Did the extended coverage policy contribute to alleviating socioeconomic inequality in untreated dental caries of both children and adolescents in South Korea?

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Abstract

Background Dental sealants have been covered by the National Health Insurance Service (NHIS) since December 2009 in South Korea. This study aims to determine whether the socioeconomic inequality in untreated dental caries decreased after implementing the extended coverage policy for dental sealant.

Methods The data were derived from the fourth (2007–2009) and sixth (2013–2015) waves of the Korean National Health and Nutrition Examination Survey (KNHANES) conducted by the Korea Centers for Disease Control and Prevention (KCDC). Dental caries and sealant experience by income quartiles were tested using the Rao-Scott chi-squared test. In order to examine socioeconomic inequalities and their trends over time, the prevalence ratios (PRs), slope index of inequality (SII), and relative index of inequality (RII) were estimated for each wave and age group. All analyses were conducted using SAS version 9.3.

Results The adjusted PRs of untreated dental caries and sealants in the poorest in the aged 6-11 group were significantly higher and lower, respectively, compared to the most affluent quartile group for the fourth wave; however, all significant differences disappeared for the sixth wave. The gap between the lowest and the highest was similar for the aged 12-18 group but the statistical significance of the PRs was still maintained for the sixth wave. Children showed decreases in both SII and RII over time so its significance disappeared. The SII among adolescents decreased over time, while the RII increased both in untreated dental caries and sealants.

Conclusions This study found that the NHIS coverage expansion of dental care had a positive effect on overall status in dental health among children and adolescents. However, younger children benefited more in terms of inequalities. Our findings indicate that strategies to enhance access to preventive dental services should consider the differential effects for the vulnerable population in terms of socioeconomic status and age from the beginning stage of the policy.

Background

Dental caries is the tenth most prevalent disease in the world, representing a significant burden of disease, especially in children [1, 2]. More than a quarter of the global population, almost 2.4 billion, suffer from untreated dental caries. Moreover, it is very expensive, as shown to be the fourth most expensive disease for effective treatment [3]. The bigger issue is that oral health conditions often indicate socioeconomic inequalities. A previous systematic review revealed that an individual's socioeconomic position (SEP), such as parental or own education, occupation, and family income, was significantly associated with dental caries [4]. Those with higher SEP had a lower risk of having or having experienced dental caries.

Preventive care is the most effective way to minimize both the health and financial burdens of untreated caries. Dental sealants and fluoride applications are common and effective methods for preventing dental caries [5]. In the United States, school-based programs provide sealants to children, especially for subsidized meal program recipients [6]. Students who did not receive sealant treatment showed a two to three time higher mean numbers of decayed or filled first molars than students who did [7]. They suggested that universal caries prevention could reduce the incidence of dental caries by up to 80%, leading to savings on dental expenses [8]. A Chinese cohort study also showed that the hazard ratio for dental caries was 0.6 times lower in the treatment group received sealants compared to the control group [9].

However, a Dutch study showed undesirable outcomes regarding socioeconomic inequalities in dental health in spite of the expansion of dental care coverage. The Netherlands' government offers free dental services for individuals under nineteen years old and most of the participants visited dental professionals almost every year. Even after the expansion children in low SEP still had 1.5 times higher risk of having caries than children in higher SEP. This gap persisted beyond childhood and continued until they were young adults [10]. Similar results were found in Sweden, where the government provides free dental services for children and adolescents. The children in lower SEP had two to five times higher odds ratios of having dental caries than the higher SEP group, controlling for covariates such as ethnicity, wealth, parental education, and employment [11]. A meta-analysis also reported that developed countries with relatively equal income distribution showed more unequal caries experience, compared to developing countries with unequal income distribution [4]. These inconsistent findings suggest that there must be diverse factors related to the prevalence or experience of dental caries and that similar factors might have different effects, depending upon countries' health care systems and their economic development status [12–14].

