REVIEW ARTICLE

A Systematic Review on Oral Health Care Programs for the Elderly in Korea (2009~2020)

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Background: Various oral health management programs in Korea affect the oral health improvement in the elderly Several studies have been conducted to date; however, those studies have not shown uniform results due to the differences in research methods or designs. Hence, this study aimed to review the overall research trends of the reported oral health care programs for the elderly in Korea, verify their effects, and clarify them based on the systematic literature review.

Methods: The literature search selected intervention studies that applied the oral health care program for the elderly in Korea from 2001 to 2020. Following the COre, Standard, and Ideal (COSI) models presented by the US National Library of Medicine, we selected databases including Korean studies Information Service System (KISS), ScienceOn, Research Information Sharing Service (RISS), DBpia, PubMed, and Google Scholar. Of the 1,335 studies searched using keywords, titles, and abstracts, 21 were finally selected based on primary and secondary exclusion criteria.

Results: The most frequent intervention period was 4 weeks, and the number of interventions varied between 2 and 90 times. As for the type of intervention, 14 studies that conducted both theory and practice were the most frequent. Significant differences in the clinical indicators, such as calculus, halitosis, salivation rate, swallowing function, and dry mouth, were found in most oral health care programs.

Conclusion: Based on the results of this study, the intervention program needs further verification using multiple indicators in future studies. In addition, a study extending the intervention period and the number of samples is considered necessary for verifying continuous effectiveness of the intervention program.

Key Words: Elderly, Health plan implementation, Oral health, Systematic Review

Introduction

Recent advances of healthcare technologies and extended average lifespan as a result of improved standard of living and expanded healthcare services, there has been a dramatic expansion of the elderly population, which has led to a growing prevalence of a variety of physical, social, and mental health problems in this population[1].

Most of the health problems affecting older adults are physical and functional problems, and 38.1% of older adults aged 65 and over were found to suffer from oral health problems[2]. In general, older adults show reduced salivary secretion as a result of aging and drugs. This leads to oral diseases such as dry mouth, impaired mastication, pronunciation, and swallowing, periodontal diseases, and tooth loss[3]. Such oral health problems affecting older adults are closely linked to systemic health as well as oral health-related quality of life (OHRQOL)[4]. Therefore, routine prevention and management are crucial. However, older adults accept these oral problems as a natural process of aging[5]. Hence, continuous oral health management programs that enhance oral functions and prevent oral diseases in

older adults by altering their perception, behavior, and attitude are needed[6].

Previous studies reported that oral health management programs influence older adults' dental plaque management[7,8], denture hygiene management[9], oral environmental management[9], dry mouth[10,11], bad breath[12], salivary secretion rate[13,14], mouth opening[15], orbicularis oris muscle strength[10], voluntary behavioral change to promote oral health[11], change of perception about oral health[10], and OHRQOL[11].

As shown here, various oral health management programs in Korea are important factors that affect older adults' oral health management. However, describing and comparing the effects of various interventions as well as generalizing the effectiveness of these interventions are difficult due to the varying methods of operation, research methodology, and associated factors. Hence, objectively assessing the effects of interventions through a literature review and presenting a direction for follow-up studies are crucial in substantiating the effectiveness of oral health management programs for older adults.

In this context, this study aims to review the trends of intervention studies involving oral health management programs for older adults and analyze the contents and outcomes of the interventions so as to evaluate the effects of these programs on older adults and to provide foundational data recommending the directions of future research on the topic.

Materials and Methods

1. Literature search

A literature search was performed with reference to the Korean version of Preferred Reporting Items for Systematic Reviews and Meta-Analysis (PRISMA), a modified and expanded version of the original tool[16]. The literatures were selected based on the PICO (Participants, Intervention, Comparisons, Outcomes) strategy for systematic reviews. Participants (P) were set to older adults ($\geq$60 years in Korea) as defined as the elderly recipients of the national pension per the National Pension Act[17]. Intervention (I) was set to oral health management programs for older adults. Comparisons (C) were not specifically defined, and one-group pretest-posttest designs were also included. Outcomes (O) were set to the effects of the program.

A literature search was conducted using Korean databases from November 2020 to May 2021. Based on the COre, Standard, and Ideal (COSI) model proposed by the US National Library of Medicine, the search was conducted in the COre databases of Korea as recommended by the National Evidence-Based Healthcare Collaborating Agency (NECA) and standard databases, namely Korean Studies Information Service System (KISS), ScienceOn, Research Information Sharing Service (RISS), and DBpia. Combinations of the search terms "older adults" for participants and "oral health management program," "continuous oral health management," and "oral health education" for intervention were used.

