BIOSCIENCE JOURNAL

EFFECT OF ORAL HEALTH INTERVENTION PROGRAM ON THE SELF ORAL CARE OF CHILDREN ATTENDING CHILDCARE FACILITIES: A QUASI-EXPERIMENTAL STUDY

Su-Jung LEE[1], Jong-Hwa JANG[2]

[1] Department of Dental Hygiene, Andong Science College, Andong-si, Gyeongsangbuk-do, Republic of Korea.
[2] Department of Dental Hygiene, College of Health Science, Dankook University, Cheonan-si, Chungnam, Republic of Korea.

Corresponding author:
Jong-Hwa Jang
jhj@dankook.ac.kr

How to cite: LEE, S.J. and JANG, J.H. Effect of oral health intervention program on the self oral care of children attending childcare facilities: a quasi-experimental study. *Bioscience Journal*. 2022, **38**, e38057. https://doi.org/10.14393/BJ-v38n0a2022-60030

Abstract

This study aimed to conduct a quasi-experimental study for assessing the effects of an oral health intervention program (OHIP), on the self-management of oral health in children attending childcare centers. The participants recruited were 83 children from two childcare centers, who were allocated to the intervention and control groups. The intervention group received the OHIP. At baseline, a self-reported survey of parents was conducted. In addition, the oral status of the children at baseline and at 5 weeks was evaluated. Their brushing behavior was assessed once a week and every day during the OHIP intervention period and at home, respectively. After the follow-up at 12 weeks, dental plaque index (PI) was measured and two-way repeated measures analysis of variance was performed. The PI of the intervention group significantly decreased at week 5, compared to the baseline (1.90 ± 0.53, $p < 0.001$). Despite a substantial increase in week 12 (2.67 ± 0.08, $p < 0.001$), the PI was significantly lower than that of the control group (3.37 ± 0.60). The OHIP was effective in reducing the PI and modifying the brushing behavior among children. It is necessary to develop and expand a systematic oral health education program to promote self-management of oral health in children.

Keywords: Children Day Care Centers. Dental Health Education. Dental Plaque. Oral Health in Children. Self Care. Toothbrushing.

1. Introduction

Increased social activities of parents and family structural changes have augmented the use of childcare centers, for infants and pre-school children. Approximately 80.9% children aged 3–5 years used childcare centers in Korea in 2019 (Choi 2019). Food provided there comprises several cariogenic products, like bread, yoghurt, and beverages, resulting in a high incidence of dental caries. Therefore, appropriate oral health management is warranted (Bae et al. 2009).

Dental caries in the deciduous dentition mostly occurs during pre-school age (Anil and Anand 2017); it is associated with dental caries in the permanent dentition, premature tooth loss, decreased masticatory function, malocclusion, oral soft tissue disease, and bad oral habits (Choi 2019). Therefore, oral health management in pre-school children is crucial (Bae et al. 2009; Masumo et al. 2020). As part of national oral health promotion, the National Health Promotion Comprehensive Plan aims to improve the rate of brushing after lunch, which is an index for reducing dental caries and facilitating the management of oral health in children (Choi and Ma 2020). However, according to the 2018 Child Oral Health Survey, 68.5% of 5-year-olds

experienced dental caries, and an average of 3.43 teeth of each child developed caries (Choi 2019; You et al. 2019).

Pre-school age is important in forming healthy behavior and eating habits (Elidrissi and Naidoo 2016). As children spend most of their day in childcare centers, their teachers influence preventive oral health promotion (Eden et al. 2019). Moreover, parents play a crucial role in pediatric oral health at home (Bozorgmehr et al. 2013). Poor oral health knowledge in parents can negatively affect the oral health behavior in children (Barasuol et al. 2021). Thwin et al. (2018) reported the efficacy of comprehensive oral health education through an extensive oral health promotion program involving experts, parents, and teachers. However, previous studies conducted in Korea have reported the lack of knowledge and interest in oral health education among teachers (Kim and Kim 2015).