In South Korea (hereafter, Korea), dental sealants have been covered by the National Health Insurance Service (NHIS) since December 2009 [15]. In the beginning, the policy offered limited coverage, only the first molars of children aged 6 to 14. In May 2013, the coverage was expanded up to the second molars of children up to 18 years old. Accordingly, the proportion of children aged 6–14 years who received dental sealant increased encouragingly, from 28.7–34.9% [16]. A Korean study reported that after the policy implementation, dental sealant increased and untreated caries decreased, especially among lower SEP groups [17]. Many existing studies have suggested that equal access to dental treatment is essential to improve the dental status of all [18]. However, there is a gap in the literature concerning whether these governmental policies contribute to alleviating inequality in children's oral health [19].

This study aims to determine whether the socioeconomic inequality in untreated dental caries decreased after implementing the extended coverage policy for dental sealant in South Korea.

Methods

Study design and participants

The data were derived from the fourth (2007–2009) and sixth (2013–2015) waves of the Korean National Health and Nutrition Examination Survey (KNHANES) conducted by the Korea Centers for Disease Control and Prevention (KCDC). The KNHANES is a repeated cross-sectional survey on a representative national sample that is based on multi-stage clustered probability samples from Korean households representing the civilian non-institutionalized population aged one year and older [20]. Each year, 192 sampling units and 20 households per primary sampling unit are selected according to location, age, and gender, yielding approximately 10,000 subjects in the age group. The survey consists of a health examination, a health interview, and a nutrition survey. It also includes an oral health examination by a dentist and a questionnaire interview regarding oral health behaviors. The KNHANES is certified and used as the national statistics by the Korea Department of Statistics. The raw data of the KNHANES are publicly available on their official website [21]. For the samples used in this study, the response rates were 78.4% in the fourth [22–24] and 78.3% in the sixth-wave [25–27], respectively. A total of 50,405 individuals participated, with informed consent. This study

analyzed data from 7,410 participants aged 6–18 years old (4,353 in the fourth and 2,915 in the sixth-wave) after excluding 1,040 individuals due to missing information about oral health status, household income, and dental health behaviors. The study participants were divided into two groups: children aged 6–11 years old and adolescents aged 12–18 years old. The Institutional Review Board of Gangneung-Wonju National University reviewed and approved this study (GWNUIRB-2016-07).

Data Variables

We set the outcome variables as dental caries and sealant experience, evaluated by dentists based on WHO criteria, who had completed the calibration training program and carried out clinical oral examinations in the mobile health examination centers [28]. For the dentist calibration training, the dental status measures were validated by comparing it with a reference dentist. As inter-examiner reliabilities, the mean Kappa values for tooth status were 0.711 to 0.919 in the fourth [29–31] and 0.892 to 0.939 in the sixth-wave [32–34]. Socioeconomic variables included household monthly income, equivalized for household size (equivalent household income = total household income ÷ [household size]$^{0.5}$) and categorized into four quartiles. Dental health behaviors were considered as potential mediators to the relationship between income and dental health, while age and gender were considered as confounders. The frequency of tooth brushing (FTB) was categorized into two groups: brushing less than twice a day vs. two or more times a day. Regular dental check-ups (RDC) was classified as yes or no, asking whether they had visited the dentist for a regular check-up without any symptoms during the year prior to the interview.

Data analysis

We used a complex sample analysis method to consider complex sample designs, including primary sampling units, stratification, and sample weights. The oral health conditions by income quartiles were tested using the Rao-Scott chi-squared test (Proc Surveyfreq). In order to examine socioeconomic inequalities and their trends over time, the prevalence ratios (PRs), slope index of inequality (SII), and relative index of inequality (RII) were estimated for each wave and age group. The PRs and 95% confidence intervals (CIs) were estimated to assess the association between household income quartiles and untreated dental caries or sealant experiences in Korean children. SII represents the absolute difference in values between the lowest and the highest ends of SEP [35], while RII represents the ratio of the prevalence between the highest and lowest ends [35–37] A PROC GENMOD log-binomial regression was used to estimate PRs and their 95% CIs, SII, and RII. All analyses were conducted using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA). Convergence availability was confirmed for all calculations of PR, SII, and RII.

