Korean Dentistry*. Seoul, South Korea: Korean Dental Association, Health Policy Institute; 2019:57.
7. Health Insurance Review & Assessment Service. http://www.hira.or.kr/dummy.do?pgmid=HIRAA050200000000&cmsurl=/cms/medi_info/02/01/1343482_27565.html&subject=%EC%B9%98%EB%A9%B4%EC%97%B4%EA%B5%AC%EC%. Accessed 21 January 2020.
8. Choi JS, Park DY, Jung SH. The relationship between pit and fissure sealant (PFS) experience and the socio-economic factors of adolescents before and after coverage by National Health Insurance (NHI). *J Korean Acad Oral Health.* 2017;41(2):116–21.
9. Choi JS, Park DY. The impact of national health insurance coverage on pit and fissure sealing experience. *Rural Remote Health.* 2018;18(4):
10. Ministry of Health & Welfare. *2010 Oral Health Services Manual*. Seoul, South Korea: Ministry of Health & Welfare; 2010:1-5.
11. Ministry of Health & Welfare. 2015 Korean Children's Oral Health Survey. Sejong-Cheongju, South Korea: Ministry of Health & Welfare; 2015:130.
12. Ministry of Health & Welfare. 2018 Korean Children's Oral Health Survey. Sejong-Cheongju, South Korea: Ministry of Health & Welfare; 2018:114.
13. Korea Centers for Disease Control and Prevention, Korean National Health and Nutrition Examination Surveys. https://knhanes.cdc.go.kr/knhanes/sub01/sub01_02.do. Accessed 02 Jan. 2020.
14. Korean National Health and Nutrition Examination Surveys. Raw data. Data Analysis Guide. https://knhanes.cdc.go.kr/knhanes/sub03/sub03_06_mod.do. Accessed on 02 Jan. 2020.

15. Korea Centers for Disease Control and Prevention. Standardization for Oral Health Survey in KNHANES. Sejong-Cheongju, South Korea: Korea Centers for Disease Control and Prevention;2014:3-6
16. Ministry of Health & Welfare, Korea Centers for Disease Control and Prevention. the sixth (2013-2015) Instructions for Use of Raw Data. Sejong-Cheongju, South Korea: Ministry of Health & Welfare, Korea Centers for Disease Control and Prevention;2015:2.
17. Ekstrand, KR, Martignon S, Christiansen ME. Frequency and distribution patterns of sealants among 15-year-olds in Denmark in 2003. *Community Dent Health*. 2007;24(1):26-30.
18. Choi JS, Ma DS, Jung SH, Cho EP, Park DY. Changes in the amount of pit and fissure sealants supplied in Korea after inclusion in the National Health Insurance coverage. *J Korean Acad Oral Health* 2015;39(1):69–77.
19. Al Agili DE, Griffin SO. Effect of family income on the relationship between parental education and sealant prevalence, National Health and Nutrition Examination Survey, 2005-2010. *Prev Chronic Dis*. 2015; 12:E138.
20. Ufsbd, M'T dents. <https://www.ufsbd.fr/mt dents1/>. Accessed 02 Jan. 2020.
21. Korea Institute for Health and Social Affairs. Social Security in Major Countries - Sweden-. Korea Institute for Health and Social Affairs . Sejong-Cheongju, South Korea: Korea Institute for Health and Social Affairs ;2012:312-3.
22. The Seoul institute. Policy evaluation of family dentist system for students and children of low-income households and its suggestions. the Seoul institute. Seoul ,South Korea: The Seoul institute;2016:4.
23. Korean Government Services. <https://www.gov.kr/portal/service/serviceInfo/324000000027>. Accessed 02 Jan. 2020.
24. The Seoul institute. Policy evaluation of family dentist system for students and children of low-income households and its suggestions. the Seoul institute. Seoul ,South Korea: The Seoul institute;2016:110.
25. Ministry of Health & Welfare. 2000 Korean National Oral Health Survey. Ministry of Health & Welfare. Seoul ,South Korea: Ministry of Health & Welfare; 2001:78-9
26. Healthcare gig data bub. <http://opendata.hira.or.kr/op/opc/olapHifrqSickInfo.do>. Accessed 02 Jan. 2020.
27. Going, RE, Haugh LD, Grainger DA, Conti AJ. Four-year clinical evaluation of a pit and fissure sealant. *J Am Dent Assoc*. 1977;95(5):972–81.
28. Kühnisch, J.; Mansmann, U.; Heinrich-Weltzien, R.; Hickel, R. Longevity of materials for pit and fissure sealing—results from a meta-analysis. *Dent Mater*. 2012;28(3):298–303.
29. Choi JS, Park DY. Comparison of supplied amount of pit and fissure sealing on the first permanent molars by age and disparity of dental accessibility using National Health Insurance data. *J Korean Acad Oral Health*. 2016;40(3):171–7.