Teachers are aware of the need for oral health education for children, but it has been found that there are not enough educational aids and media, and the oral health education-related programs conducted in childcare centers are insufficient (Choi et al. 2013). In previous studies, although there were differences in the effects on oral health behaviors depending on the educational method and medium, oral health education using appropriate educational media had positive changes in dental plaque control and oral health behavior (Lee and Choi 2017; Sharififard et al. 2020). The plaque index (PI) measures the degree of coloration of food residues on the tooth surface. Food residue causes dental caries and the PI measures oral health and can be managed by toothbrushing (Kang et al. 2008).

In Korea, the Ministry of Health and Welfare (MHW) and the Korean Oral Health Association (KOHA) develops and distributes oral health education media every year (Lee and Choi 2017). Nonetheless, there are insufficient oral health educational programs in childcare centers. Oral health intervention program (OHIP), developed using a universally distributed audio-visual media with expected definitive effects on children, may be used by childcare centers for oral health education. The aim of the study was to evaluate the children's toothbrushing behavior and the changes in PI for 5 weeks by applying the OHIP with the help of teachers and parents, and to conduct PI evaluation through a follow-up at 12- weeks.

2. Material and Methods

Study design and participants

The study design was quasi-experimental with a non-equivalent control group and pretest-posttest measurement. Participants were children aged 4-6 years, attending two childcare centers in Seosan, Korea. A total of 84 children whose parents agreed to participate in the OHIP were selected. Children with two or more absences were excluded. The childcare centers were divided into an intervention group and a control group, and 44 and 39 participants were selected, respectively. One participant with low attendance was excluded.

Sample size determination

The sample size was analyzed by selecting a number of repeated measurement times of 5, 0.25 effect size, 0.05 significance level, and 0.80 power in repeated measures analysis of variance (ANOVA), using the G*Power program (Faul et al. 2007). The appropriate sample size calculated was 64. Anticipating drop out, we included 84 participants.

Ethical considerations

Our study complied with the guidelines of the Declaration of Helsinki and was approved by the Institutional Review Board of Dankook University (DKU 2018-09-025-001). Moreover, informed consent was obtained from the guardians of pre-school children and from the directors of the participating childcare centers.

Oral health intervention program

The OHIP (Table 1) includes educational materials for children, provided to oral health educators by the MHW and KOHA (Lee and Choi 2017). Moreover, its feasibility was verified by consulting early childhood educators and oral health experts.

Table 1. Oral health intervention program.

Session	Topic	Contents	Media	Feedback	Time (min)
1	Motivation Oral care I	-The importance of teeth -How to brush your teeth	PPT Video 1	Brushing- calendar	15
2	Oral care II	-Cause, symptoms, and- management of dental caries -How to brush your teeth	Video 1 Video 2	Brushing- calendar	15
3	Oral care III	-Oral health and food -Cause, symptoms, and- management of dental caries -Fluoride use -How to brush your teeth	Video 1 Video 3	Brushing- calendar	15
4	Oral care IV	-Bad breath -Cause, symptoms, and- management of dental caries -How to brush your teeth	Video 1 Video 4	Brushing- calendar	15
5	Oral care V	-The importance of teeth -Cause, symptoms, and- management of dental caries -How to brush your teeth	Video 1 Video 5	Brushing- calendar	15

Video 1 = Let's brush our teeth as we sing; Video 2 = Tooth decay; Video 3 = The tooth fairy and the tooth witch of the tooth kingdom; Video 4 = Brush your teeth well; Video 5 = Why do dental caries occur.

The authors planned the OHIP procedures considering the concentration level in children. Audio-visual education on oral health was provided for less than 15 minutes, once a week for 5 weeks. The participants practiced brushing their teeth while watching a music video "Let's Brush Our Teeth as We Sing" every day after lunch at the centers, assisted by their teachers. Besides, the parents were provided with a "brushing check calendar" every week with instructions to increase the frequency of tooth brushing at home.

The children were encouraged to mark the calendar after brushing every day. The control group was not provided any specific oral health education during the intervention period and performed brushing after lunch as usual. The authors conducted a questionnaire survey and measured the oral health in both the groups. Nonetheless, children in the control group received similar oral health education as the intervention group, 12 weeks after the completion of the follow-up.