Results

The general characteristics of the study participants are shown in Table 1. The gender and income distribution of both age groups were similar at the fourth and sixth wave, respectively.

Table 1
Study Sample Characteristics: N (%)

	Children aged 6–11			Adolescents aged 12–18		
Variables	2007–09	2013–15	P-value	2007–09	2013–15	P-value
Total	2,240 (100)	1,449 (100)		2,113 (100)	1,466 (100)	
Gender						
Male	1,167 (52.1)	758 (51.9)	0.937	1,113 (53.7)	812 (52.1)	0.572
Female	1,073 (47.9)	691 (48.1)		1,000 (46.3)	718 (47.9)	
Income level						
I (lowest)	553 (24.9)	347 (23.7)	0.671	524 (24.8)	348 (25.0)	0.872
□	544 (23.9)	359 (26.7)		518 (24.8)	363 (25.1)	
□	568 (25.3)	368 (25.2)		522 (24.8)	391 (25.7)	
□ (highest)	575 (25.9)	375 (24.4)		549 (25.6)	364 (24.2)	
FTB						
< 2	308 (13.8)	117 (7.9)	< 0.001	261 (12.3)	108 (7.7)	< 0.001
≥ 2	1,932 (86.2)	1,332 (92.1)		1,852 (87.7)	1,358 (92.3)	
RDC						
No	755 (32.2)	427 (28.4)	0.116	1,124 (53.4)	820 (57.3)	0.025
Yes	1,485 (67.8)	1,022 (71.6)		989 (46.6)	646 (42.7)	
FTB (frequency of tooth brushing), RDC (regular dental check-ups)						

Table 2 shows the prevalence of untreated dental caries and sealant by gender and household income. The prevalence of untreated dental caries decreased in both age groups and all the income groups over time, except for the highest income quartile of the children. In contrast, the sealant prevalence increased over time across all ages and income groups. For the fourth wave, there was a significant socioeconomic inequality in untreated dental caries and sealant prevalence in both age groups; however, for the sixth wave, there was no significant difference among the aged 6–11 group.

Table 2

Prevalence rates of untreated dental caries and sealant by income level

	Children aged 6–11			Adolescents aged 12–18		
Variables	2007–09	2013–15	Difference	2007–09	2013–15	Difference
Untreated dental caries						
Total	8.7 (7.3–10.1)	5.7 (4.3– 7.1)	-3.0	32.7 (30.1–35.3)	23.7 (20.7–26.7)	-9.0
Gender						
Male	8.9 (6.9–10.9)	5.3 (3.5–7.2)	-3.5	31.6 (28.3–35.0)	24.7 (21.0–28.4)	-6.9
Female	8.5 (6.6–10.4)	6.1 (4.2–8.1)	-2.4	34.0 (30.4–37.6)	22.6 (18.7–26.6)	-11.4
P-value	0.795	0.536		0.315	0.386	
Income level						
I (lowest)	11.9 (8.8–14.9)	5.7 (3.2–8.2)	-6.2	42.0 (36.5–47.4)	32.0 (25.9–38.1)	-10.0
II	10.5 (7.5–13.6)	7.1 (4.0–10.1)	-3.5	33.3 (28.5–38.1)	20.6 (15.3–25.8)	-12.7
III	7.4 (4.9–9.8)	3.2 (1.4–5.0)	-4.1	27.6 (22.8–32.3)	22.3 (17.2–27.4)	-5.2
IV (highest)	5.2 (3.2–7.1)	6.8 (3.6–10.0)	1.6	28.2 (23.8–32.7)	19.9 (14.1–25.6)	-8.4
P-value	0.001	0.152		< 0.001	0.006	
FTB						
< 2	14.8 (10.4–19.3)	9.6 (3.6–15.5)	-5.3	30.7 (23.9–37.4)	31.0 (21.2–40.7)	0.3
≥ 2	7.7 (6.2–9.2)	5.4 (4.0–6.8)	-2.3	33.0 (30.4–35.7)	23.1 (20.0–26.2)	-9.9
P-value	0.001	0.091		0.513	0.095	
RDC						
No	10.0 (7.6–12.3)	5.1 (2.8–7.3)	-4.9	34.2 (30.8–37.6)	28.1 (24.0–32.2)	-6.1

P-values were obtained from complex samples crosstabs: Rao-Scott chi-squared test.