2. Selection criteria

Experimental studies that administered an oral health management intervention for Korean older adults aged 60 years and over were selected. Posters and conference proceedings were excluded, but theses and dissertations were included in addition to journal articles to review diverse interventions. Oral programs administered by nurses and certified nursing assistants trained by the researchers were also included. One-group pretest-posttest designs were also included, but studies that did not present the details of the oral health management program and studies that
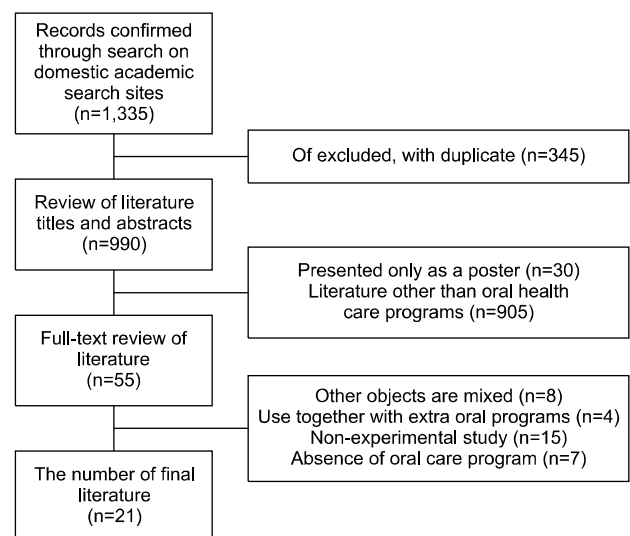

Fig. 1. A flow diagram for data collection.

concurrently administered another type of health management program in addition to the oral health management program were excluded. In addition, studies with a study population comprising different age groups other than older adults were excluded. Based on this inclusion and exclusion criteria, 21 out of 1,335 search results were selected in this descriptive literature review (Fig. 1, Table 1, 2).

3. Analysis

The general characteristics of the 21 included studies were described by publication year, sample size, sex of participants, study design, and setting of study. The interventions were described by intervention frequency, duration of intervention, type of intervention, contents of intervention, and effects of intervention, and the data were analyzed with frequency analysis using the 2017 IBM SPSS Statistics version 25 (IBM Corp., Armonk, NY, USA). The statistical significance level was set at 0.05.

Results

1. General characteristics of included studies

The most common publication year was between 2016 and 2020 (11 studies), and the most common sample size was 50 to 99 (11 studies). Seventeen studies enrolled both male and female, and the most common study design was nonequivalent pretest-posttest design (16 studies). The most common setting of study was long-term care center, followed by senior centers, long-term care hospitals, and senior schools (Table 3, 4).

2. Results of intervention of studies

Table 5 shows the duration, number of sessions, type, and contents of the oral health management interventions.

The most common duration of intervention was four weeks (6 studies), and the number of sessions of intervention ranged from 2 to 90 sessions. The most common type of intervention was mixed intervention consisting of theoretical education and hands-on training (9 studies).

Among clinical indices, the most significant changes were observed in dental plaque, followed by tongue coating, mouth opening, and bad breath ($p < 0.05$). Changes of oral health behaviors were assessed in terms of toothbrushing effort, ability to manage oral environment, use of oral products, denture cleaning frequency, toothbrushing frequency, oral health behaviors, and voluntary preparation for dry mouth. Statistically significant changes were observed in oral health behaviors in all five studies included in the said assessment ($p < 0.05$).

Changes of oral health perception were assessed based on interest in oral health in one study, and the changes were statistically significant ($p < 0.01$). Changes in self-efficacy were assessed based on OHRQOL in six studies, and the changes were statistically significant ($p < 0.05$).

Discussion

This study aimed to analyze the trends of oral health management intervention studies and the effects of these interventions for the Korean elderly population (≥ 60 years) by reviewing the methodology, contents, and outcomes reported in the literature and to present evidence data for developing oral health management programs for older adults.

Table 1. The Selection Criteria for Papers

Type	Inclusion	Exclusion
Year	2009~2020	<2021
Type of literature	Domestic journals, unpublished master's thesis	Foreign journals, books
Study object	Elderly (≥60)	Adults (<60)
Study design	NCGPPD, OPPD, RCGPPD	-
Contents	Intervention effect of oral care program	-

NCGPPD: non-equivalent control group pretest-posttest design, OPPD: one group pretest-posttest design, RCGPPD: randomized control group pretest-posttest design, -: not available.