Data collection

The OHIP was conducted from 24 October to 28 November 2018. It also consisted of a questionnaire survey of parents, observation of children's brushing behavior, and oral status examination with items based on a previous study (Lee 2010). They included the sociodemographic characteristics of children (sex, age, and number of siblings), children's oral health behavior as perceived by the parents (number of times of brushing daily, brushing time required, and oral health check-up), completion of oral health education, and oral health knowledge of the parents. The oral health knowledge was assessed by assigning 1 and 0 points to the correct and incorrect answers, respectively, per question. The highest possible score was 10. A higher score indicated greater oral health knowledge.

Oral health of children was assessed by examining their decayed teeth (dt) and filled teeth (ft), based on the criteria proposed by the WHO (Petersen 2009). Moreover, PI, developed by Quigley and Hein (Kang 2008), was used to assess the levels of self-managed oral hygiene. PI was assessed by applying a disclosing solution (Dharma Research, Inc.) over every tooth. Where dental plaque was colored and for no discoloration, 1 and 0 points were given, respectively per tooth surface. The highest possible score was 5. Higher scores indicated poor oral hygiene self-management. Additionally, the authors observed the brushing

behavior (horizontal, vertical, circle, and rolling methods), brushing area (upper and low occlusal and tongue surfaces), brushing time, and number of mouth rinses every week during the intervention period.

After a baseline assessment using parental questionnaire and oral health examination, the same were measured at week 5. The PI and brushing behavior were evaluated by a team of a dentist and a dental hygienist. The PI was evaluated at 12 weeks of follow-up to confirm the continued effectiveness of OHIP for children.

Data analysis

Data were performed for normality, and homogeneity analysis of sociodemographic characteristics and oral status between the intervention group and the control group. Before and after comparison of the children's brushing behavior were analyzed using the Chi-square test, Fisher's exact test, and paired t-test. The effects of OHIP on PI in children were assessed using the two-way repeated measures ANOVA. Statistical analysis was performed using the SPSS 23 program (IBM Corp., Armonk, N.Y., USA), and the significance level was set to $\alpha = 0.05$.

3. Results

Homogeneity test of oral condition and oral health behavior by group

Table 2 summarizes the results of the homogeneity test on the oral conditions and oral health behaviors of children at baseline. There were no significant differences between the two groups, thus ensuring homogeneity ($p > 0.05$).

Table 2. Homogeneity test of children's oral health behaviors of perceived parents by group at baseline.

Variables	Category	CG (n = 39)	IG (n = 44)	p-value*
Brushing frequency per day	1	6 (15.4)	6 (13.6)	0.134
	2	26 (66.7)	21 (47.7)	
	3	7 (17.9)	14 (31.8)	
	4 ≤	-	3 (6.8)	
How long it takes to brush	30 sec	6 (15.4)	2 (4.5)	0.441
	1 min	11 (28.2)	17 (38.6)	
	2 min	17 (43.6)	21 (47.7)	
	3 ≤ min	5 (12.8)	4 (9.1)	
Regular oral examination	yes	29 (74.4)	31 (70.5)	0.692
	no	10 (25.6)	13 (29.5)	
Parents' experience of- receiving oral health education	yes	16 (41.0)	28 (63.6)	0.117
	no	23 (59.0)	16 (36.3)	

CG = control group, IG = intervention group; * by Chi-square test or fisher's exact test at $\alpha = 0.05$; Data are presented as n (%).

Table 3 shows the results of the comparative analysis of the oral health levels of the groups. We observed no significant differences in the oral health status between the groups.

Level of oral health knowledge in parents of preschool children

Table 4 summarizes the analysis of the oral health knowledge of the parents in both groups at baseline. The highest possible score was 10. Parents in the control group had a slightly higher level of oral health knowledge than those in the intervention group (6.92 ± 1.40 vs. 6.64 ± 1.48, $p = 0.369$). The rate of correct answer for the question 'water fluoridation is a safe and effective way to prevent tooth decay' was extremely low in both the control (20.5%) and the intervention (11.4%) groups. Moreover, both the control

(38.5%) and intervention (27.3%) groups revealed poor knowledge for the question 'the teeth fall out because of aging'.

Table 3. Homogeneity test of oral health level of preschool children by group at baseline.