Values are presented by weighted prevalence % (95% CI).

FTB (frequency of tooth brushing), RDC (regular dental check-ups)

	Children aged 6–11			Adolescents aged 12–18		
Yes	8.1 (6.3–9.8)	6.0 (4.2–7.7)	-2.1	31.0 (27.5–34.5)	17.8 (14.5–21.1)	-13.2
P-value	0.192	0.553		0.166	< 0.001	
Sealants						
Total	30.6 (28.0–33.3)	40.7 (37.5–44.0)	10.1	26.8 (24.2–29.3)	37.0 (33.8–40.2)	10.2
Gender						
Male	29.6 (26.3–32.9)	40.3 (36.2–44.4)	10.7	26.1 (23.1–29.2)	36.4 (32.5–40.3)	10.3
Female	31.7 (28.2–35.2)	41.2 (36.9–45.6)	9.5	27.5 (23.9–31.1)	37.6 (33.3–41.9)	10.1
P-value	0.320	0.737		0.539	0.651	
Income level						
I (lowest)	24.5 (20.2–28.7)	40.1 (34.1–46.1)	15.6	16.9 (13.0–20.7)	27.8 (22.5–33.0)	10.9
II	31.7 (26.9–36.4)	37.5 (31.6–43.4)	5.8	24.4 (19.7–29.0)	38.5 (32.3–44.6)	14.1
III	30.9 (26.0–35.8)	42.7 (36.8–48.6)	11.8	29.6 (25.1–34.1)	37.3 (31.8–42.7)	7.7
IV (highest)	35.3 (30.5–40.1)	42.9 (36.7–49.2)	7.6	35.9 (30.9–40.9)	44.6 (38.3–51.0)	8.7
P-value	0.008	0.522		< 0.001	0.001	
FTB						
< 2	24.6 (19.2–30.0)	35.1 (25.7–44.5)	10.5	20.4 (15.1–25.7)	35.6 (25.5–45.8)	15.2
≥ 2	31.6 (28.8–34.4)	41.2 (37.8–44.6)	9.7	27.7 (25.0–30.3)	37.1 (33.8–40.4)	9.4
P-value	0.024	0.240		0.020	0.789	
RDC						
No	24.8 (20.7–28.9)	36.1 (30.3–41.9)	11.3	21.9 (18.8–25.0)	33.4 (29.5–37.3)	11.6

P-values were obtained from complex samples crosstabs: Rao-Scott chi-squared test.

Values are presented by weighted prevalence % (95% CI).

FTB (frequency of tooth brushing), RDC (regular dental check-ups)

	Children aged 6–11			Adolescents aged 12–18		
Yes	33.4 (30.3–36.5)	42.6 (38.9–46.3)	9.2	32.4 (28.7–36.1)	41.7 (37.2–46.2)	9.4
P-value	0.001	0.062		< 0.001	0.003	
P-values were obtained from complex samples crosstabs: Rao-Scott chi-squared test.						
Values are presented by weighted prevalence % (95% CI).						
FTB (frequency of tooth brushing), RDC (regular dental check-ups)						

Table 3 shows the adjusted PRs of untreated dental caries and sealants by income quartiles for the fourth and sixth waves. The adjusted PRs of untreated dental caries and sealants in the lowest income quartile in the aged 6–11 group were significantly higher or lower, respectively, compared to the highest quartile group for the fourth wave; however, all significant differences disappeared for the sixth wave. The gap between the lowest and the highest was similar for the aged 12–18 group but the statistical significance of the PRs was still maintained for the sixth wave.