Table 2. References to the Intervention Studies

Number	Main author	Publication year	Title	Publisher or journal	URL
1	YH Lee	2009	Effect of oral health management program for the elderly in an urban community	Yeungnam University Graduate School	https://www.riss.kr/link?id=T11780067
2	KW Kim	2010	Effects of oral hygiene improvement of the elderly patients by caregiver's in rural long-term care hospital	*Journal of Agricultural Medicine & Community Health*	https://www.koreascience.or.kr/article/JAKO201017241417217.pdf
3	HJ Bok	2010	Evaluation on home visiting oral health programe for the elderly in rural community	Daegu Haany University Graduate School	https://www.riss.kr/link?id=T11959779
4	DY Kim	2012	Effect of a mouth exercise program on improvement of functions and quality of life related to oral health in the elderly	InJe University Graduate School	https://www.riss.kr/link?id=T12915296
5	CY Kim	2012	Development and evaluation of a dysphagia assessment tool and an intervention program for the elderly in the long-term care facilities	*Journal of the Korea Academia-Industrial Cooperation Society*	https://www.koreascience.or.kr/article/JAKO201210348673825.pdf
6	YH Lee	2012	The effect of oral care program for the elderly women of the visiting oral health care	*Journal of Dental Hygiene Science*	https://www.koreascience.or.kr/article/JAKO201223263074780.pdf
7	MM Cho	2013	Promotion of periodontal health through professional toothbrushing and education on the use of the interdental brush in the elderly	*Journal of Korean Academy of Oral Health*	https://pdfs.semanticscholar.org/0bde/4a967f3188dc09f519d26ea7bdb06d628500.pdf
8	HL Bang	2014	The effect of an exercise-based swallowing training program for nursing home residents with stroke	*Journal of Muscle and Joint Health*	https://www.koreascience.or.kr/article/JAKO201426059105224.pdf
9	M Kim	2015	The effect of oral health education for the elderly using Qscan^{TM}	*Journal of Korean Society of Dental Hygiene*	https://www.koreascience.or.kr/article/JAKO201527359533134.pdf
10	WC Park	2015	Promotion of oral health and quality of life for elderly in korea	Seoul National University Graduate School	https://www.riss.kr/link?id=T13744487
11	YS Kim	2016	The effect of oral function improvement with oral exercise program by elderly people	*Journal of Korean Society of Dental Hygiene*	https://www.koreascience.or.kr/article/JAKO201627038926293.pdf
12	KY Lee	2016	Effect of professional oral healthcare program on the oral status of elderly residents in long-term care facilities	*Journal of Dental Hygiene Science*	https://www.koreascience.or.kr/article/JAKO201608967047029.page
13	SH Lee	2016	Comparison of effects according to type of oral exercise program for elderly in Gangneung city	*Journal of Dental Hygiene Science*	https://www.koreascience.or.kr/article/JAKO201608967047021.pdf
14	IS Jang	2016	The effect of denture care skills education program on denture self-care, denture satisfaction and oral health-related quality of life (OHIP-14) among the elderly	*Journal of Korean Biological Nursing Science*	https://www.koreascience.or.kr/article/JAKO201607365702514.pdf
15	GR Hong	2016	Effect of an educational tooth-brushing program using priming in an elderly population with dementia residing in nursing homes	*Journal of Korean Academy of Oral Health*	https://www.kci.go.kr/kciportal/ci/sereArticleSearch/ciSereArtiView.kci?sereArticleSearchBean.artiId=ART002153114

Table 2. Continued

Number	Main author	Publication year	Title	Publisher or journal	URL
16	JY Jang	2017	Effect of oral health promotion program on the elderly in nursing homes	Korean Society of Alcohol Science and Health Behavior	https://www.earticle.net/Article/A299639
17	JH Han	2017	Home visiting oral health program of long term home care service and the change of salivary bacterial counts in denture	Hanseo University Graduate School	https://www.riss.kr/link?id=T14465507
18	JH Kim	2018	Effects of an oral self-care program on the elderly's xerostomia and oral health-related quality of life	*Journal of Korean Academy of Community Health Nursing*	https://synapse.koreamed.org/upload/SynapseData/PDFData/0200JKACHN/jkachn-29-382.pdf
19	SH Moon	2018	Effect of Integrated oral health care program for older adults in long-term care facilities	Hanyang University Graduate School	https://www.riss.kr/link?id=T14874498
20	JY Oh	2018	The effect of systemic health and salivary massage on saliva flow	Dong-Eui University Graduate School	https://www.riss.kr/link?id=T15062656
21	CH Im	2020	Effects of oral care Interventions for the older adult in long-term care hospital on oral health and oral health related quality of life	Busan National University Graduate School	https://www.riss.kr/link?id=T15665683