Variables	CG (n = 39)	IG (n = 44)	p-value
	Mean ± SD, %	Mean ± SD, %	
df rate (%) *	28.2	38.6	0.120
dt rate (%) *	65.9	32.8	0.060
ft rate (%) *	34.1	67.2	0.060
PI**	3.15 ± 0.54	3.37 ± 0.60	0.081

CG = control group, IG = intervention group; Mean ± SD: Mean ± Standard deviation; * by Chi-square test or fisher's exact test, **by the independent test at α = 0.05; df = decayed teeth + filled teeth; dt = decayed teeth; ft = filled teeth; PI = dental plaque index.

Table 4. Level of oral health knowledge of the parents of preschool children at baseline.

Variables	CG (n = 39)	IG (n = 44)	p- value*
Tooth decay is a bacterial infection (O)	71.8	75.0	0.862
Consumption of sweet foods such as sugar causes tooth decay (O)	100.0	97.7	0.344
If you don't treat tooth decay in your teeth, you can get tooth decay in your permanent teeth (O)	82.1	90.9	0.490
Fluoride prevents tooth decay (O)	66.7	68.2	0.582
Water fluoridation is a safe and effective way to prevent tooth decay (O)	20.5	11.4	0.254
Periodontal disease is a disease caused by infection by bacteria (O)	74.4	84.1	0.474
Do not brush the swollen area due to periodontal disease (X)	66.7	50.0	0.238
Scaling can damage teeth (X)	76.9	59.1	0.025
Smoking has nothing to do with oral health (X)	94.9	100.0	0.315
The teeth fall out due to aging as the age increases (X)	38.5	27.3	0.510
All (Mean ± SD)	6.92 ± 1.40	6.64 ± 1.48	0.369 **

CG = control group, IG = intervention group; Mean ± SD: Mean ± Standard deviation; *by the Chi-square test or fisher's exact test at α = 0.05; **by the independent t-test at α = 0.05; Data are presented as %.

Effects of OHIP on self-management of oral health

Table 5 depicts the changes in the brushing behavior of children in the intervention group. The brushing time increased by 50.2% after 5 week (175.2 s) of OHIP application, compared to baseline (88.0 s). This increase continued for almost 5 weeks. The rate of tongue brushing increased from 13.6% at baseline to 70.5% after 5 weeks, respectively. Despite the rate of rolling method being 0% at baseline, it increased continuously after 5 weeks at a rate of 50.0%, respectively. The mandibular posterior occlusal surface was predominantly brushed at baseline. However, starting at week 5, at least 79.5% children brushed the maxillary posterior occlusion surface and both the maxillary and mandibular posterior lingual surfaces.

Table 5. Changes in self-care behavior after applying OHIP for 5 weeks.

Variables	Groups	Baseline	After 5 wks	p-value
Toothbrushing time (sec)*	CG	66.72 ± 32.44	71.03 ± 26.98	0.217
	IG	87.95 ± 27.16	175.20 ± 27.73	< 0.001
Tongue brushing (%)**	CG	10.3	5.1	0.675
	IG	13.6	100.0	< 0.001
Tooth brushing method (%)**				
Horizontal	CG	79.5	84.6	0.769
	IG	97.7	86.4	0.049
Vertical	CG	51.3	43.6	0.650
	IG	50.0	72.7	0.029
Circle	CG	7.7	10.3	1.000

Rolling	IG	6.8	34.1	0.003
	CG	10.3	5.1	0.675
Tooth brushing area (%)**	IG	0	50.0	< 0.001
Max. post occlusion	CG	46.2	41.0	0.820
	IG	18.1	79.5	< 0.001
Man. post occlusion	CG	100.0	100.0	-
	IG	97.7	100.0	1.000
Max. post lingual	CG	20.5	23.1	1.000
	IG	9.1	90.9	< 0.001
Man. post lingual	CG	35.9	41.0	0.816
	IG	15.9	93.2	< 0.001

CG = control group, IG = intervention group; Max = maxillary, Man = Mandible; * by the paired t-test at α = 0.05; ** by the Chi-square test or fisher's exact test at α = 0.05.