Table 4 shows the absolute and relative inequalities in untreated dental caries and sealant prevalence in both age groups by income quartiles. Between the fourth and the sixth wave, the SII and RII of sealant and untreated dental caries prevalence were different in two age groups. Children showed decreases in both SII and RII over time so its significance disappeared. The SII among adolescents decreased over time, for example, from 16.4 (95% CI: 9.6–23.2) to 13.9 (95% CI: 6.5–21.2), while the RII increased from 1.7 (95% CI: 1.4–2.2) to 2.1 (95% CI: 1.5–2.9) both in untreated dental caries and sealants.

Table 3

Changes in prevalence ratios (PRs) (95% CI) of untreated dental caries and sealant by income level

	Children aged 6–11				**Adolescents aged 12–18**			
	2007–09		2013–15		2007–09		2013–15	
	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]
Untreated dental caries								
Income level								
I (lowest)	2.29 (1.51, 3.50)***	2.11 (1.38, 3.23)***	1.12 (0.64, 1.96)NS	1.10(0.62, 1.93)NS	1.47 (1.24, 1.74)***	1.44 (1.22, 1.71)***	1.77 (1.37, 2.32)***	1.67 (1.28, 2.18)***
	2.18 (1.43, 3.34)***	2.14 (1.40, 3.28)***	0.91 (0.51, 1.63)NS	0.91 (0.51, 1.63)NS	1.12 (0.93, 1.35)NS	1.11 (0.92, 1.33)NS	1.19 (0.88, 1.59)NS	1.15 (0.85, 1.54)NS
III	1.44 (0.91, 2.27)NS	1.44 (0.91, 2.27)NS	0.66 (0.35, 1.25)NS	0.67 (0.36, 1.27)NS	0.96 (0.79, 1.17)NS	0.96 (0.79, 1.17)NS	1.17 (0.87, 1.56)NS	1.16 (0.87, 1.55)NS
(highest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Sealants								
Income level								
I (lowest)	0.70 (0.59, 0.85)***	0.73 (0.61, 0.88)***	0.90 (0.76, 1.06)NS	0.92 (0.78, 1.09)NS	0.54 (0.45, 0.66)***	0.57 (0.47, 0.70)***	0.70 (0.58, 0.85)***	0.70 (0.58, 0.86)***
II	0.88 (0.74, 1.03)NS	0.89 (0.75, 1.04)NS	0.89 (0.75, 1.04)NS	0.90 (0.76, 1.06)NS	0.68 (0.57, 0.82)***	0.71 (0.59, 0.84)***	0.86 (0.73, 1.03)NS	0.87 (0.73, 1.03)NS
III	0.89 (0.76, 1.05)NS	0.90 (0.76, 1.05)NS	1.01 (0.86, 1.18)NS	1.01 (0.87, 1.18)NS	0.85 (0.72, 1.00)*	0.85 (0.73, 1.00)NS	0.86 (0.73, 1.02)NS	0.86 (0.73, 1.01)NS
IV (highest)	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00

[a] Adjusted for age, gender.

[b] Adjusted for age, gender, FTB, and RDC

* P < 0.05, **P < 0.01, *** P < 0.001

Table 4
Absolute and Relative socio-economic inequalities in prevalence rate (PRs) (95% CI) of untreated dental caries and sealant by income level