Table 3. General Characteristics of the Included Studies

Characteristic	Category	Value
Year	≤2010	3 (14.3)
	2011~2015	7 (33.3)
	2016~2020	11 (52.4)
Sample size	≤49	7 (33.3)
	50~99	11 (52.4)
	100~149	3 (14.3)
Sex	Male & Female	17 (81.0)
	Female	2 (9.5)
	NR	2 (9.5)
Study design	NCGPPD	16 (76.2)
	OPPD	4 (19.0)
	RCGPPD	1 (4.8)

Values are presented as number (%).
NR: not report, NCGPPD: non-equivalent control group pretest-osttest design, OPPD: one group pretest-posttest design, RCGPPD: randomized control group pretest-posttest design.

Table 4. The Settings of the Studies

Characteristic	Category	Value
Sample site	Long-term care hospital	3 (11.1)
	Long-term care center	9 (33.3)
	Senior center	5 (18.5)
	Senior welfare center	1 (3.7)
	University of the elderly	3 (11.1)
	Home care elderly	1 (3.7)
	Nursing home	1 (3.7)
	General hospital	1 (3.7)
	Community welfare center	2 (7.4)
	Long-term home care hospital	1 (3.7)

Values are presented as number (%).

A total of 21 Korean studies that administered an oral health management program among older adults and published in or before 2020 were selected through Korean databases. The trends of these studies as well as the methods and effects of oral health management interventions were analyzed as follows.

Most of the studies were published between 2016 and 2020 (11 studies), with the least number of studies published prior to 2010 (3 studies). A variety of studies have been conducted on oral health among older adults as Korea became an aged society. This shows that interests on oral health management have been mounting in response to the dramatic expansion of the older adult population[18].

The most common setting of research was long-term

Table 5. Results of the Intervention of Studies

Author (year)	Duration (frequency)	Participants	Research institute	Study design	Intervention	Meaeurement tools	Outcome
Lee, 2009	**3 months** (Exercise: about 24 times, management: 3 times, Education: 1 times) \<Oral function improvement exercise: twice a week, oral hygiene management: once a month, group oral hygiene education: 1 times\>	Researcher	University of the elderly	NCGPPD	**Theoretical education:** oral health education (oral health knowledge, teeth brushing method, floss method) **Practical training:** oral function improvement gymnastics (muscular exercise, tongue muscle exercise, lip muscle exercise, stimulating salivary glands, vocal exercises), teeth brushing training, dental flossing training **Expert management:** scaling	**Real condition of oral hygiene:** O'Leary index **Oral examination Repeat deglutition test:** RSST **Salivary effusion examination:** shimmerstrip **Pronunciation test:** in order of patakara pronunciation **Stretching cheeks:** whether your left and right cheeks can swell up by closing your lips **Amount of opening:** electronic ruler **Oral health-related quality of life:** OHIP-14	**Clinical indicators** (plant residue, coated tongue*, degree of dirty teeth/denture*, dental plaque*, number of repeat deglutition*, amount of saliva*, the amount of opening*, stretching cheeks at the same time**) **Self-efficacy** (oral health-related quality of life*)
Kim et al., 2010	**3 months** (90 times) \<Caregivers who have completed training take oral care once a day for 3 months\>	Caregiver	Long-term care hospital	NCGPPD	**Practical training:** teeth brushing (rotation method, tongue brushing), management of artificial teeth	**Dental plaque:** O'Leary index **Oral examination**	**Clinical indicators** (dental plaque*, coated tongue*, denture hygiene*)
Bok, 2010	**6 months** (NR)	Dentist, dental hygienist	Home care elderly, nursing home, long-term care center	OPPD	**Theoretical education:** oral health education, teeth brushing training, denture care training, interdental care training, oral counseling, halitosis management, stomatitis management, denture cleaning **Practical training:** oral mucous membrane massage, oral muscle massage, tongue exercise **Expert management:** professional teeth brushing, fluoride application	**Coated tongue:** divide the entire tongue into 9 parts to determine whether the tongue is attached **Salivation rate:** KISO WeT Tester **Oral environment management ability:** PHP **Halitosis:** BB checker **Denture hygiene:** the number of schuber's denture hygiene **Oral health care survey**	**Clinical indicators** (coated tongue**, denture hygiene**) **Oral health behavior** (number of teeth brushing, number of denture washed, the number of oral supplements increased, oral environment management ability**)