Table 6 shows the effects of OHIP on PI. We conducted a univariate analysis after establishing the sphericity assumption. There were significant differences between the two groups ($p < 0.001$) and the two time points ($p < 0.001$). Moreover, the two groups showed different changes over time. Additionally, there was a significant interaction between the groups and the time points ($p < 0.001$). Therefore, we conducted the analysis at a controlled state. The PI in the control group increased after 5 weeks (M = 3.15), compared to a slight decrease after 12 weeks (M = 3.09). Nonetheless, the difference was insignificant ($p > 0.05$).

Contrarily, in the intervention group, PI was substantially lower after 5 weeks (M = 1.90), compared to baseline (M = 3.37). Furthermore, it slightly increased after 12 weeks (M = 2.67), showing a significant difference, compared to the baseline ($p < 0.001$).

Table 6. Changes of plaque index according to oral education program.

Groups	Baseline	After 5 wks	After 12 wks	p-value*
	Mean ± SE	Mean ± SE	Mean ± SE	
Control group (n = 39)	3.15 ± 0.09^a	3.40 ± 0.09^b	3.09 ± 0.09^a	< 0.001
Intervention group (n = 44)	3.37 ± 0.09^a	1.90 ± 0.08^b	2.67 ± 0.08^c	

M ± SE: Mean ± Standard error; * by two-way repeated measures ANOVA test; a,b,c statistically significant difference at α = 0.05.

4. Discussion

Poor oral health is a public health problem. Dental caries in pre-school children significantly effects their health and development. It causes pain, eating disorders, speech impairment, and financial burden to families and societies (Gilchrist et al. 2015). Children attending childcare centers are given meals and snacks, and they brush their teeth every day at the centers. They are exposed to oral health problems and are directly or indirectly motivated to maintain oral hygiene. Therefore, although oral health education for children in childcare centers is very necessary, systematic education is insufficient. Most of the teachers reported that they needed the help of other experts such as child nurses for health management of childcare centers (Murray et al. 2013), and it was reported that parents' satisfaction with health, safety, and nutrition management in childcare centers was low (Han and Kim 2007). A study of oral health education programs in schools revealed that brushing education performed by dentists and teachers was both effective (Eden et al. 2019).

In this study, by applying the OHIP to children, children's awareness of oral health improved and they practiced proper brushing habits. The OHIP used in our study comprised educational goals that included comprehensive oral health education, such as the role of teeth in oral health, the occurrence of dental caries, brushing, and oral health based on the growth and development of children. Additionally, the program was constructed by analyzing previous studies to induce interest and attention in the learners (Lee and Choi 2017). In this study, the providers who supported OHIP for children were parents and teachers, but there was a limitation that there was no separate education for them. Nevertheless, the teachers helped the children to brush while watching the video "Let's Brush Our Teeth as We Sing" every day after lunch.

Furthermore, the parents encouraged their children to regularly check the calendar, thus ensuring their oral health. The level of the parents' oral health knowledge and the brushing behavior of the children were poor at baseline. However, after applying the OHIP, the intervention group changed to appropriate brushing behavior, and the PI decreased from the baseline at 3.37 points to 1.90 points after 4 weeks compared with the control group.

Our results were consistent with studies on repeated brushing education for pre-school children (Lee and Choi 2017), multimedia education (Sharififard et al. 2020), education through theory and dental model practice (Eden et al. 2019), and 'smart brushing system' (Kim and Lee 2015). Another study (Sharififard et al. 2020) applied an educational program containing various multimedia educational activities, like fairy tales and animation videos, four times, which lowered PI. Despite evaluating the short-term effects of the educational program, the researchers could not verify its effectiveness in a follow-up survey, and they could not assess the continued effects of oral health education after the intervention period. In this study, PI was found to be lower even at 12 weeks after application of the OHIP compared to the baseline assessment. Therefore, OHIP is effective in improving oral health care and practice and the ability of maintaining oral hygiene among pre-school children. Despite the difference in the teaching methods and participants, the necessity of oral health education has been sufficiently demonstrated in studies, including our study.