	Children aged 6–11				Adolescents aged 12–18			
	2007–09		2013–15		2007–09		2013–15	
	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]	Model 1[a]	Model 2[b]
Untreated dental caries								
SII	7.3 (3.3, 11.3) ***	7.0 (2.8, 11.2)**	0.8 (-3.3, 4.8)NS	0.4 (-3.6, 4.4)NS	16.4 (9.6, 23.2)***	15.9 (9.0, 22.7)***	13.9 (6.5, 21.2)***	11.7 (4.3, 19.2)**
RII	3.1 (1.9, 5.0) ***	2.7 (1.7, 4.5)***	1.2 (0.6, 2.6)NS	1.2 (0.5, 2.5)NS	1.7 (1.4, 2.2)***	1.7 (1.4, 2.1)***	2.1 (1.5, 2.9)***	1.9 (1.3, 2.6)***
Sealants								
SII	-11.7 (-18.1, -5.4)***	-9.3 (-16.4, -2.2)**	-7.1 (-15.2, 0.9)NS	-5.0 (-13.2, 3.1)NS	-20.9 (-27.6, -14.3)***	-18.1 (-24.8, -11.4)***	-14.9 (-23.7, -6.2)***	-14.3 (-23.1, -5.4)**
RII	0.7 (0.5, 0.8)***	0.7 (0.6, 0.9)***	0.8 (0.7, 1.0)NS	0.9 (0.7, 1.1)NS	0.5 (0.4, 0.6)***	0.5 (0.4, 0.6)***	0.7 (0.5, 0.9)**	0.7 (0.5, 0.9)**

[a] Adjusted for age, gender.

[b] Adjusted for age, gender, FTB, and RDC

* P < 0.05, **P < 0.01, *** P < 0.001

Discussion

This study found that socioeconomic inequality in untreated dental caries and sealant treatment was alleviated for children by an expansion of NHIS coverage in Korea.

After the coverage expansion of dental sealants, the prevalence of untreated dental caries decreased and that of having sealant treatment increased in both children and adolescents. This study also showed an overall increase in dental service usage after the coverage expansion [17]. A similar review on smoking inequality in youth after tobacco control policies concluded that [38] education and information communication led to widening inequalities, while the tobacco price policy reduced socioeconomic inequalities. This is supported by the argument that some public health interventions may increase inequalities [39]. “Upstream” interventions such as reducing price barriers are more likely to have positive effects on alleviating inequalities compared to “downstream” interventions to focus on individual-level factors such as information provided through education. Based on the review of the effects of public health policies on health inequalities, Thomson et al.

[40] concluded that two types of oral health interventions had positive effects on inequalities: water fluoridation [41] and a national tooth brushing education campaign [42]. Another study pointed out that dental insurance is an important driver for dental service use, as tackling financial barriers mostly reduces unmet dental needs [17, 43]. US studies to examine the effects of the Children's Health Insurance Program also reported an increase in sealant treatment, fluoride tablets, and dental visits and a decrease in untreated caries since 1997, especially in children from lower-income households who benefited from free or subsidized school lunch programs [44].

Our study showed differential impacts of coverage expansion on dental health inequality between children and adolescents; the alleviation of inequalities was more salient among children while not among adolescents. What could explain such a difference? First, inequality may worsen as children grow older, as shown in previous studies [45–48]. A study based on the United Kingdom Millennium Cohort showed relatively narrow in health inequality when the children were younger (aged 3–5) [45]. They were born when the New Labor Government introduced a sustainable strategy to address health inequalities. It could be inferred that the use of preventive dental services may alleviate the disease. Even the same intervention could not have the same effect on older children to alleviate inequality. The second possibility is the 'inverse care law' of public health care [49–52]. In the early stage, public health care is used by people with more resources such as information, time, availability, or money, which leads to deepening inequalities. The NHIS dental care coverage was implemented in December 2009, and it covered only children aged 6–14 years old for the first molar in permanent dentition with a 30% copayment. In 2012, the coverage was expanded to the second molar and adolescents up to 18 years old in 2013. It means that the adolescents aged 12–18 in the sixth wave were 6–12 years old in the fourth wave (2007–2009). A part of them was not eligible for the service because of age limitations until 2013. Later the service was available to all, but some of them already had or had experienced caries, in which dental sealants were no longer applicable. Third, as McLaren pointed out, sometimes the population strategy of prevention will not be effective in narrowing socioeconomic inequalities in health [53]. Preventive services such as sealant treatment could inhibit dental caries, but it is not guaranteed to reduce socioeconomic inequalities in oral health [54]. Based on Taiwan's National Health Insurance Research Database, Hsu et al. showed that including the preventive provision of fluoride has an effect, but only for specific groups of children who are vulnerable to dental problems [55]. Even though the percentage of children receiving fluoride was increasing, visits for dental caries decreased among those with highly severe caries of primary dentition. One UK study also showed that socioeconomic inequality remained despite no difference in dental health utilization [56]. In the United States, income-related inequality in untreated dental caries among children has been steady over three decades since the 1970s [46, 47]. More salient inequality in dental health observed in developed countries rather than developing ones [4] may be associated with accessibility to dental treatment services as well as sugar consumption [48].