Table 5. Continued 1

Author (year)	Duration (frequency)	Participants	Research institute	Study design	Intervention	Measurement tools	Outcome
Kim, (2012)	**3 months** (24 times) <Oral health and oral exercise program education twice a week for 30 minutes>	Dental hygienist	Long-term care center, long-term care hospital	NCGPPD	**Theoretical education:** oral health education (the importance of oral health and oral function in the elderly) **Practical training:** oral exercise program (preparatory exercise, oral opening and closing, tongue exercise, neck exercise, tongue exercise, masticatory strengthen exercise, cheek exercise, vocal exercises, deglutition strengthen exercise, stimulation of saliva exercise, finish exercise)	**Halitosis:** mBA-21 Oral Gas Detector **Oral microbes:** *Streptococcus mutans* separate culture **Salivation rate:** measurement method of non-stimulating saliva secretion **Maximum opening:** electronic ruler **Oral exchange exercise:** in order of patakara pronunciation OHIP-14	**Clinical indicators** (oral microbes*, halitosis*, the amount of opening*, salivation rate*, oral interaction exercise*, restriction of jaw function*, subjective xerostomia score*) **Oral health behavior** (spontaneous behavior to prepare for xerostomia*) **Self-efficacy** (oral health-related quality of life*)
Kim et al., 2012	**4 weeks** (84 times) <3 times a day for 4 weeks for 10 to 60 minutes>	Nurse, nursing care worker	Long-term care center	NCGPPD	**Expert management:** maintain cognitive function, maintain proper intake, maintain sitting posture, suction prevention	**Total time for deglutition:** electromotive forceps	**Clinical indicators** (deglutition function*)
Lee et al., 2012	**6 weeks** (4 times) <Revisiting 3 times every 2 weeks> <Individual oral gymnastics will be held 3 times a week>	Researcher	Senior center	NCGPPD	**Theoretical education:** oral health education, oral hygiene management method education, teeth brushing training **Practical training:** individual oral exercise (opening and closing exercises, jaw muscle exercise, lip muscle exercise, salivary gland stimulation exercise, vocal exercises) **Expert management:** denture cleaning, Watanabe brushing teeth	**Oral examination** **Plaque index:** O'Leary index **Coated tongue index:** divide the entire tongue into 9 parts to determine whether the tongue is attached **Repeat function:** RSST **Salivation rate:** KISO WeT Tester **The amount of opening:** electronic ruler **Oral health-related quality of life:** OHIP-14	**Clinical indicators** (dental plaque index*, coated tongue*, number of repeat deglutition*, amount of saliva*, amount of opening**) **Self-efficacy** (oral health-related quality of life*)
Cho et al., 2013	**8 weeks** (4 times)	Researcher	General hospital	OPPD	**Practical training:** interdental brushing (demonstration practice) **Expert management:** professional teeth brushing (Watanabe brushing teeth)	**Gingival bleeding:** GBI **Dental plaque adhesion degree:** PHP	**Clinical indicators** (dental plaque*, gingival bleeding index*)