Oral health education methods are expected to gradually incorporate media in the form of app-game learning (Subhash and Cudney 2018) and YouTube (Duman 2020) using smartphones or tablet PCs. They can be easily accessible with an enjoyable learning experience. Oral health education is relatively better in elementary, middle, and high schools where health teachers serve than in childcare centers attended by pre-schoolers, like day-care centers and kindergartens. Moreover, research and development is extensive in oral health education programs for school-going students compared with pre-school children (Eden et al. 2019; Duman 2020). Various oral intervention studies are being taken to improve oral health (Gilchrist et al. 2015; Bhatti et al. 2021). However, oral health education should be prioritized to cultivate appropriate lifestyle habits by promoting awareness.

Our study had a limitation since the educational media used were previously developed conservative materials, and not recent materials reflecting the latest trends in the field. There may also have been a selection bias as only two daycare centers were selected for the study. In addition, the results do not reflect the influence of various factors such as children's eating habits and parental education. Nevertheless, it is provided by public institutions of the country, and experts have confirmed its validity. Moreover, our study contributes to literature as our results confirmed the effects of OHIP while considering the characteristics of children in the centers.

Therefore, this study is significant as it has prepared a basis for the use of OHIP as children's oral health promotion program. The OHIP helped improve the children's brushing habits and significantly decrease the PI. Interventional studies that can assess the effects of programs using a variety of educational media and long-term longitudinal studies are necessary in future. Moreover, there is a need to strengthen the support and improve the system to vitalize oral health education for pre-school children with weak educational environments.

5. Conclusions

The application of OHIP reduces PI by promoting correct brushing behavior in children attending childcare centers. Considering the effectiveness of OHIP in improving self oral healthcare among pre-school children, it is necessary to develop and expand systemic oral health education programs using a teaching-learning model.

Authors' Contributions: J.H.J: conception and design, analysis and and interpretation of data, drafting the manuscript, critical review of important intellectual content, final approval; S.J.L: acquisition of data, analysis and and interpretation of data, drafting the manuscript, critical review of important intellectual content, final approval.

Conflicts of Interest: The authors declare no conflicts of interest.

Ethics Approval: Approved by the Institutional Review Board of Dankook University. DKU: 2018-09-025-001. KCT 0005914.

Acknowledgments: We would like to thank Editage (www.editage.co.kr) for English language editing.

References

ANIL, S. and ANAND, P.S. Early childhood caries: prevalence, risk factors, and prevention. *Frontiers in Pediatrics,* 2017, **5**, 157. https://doi.org/10.3389/fped.2017.00157

BAE, S. M., SONG, K.S. and RYU, D.Y. A survey on childcare teachers' practice about preschool children oral health promotion. *Journal of Korean Academy of Dental Hygiene Education*, 2009, **9**(4), 864-871.

BARASUOL, J.C., et al. The perception of caregivers of poor oral health of their children and its related clinical conditions. *Revista Paulista de Pediatria*. 2021, **39**, e2019381. https://doi.org/10.1590/1984-0462/2021/39/2019381

BHATTI, A., et al. Recommendations for delivering oral health advice: a qualitive supplementary analysis of dental teams, parents' and children's experiences. *BMC Oral Health*. 2021, **21**(1), 210. https://doi.org/10.1186/s12903-021-01560-w

BOZORGMEHR, E., HAJIZAMANI, A. and MOHAMMADI, T.M. Oral health behavior of parents as a predictor of oral health status of their children. *International Scholarly Research Notices Dentistry*. 2013, **2013**, e741783. https://doi.org/10.1155/2013/741783

CHOI, Y.K., et al. Evaluation on the oral health promotion program effect from a part of community child center. *Journal of the Korea Academia-Industrial cooperation Society*. 2013, **14**(8), 3850-3857. https://doi.org/10.5762/KAIS.2013.14.8.3850

CHOI, Y.H. Korea national oral health survey systems and recent oral health status in children. *The Journal of the Korean Dental Association*. 2019, **58**(1), 28-37.