This study analyzed data from KNHANES, which is a yearly repeated cross-sectional survey and the data for every three years represent a different wave. The survey continues for three years, which offers the advantage of reflecting fast-changing disease patterns. There could be slight differences every year, meaning that it is imperative that data are handled carefully [20]. This was the reason to analyze this data to compare before and after the policy implementations such as natural experiments. It can be assumed that the changes of Korean people could be found by this sample. Another advantage of this survey is carefully designed to be representative of national non-institutionalized civilians in South Korea. Well-trained dentists took part in this

survey which makes the result stronger and reliable. The survey is repeated every year with different samples, not like a cohort. It could be a strength of this survey because the cohort might be impossible to reflect the change of the caries trends with representative samplings. The different characteristics of the fourth and sixth wave samples were applied to the data set with caries and sealant status changes.

There are several limitations of this study related to the coverage of dental sealants. The NHIS policy changes too often in relation to dental sealant treatment. From the 2010s, the government just agreed on an extension of the coverage provided for dental care to include preventive treatment for the first time. This has not been implemented before, as the government was wary of the possible financial burden. However, their expectations proved to be inaccurate, as fewer than 10% of children received the dental sealant service under the policy coverage every year. Because it was a new approach, the policy went through a transitional phase concerning the extended coverage of dental service in the beginning. This means that the change in policy could have affected the children and adolescents in this study unevenly. Later, in 2017, the government reduced the out-of-pocket payment from 30–10% of the total fee. This limitation can be overcome if monitoring of next wave study samples continues.

Conclusion

This study found that the NHIS coverage expansion of dental care had a positive effect on overall status in dental health among children and adolescents. However, younger children benefited more in terms of inequalities. Our findings indicate that strategies to enhance access to preventive dental services should consider the differential effects for the vulnerable population in terms of socioeconomic status and age from the beginning stage of the policy.

List Of Abbreviations

SEP: Socioeconomic Position; Korea: South Korea; NHIS: National Health Insurance Service (NHIS); KNHANES: Korean National Health and Nutrition Examination Survey; KCDC: Korea Centers for Disease Control and Prevention; WHO: World Health Organization; FTB: Frequency of Tooth Brushing; RDC: Regular dental check-ups; PRs: Prevalence Ratios; SII: Slope Index of Inequality; RII: Relative Index of Inequality; CIs: Confidence Intervals

Declarations

Ethics approval and consent to participate

This study used data from the fourth (2007-2009) and sixth (2013-2015) KNHANES conducted by the Korea Centers for Disease Control and Prevention that written informed consent was obtained from participants and a parent or guardian for participants under 14 years old. It was exempted from review (GWNUIRB-2016-07) by the Institutional Review Board (IRB) at Gangneung-Wonju National University.

Consent for publication

- Not applicable

Availability of data and material

- The datasets used and/or analyzed during the current study are available from the corresponding author on reasonable request.

Competing interests

- The authors declare that they have no competing interests.

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Authors' contributions

- All authors contributed extensively to the work presented in this paper. BM has been involved in acquisition of data, analysis and interpretation of data and drafting the manuscript; JI has made substantial contributions to conception and design, interpretation of data and drafting the manuscript; SH and MH have been revising it critically for important intellectual content; and All authors have given final approval of the version to be published. Each author have participated sufficiently in the work to take public responsibility for appropriate portions of the content and agreed to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved.

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