Table 5. Continued 2

Author (year)	Duration (frequency)	Participants	Research institute	Study design	Intervention	Meaeurement tools	Outcome
Bang, 2014	**8 weeks** (24 times) <3 times a week for 30 minutes>	Researcher	Long-term care center	NCGPPD	**Practical training:** deglutition movement program (exercise: oral exercise, expiratory muscle strength exercise; maneuver: effort deglutition, Mendelsohn maneuver)	**Screening test for deglutition disorder:** GUSS **Deglutition symptom questionnaire:** SSQ **Tongue pressure:** IOPI	**Clinical indicators** (screening test for deglutition disorder**, questionnaire score of deglutition symptom*, tongue pressure*)
Kim et al., 2015	**7 weeks** (3 times) <Theory and practical training once every two weeks, last week-evaluation>	Investigator, guardian	Senior center	NCGPPD	**Theoretical education:** oral disease, xerostomia **Practical training:** teeth brushing (correct teeth brushing), management of artificial teeth (denture care demonstration practice), oral exercise (simple oral exercise, active oral exercise)	**Dental health behaviors:** OHB index **Gingivitis index:** GI **Dental plaque:** QHI **Educational tool:** Qscan	**Clinical indicators** (dental plaque*, gingivitis index*) **Oral health behavior** (dental health behaviors*)
Park, 2015	**5 weeks** (5 times) <Once a week> <Do oral exercise 5 times a day>	Professional instructor	Senior center	OPPD	**Practical training:** oral exercise program (a e i o u training, racukapacha training, facial muscle training, healthy breathing training, stimulating salivary glands, tongue muscle training, tongue stick training)	**The amount of opening:** electronic ruler **Effect of improving pronunciation skills:** in order of racukapacha pronunciation	**Clinical indicators** (maximum opening*, racukapacha pronunciation speed*)
Kim, 2016	**2 months** (8 times) <Twice a week for 2 months>	Dental hygienist	Long-term care center	NCGPPD	**Theoretical education:** training before the program (the importance of oral health and oral function, types of oral function improvement exercises) **Practical training:** oral exercise (preparatory exercise, oral opening and closing, tongue stretching, cheek exercise, neck stretching, tongue exercise, masticatory exercise, vocal exercises, deglutition exercise, finish exercise)	**Oral wettability:** oral water meter **Mouth muscle strength:** retremeter **Occlusal strength:** oak zalposme **Deglutition strength:** RSST	**Clinical indicators** (oral wettability**, mouth muscle strength**, deglutition strength**, occlusal strength**)

Table 5. Continued 3

Author (year)	Duration (frequency)	Participants	Research institute	Study design	Intervention	Meaeurement tools	Outcome
Lee et al., 2016	**12 weeks** (6 times, 12 times) <Expert hygiene management: ability to carry out daily life less than 75 points-twice a week, 75 points or higher-once a week; Education: 2 times>	Nursing care worker, dental hygienist	Long-term care center	NCGPPD	**Theoretical education:** the importance of oral care, elderly oral problems **Practical training:** brushing teeth method (rotation method, Bass, method, composite method, tongue cleaning), directions for using oral supplements, Watanabe brushing teeth, teeth brushing, mouth muscle massage, salivary massage, oral health education, oral supplements	**Dental plaque:** O'Leary index **Halitosis:** refres halitosis measuring instrument **Coated tongue:** winkel tongue coating index **Salivation rate:** swap method	**Clinical indicators** (dental plaque*, halitosis**, coated tongue**, salivation rate*)
Lee et al., 2016	**3 weeks** (self: 3 times, expert: 9 times) <Self: once a week; Expert: third a week>	Self: researcher Expert: expert	University of the elderly, community welfare center	NCGPPD	**Theoretical education:** oral muscle training **Expert management:** oral muscle training (oral exercise: oral muscles and tongue stimulation+mouth muscle massage: mouth muscle relaxation, stimulation of saliva)	**Salivation rate:** spitting method **Subjective xerostomia score:** interview survey	**Clinical indicators** (self- χ expert=salivation rate**, subjective xerostomia score**)
Jang et al., 2016	**6 weeks** (3 times) <Once every two weeks for 30 minutes>	Researcher	Community welfare center	NCGPPD	**Theoretical education:** the importance of managing artificial teeth, caution when using dentures **Practical training:** management of artificial teeth(demonstration practice)	**Satisfaction with dentures, oral health-related characteristic:** interview survey **Oral health-related quality of life:** OHIP-14	**Clinical indicators** (halitosis degree score*, dryness in my mouth*) **Oral health behavior** (number of denture washed*, subjective oral health status*) **Oral health recognition** (interest in oral health*) **Self-efficacy** (satisfaction with dentures*, oral health-related quality of life*)
Hong et al., 2016	**6 weeks** (12 times) <Twice a week for 30 minutes>	Researcher	Long-term care center	RCGPPD	**Practical training:** teeth brushing education using recall therapy, teeth brushing education using word completion, teeth brushing education using visual ignition, teeth brushing education using auditory ignition	**Oral health behavior:** survey **Dental plaque:** PHP **Gingival bleeding:** GBI	**Clinical indicators** (dental plaque*, gingival bleeding index*) **Oral health behavior** (subjective health status score*, teeth brushing effort degree*)