CHOI, J.S. and MA, D.S. Changes in oral health indicators due to implementation of the National Health Insurance Services coverage for first molar dental sealant for children and adolescents in South Korea. *BMC Oral Health*. 2020, **20**, 214. https://doi.org/10.1186/s12903-020-01201-8

DUMAN, C. YouTube™ quality as a source for parent education about the oral hygiene of children. *International Journal of Dental Hygiene*. 2020, **18**(3), 261–267. https://doi.org/10.1111/idh.12445

EDEN, E., AKYILDIZ, M. and SÖNMEZ, I. Comparison of two school-based oral health education programs in 9-year-old children. *International Quarterly of Community Health Education*, 2019, **39**(3), 189-196. https://doi.org/10.1177/0272684x18819980

ELIDRISSI, S. M. and NAIDOO, S. Prevalence of dental caries and toothbrushing habits among preschool children in Khartoum State, Sudan. *International Dental Journal*, 2016, **66,** 215-220. https://doi.org/10.1111/idj.12223

FAUL, F., et al. G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods*. 2007, **39**(2), 175-191.

GILCHRIST, F., et al. The impact of dental caries on children and young people: what they have to say? *International Journal of Paediatric Dentistry*. 2015, **25**(5), 327-338. https://doi.org/10.1111/ipd.12186

HAN, K. J. and KIM, J. S. Parent's needs for center-based child care health program. *Journal of Korean Academy of Child Health Nursing*. 2007, **13**(1), 43-50.

KANG, BH., et al. Effect of a tooth-brushing education program on oral health of preschool children. *Journal of Korean Academy of Nursing*. 2008, **38**(6), 914-922. https://doi.org/10.4040/jkan.2008.38.6.914

KIM, J. and KIM, G. The convergence effects of oral health education of kindergarteners. *Journal of the Korea Convergence Society*, 2015, **6**(6), 131-137. https://doi.org/10.15207/JKCS.2015.6.6.131

KIM, N.Y. and LEE, J.Y. Effect of oral health education with Q-scan in preschool children. *Journal of Dental Hygiene Science*. 2015, **15**(6), 696-702. https://doi.org/10.17135/jdhs.2015.15.6.696

LEE, Y.K. A Study on mothers' oral health knowledge and oral health management behavior of children. *Journal of Korean Society of Dental Hygiene*. 2010, **10**(1), 93-106.

LEE, J.Y. and CHOI, H.N. Effect of repeated oral health education on the oral health of preschool children. *Journal of Dental Hygiene Science*. 2017, **17**(5), 423-432. https://doi.org/10.17135/jdhs.2017.17.5.423

MASUMO, R.M., NDEKERO, T.S. and CARNEIRO, L.C. Prevalence of dental caries in deciduous teeth and oral health related quality of life among preschool children aged 4-6 years in Kisarawe, Tanzania. *BMC Oral Health*, 2020, **20**, 46. https://doi.org/10.1186/s12903-020-1032-x

MURRAY, C.J.L., et al. UK health performance: findings of the Global Burden of Disease Study 2010. *The Lancet*. 2013, **381**(9871), 997-1020. https://doi.org/10.1016/S0140-6736(13)60355-4

PETERSEN, P.E. Grobal policy for improvement of oral health in the 21st century - implications to oral health research of World Health Assembly 2007, World Health Organization. *Community Dentistry and Oral Epidemiology*. 2009, **37**(1), 1-8. https://doi.org/10.1111/j.1600-0528.2008.00448.x

SHARIFIFARD, N., et al. A music- and game-based oral health education for visually impaired school children; multilevel analysis of a cluster randomized controlled trial. *BMC Oral Health*. 2020, **20**, 144. https://doi.org/10.1186/s12903-020-01131-5

SUBHASH, S. and CUDNEY, E.A. Gamified learning in higher education: a systematic review of the literature. *Computers in Human Behavior*. 2018, **87**, 192-206. https://doi.org/10.1016/j.chb.2018.05.028

THWIN, K.M., et al. Effects of oral health education in Myanmar preschool children and guardians. *Journal of Investigative and Clinical Dentistry*. 2018, **9**(3), e12346. https://doi.org/10.1111/jicd.12346

YOU, M., SHIN, H.S. and LEE, H.S. Relationship between complementary feeding introduction and early childhood caries: results from the Korea national health and nutrition examination survey 2008-2015. *Korean Journal of Community Nutrition*, 2019, **24**(2), 97-105. https://doi.org/10.5720/kjcn.2019.24.2.97

Received: 25 March 2021 | **Accepted:** 20 July 2021 | **Published:** 12 August 2022