Table 5. Continued 4

Author (year)	Duration (frequency)	Participants	Research institute	Study design	Intervention	Measurement tools	Outcome
Jang, 2017	4 weeks (8 times) <Twice a week>	Experimental group 1: dental hygienist Experimental group 2: nursing care worker	Long-term care center	NCGPPD	**Theoretical education:** oral function improvement gymnastics (oral exercise), oral environment management method (Watanabe brushing teeth), tongue cleaning, denture cleaning and management method	**Oral wettability:** oral water meter **The amount of opening:** electronic ruler **The amount of opening:** retremeter **Deglutition strength:** RSST **Oral environment evaluation:** mBA-21 Oral Gas Detector	**Clinical indicators** (Experimental group 1: oral wettability*, amount of opening*, mouth muscle strength*, deglutition strength*, halitosis*, oral function score*, oral environment score*, oral health score*; Experimental group 2: oral wettability*, amount of opening*, mouth muscle strength*, deglutition strength*, halitosis*, oral function score *, oral environment score**, oral health score*)
Han, 2017	4 weeks (4 times) <Once a week>	Researcher	Long-term home care hospital	OPPD	**Theoretical education:** systemic disease for the elderly, correct teeth brushing. management of artificial teeth, directions for using oral supplements, oral exercise, gingiva massage	**Comparison of the number of remaining teeth:** oral examination **Coated tongue:** divide the entire tongue into 9 parts to determine whether the tongue is attached **Xerostomia, halitosis subjective symptom test, self-oral management status survey:** interview survey **Oral microbes:** sabouraud dextrose agar culture medium	**Clinical indicators** (coated tongue*, comparison of residual teeth*, symptom of halitosis before and after education*, oral microbes**)
Kim et al., 2018	4 weeks (4 times) <Once a week for 60 minutes>	Researcher, assistant	Senior welfare center, senior center	NCGPPD	**Theoretical education:** oral structure, oral function, xerostomia, nutrition care **Practical training:** teeth brushing (correct teeth brushing demonstration practice), oral supplements (Interdental brush, dental floss demonstration practice), oral exercise (demonstration practice), salivary massage (demonstration practice), mouth wash (demonstration practice)	**Xerostomia, salivary effusion:** measurement of saliva secretion using **Oral health-related quality of life:** OHIP-14	**Clinical indicators** (xerostomia**, salivation rate*) **Self-efficacy** (oral health-related quality of life**)

Table 5. Continued 5

Author (year)	Duration (frequency)	Participants	Research institute	Study design	Intervention	Measurement tools	Outcome
Moon, 2018	**8 weeks** (16 times) <Twice a week>	Researcher	Long-term care center	NCGPPD	**Theoretical education:** oral health education **Practical training:** teeth brushing, salivary massage	**Dental plaque:** O'Leary index **Oral wettability:** oral water meter **Halitosis:** mBA-21 Oral Gas Detector	**Clinical indicators** (dental plaque*, halitosis*, oral wettability*)
Oh, 2018	**4 weeks** (4 times) <Once a week>	Researcher	Senior center, University of the elderly	NCGPPD	**Theoretical education:** oral health education (necessity of oral health care for the elderly, the importance of oral health **Practical training:** oral exercise (oral opening and closing exercise, lip muscle exercise, vocal exercises, tongue exercise, cheek exercise, neck exercise), salivary massage (stimulating parotid gland, stretching parotid gland lower muscles, stimulating sublingual gland, stimulating the root of the tongue)	**Salivary effusion and PH:** saliva-check BUFFER	**Clinical indicators** (salivary effusion and PH*)
Im, 2020	**4 weeks** (12 times) <3 times a week for 20 minutes>	Researcher	Long-term care hospital	NCGPPD	**Theoretical education:** the necessity of oral care and introduction education **Practical training:** teeth brushing training (rotation method), denture care training, oral exercise (watch and follow the video)	**Xerostomia:** interview survey **Halitosis:** Tanita **Oral health-related quality of life:** OHIP-14	**Cinical indicators** (oral health*, xerostomia*, halitosis*) **Self-efficacy** (oral health-related quality of life*)

NCGPPD: non-equivalent control group pretest-posttest design, OPPD: one group pretest-posttest design, RCGPPD: randomized control group pretest-posttest design.

*p < 0.01, **p < 0.05.

care center (9 studies), and studies were rarely conducted in a welfare facility for home-dwelling older adults or retirement homes (1 study). Older adults who utilize welfare centers for home-dwelling older adults are primarily those who live at home but are suffering from physical or mental disorders. Hence, studies should continue to examine older adults who do not have the luxury of receiving continuous professional management or interventions in order to promote the oral health of older adults in various settings. Accordingly, subsequent studies should be conducted on older adults in more diverse settings that have not been the focus of past research.

With the exception of one randomized controlled trial (RCT)[7], 20 studies were quasi-experimental studies. RCTs are recognized as the standard in clinical research and is a valid methodology with the least risk of bias and error, and more RCTs of oral health management programs should be conducted.

Most studies with a duration of intervention of four weeks or less only observed changes in the clinical indices, but studies that used an intervention lasting six months or longer observed changes in oral health behaviors, including toothbrushing frequency and ability to manage oral environment, as well. A short-term oral health education and professional oral management intervention would have limitations in bring about changes in long-established lifestyles. Regarding intervention frequency, most studies administered the intervention once a week. This is presumably because weekly repeated education enhances the performance of oral management intervention, considering older adults' cognitive abilities. Thus, long-term interventions (≥ 6 months) would be needed in order to identify the specific effects of interventions and to enhance participants' performance with the intervention, and the frequency of intervention in long-term intervention studies should be set to once a week, as the frequency varied across the studies.

In addition, while oral health experts, such as dental hygienists, administered the oral health management interventions in most studies, the programs were administered by a certified nurse assistant or paid caregiver in four studies. However, the interventions produced significant outcomes in all studies regardless of the intervention trainer.

As the number of certified nurse assistants or paid caregivers providing continuous and routine oral health management is increasing, training these health-related workers with the administration of oral health education to promote older adults' oral health is also an important role of dental hygienists. Regarding the contents of the intervention, most of the studies investigated programs comprising oral exercise training and practice. This was presumably an effort to objectively confirm that oral exercise programs helped alleviate dry mouth and bad breath that are prevalent among older adults. The types of interventions included theoretical education (20 studies), hands-on training (18 studies), and professional management (6 studies). Jang et al.[19] reported that promotional event-based approaches, such as the creation of an oral health promotion environment and contests have the effect of increasing the effectiveness of health promotion programs, and Lee et al.[13] emphasized the importance of a certain degree of professional intervention. This is because participants are more engaged in new and diverse approaches, such as events, than unidirectional lectures, and involving professional management further engages the participants in the program based on trust in the professionals. Thus, subsequently, programs such as oral exercise or toothbrushing training should be administered in a demonstration-practice format to involve participants in the program, and these programs should also incorporate professional management, such as oral muscle massage or Watanabe toothbrushing technique, to further motivate voluntary participation among participants.

The effects of oral health management programs were assessed based on changes of clinical indices in all 21 included studies. These studies confirmed that oral health management programs have positive physical effects in older adults. Some studies also assessed the effects of oral health management programs based on the changes of oral health behavior, oral health perception, self-efficacy, and oral health knowledge. This is because it is important to alter older adults' behaviors, attitude, and knowledge through continuous and repetitive education and experience as part of oral health management programs. However, only five of the included studies assessed changes in oral health behaviors and knowledge. Therefore, future studies should

concurrently assess the effects of the programs on several other indices of mental and social aspects in older adults.

This study adhered to the PICO and PRISMA guidelines for a systematic review but did not establish the validity of the included studies through a quality assessment. Further, only one of the included studies was a RCT, and oral health management programs used in other countries were excluded, thus hindering a more comprehensive literature review. Only 21 studies were selected based on the selection criteria, so the findings of this study cannot be generalized.

Despite these limitations, however, this study is significant in that it attempted to review the contents, methods, and effects of oral health management interventions for older adults. Subsequent studies should appraise the quality of the included studies to substantiate their validity and also include more relevant studies for a systematic review.

Notes

Conflict of interest

No potential conflict of interest relevant to this article was reported.

Ethical approval

This study is a review-based study and does not require an IRB review.

Author contributions

Conceptualization: Hee-Jung Lim. Data acquisition: all the authors. Formal analysis: all the authors. Funding: Hee-Jung Lim, Im-Hee Jung, and Eun-Seo Choi. Supervision: Hee-Jung Lim and Im-Hee Jung. Writing-original draft: all the authors. Writing-review & editing: Hee-Jung Lim. All authors approved the final manuscript.

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