

Case Study on an Oral Health Care Program for Older Adults Based on a Public-Private-Academic Partnership

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Background: The population of Gangneung City in South Korea has shown a gradual increase in the proportion of individuals aged 65 years and older, and the most frequently reported diseases for several years have consistently been periodontal diseases, including gingivitis and periodontitis. The regional imbalance in the distribution of dental personnel and resources has emerged as a problem of inequality in the use of dental care. It has been advocated to identify areas with disadvantages in dental care and develop public dental policies based on that. This study aimed to develop a customized oral healthcare program for local seniors based on a Public-Private-Academic Partnership, and to evaluate the oral health status of older adults in Gangneung City.

Methods: The participants were residents aged 60 years and above in Gangneung City. A questionnaire including general information, systemic health status, and oral health status was administered to the participants. In addition, oral healthcare and education tailored to each individual's health status were provided once or twice based on their oral health status. The collected data were analyzed using IBM SPSS Statistics 25 for descriptive statistical analysis.

Results: Among the older adults in Gangneung City, 75% had at least one prosthesis and exhibited symptoms of gingivitis or periodontitis. Additionally, the modified sulcus bleeding index decreased among participants who underwent the program twice. Over 90% of the participants expressed satisfaction with the program.

Conclusion: The program appeared to contribute positively to the oral health promotion among local seniors. Further oral healthcare programs should focus on seniors in rural and old urban areas to reduce disparities in oral health across regions.

Key Words: Case study, Elderly, Oral health, Public-Private-Academic Partnership

Introduction

1. Background

In South Korea, the declining birth rate and increasing life expectancy predict that by 2040, the elderly population will constitute more than one-third of the total population¹⁾. In Gangwon Province, although the population of Wonju and Yeongseo areas are expected to grow, that of other regions is projected to decline. Specifically, examining population changes in Gangneung City, a region in Yeongdong, Gangwon Province, which is relatively far

from the metropolitan area, the proportion of the population aged under 14 years is lower than the national and Gangwon averages, while the proportion of the population aged 65 years and above is higher²⁾. Additionally, the proportion of the population aged 65 years and above in Gangneung has steadily increased from 22.2% in 2021 to 24.7% in 2024³⁾.

The elderly population in Gangneung is concentrated in rural and old urban areas, which are presumed to have low medical accessibility. To address their physical health issues, comprehensive counseling, provision of information, and

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financial support for service usage are essential²⁾. Accordingly, Gangwon Province has been conducting tailored home healthcare projects⁴⁾, and the 5th Gangneung Community Welfare Plan (2023~2026) included senior healthcare services and elderly care services as part of local government social security projects⁵⁾. However, these services mainly focus on systemic health and disease management, excluding major oral healthcare, despite its relationship with systemic health.

Systemic and chronic diseases are common in older adults and are closely associated with oral diseases. Medications prescribed for chronic diseases can cause oral side effects⁶⁾ and poor oral health can exacerbate systemic diseases⁷⁾. Previous studies have reported associations between oral health and cardiovascular, cerebrovascular, and respiratory diseases as well as diabetes^{8,9)}. Thus, oral health is a crucial factor for the elderly in maintaining a healthy life.

According to the 2022 Gangneung Community Health Statistics, the rate of complaints of chewing difficulty among those aged 65 years and above was 37.1% in 2019 and 28.8% in 2022, showing no clear trend¹⁰⁾. The highest rate was found among those aged 80 years and above. Furthermore, seniors living in Seoul and metropolitan areas were 0.76 times less likely to experience unmet dental-care needs compared to those in these rural areas¹¹⁾. The unmet dental-care needs across different regions were influenced by factors that go beyond economic considerations, encompassing social determinants such as urbanization, social inequalities, and resource accessibility¹²⁾. The regional imbalance in the distribution of dental personnel and resources has emerged as a problem of inequality in the use of dental care. It has been advocated to identify areas with disadvantages in dental care and develop public dental policies based on the data¹³⁾. In the states of Connecticut and Iowa, USA, local healthcare professionals, including dental hygienists, operate programs targeting oral health promotion for pregnant women and children in medically underserved areas. These programs include oral health education, screening, preventive therapies, treatment, and emergency services tailored to specific oral health risk profiles¹⁴⁾. Similar collaborative initiatives involving various community resources have been launched in South Korea to implement oral health promotion programs for

local residents. Such programs may have a positive impact on fostering social and physical support environments¹⁵⁾.

2. Objectives

This study aimed to develop and provide a customized oral healthcare program for local seniors based on a Public-Private-Academic Partnership (PPAP), and to evaluate the oral health status of older adults in Gangneung City.

Materials and Methods

1. Participants

This study was approved by the Institutional Review Board of the Gangneung-Wonju National University. It was conducted between September and December 2023. To recruit participants, official letters were sent to senior welfare centers and organizations in the region, explaining the purpose and content of the program. Participants were 32 residents from Gangneung aged 60 years and above, when chronic diseases and other health problems typically begin to occur, who understood the program's purpose and voluntarily agreed to participate. Detailed explanations of the research purpose, methods, and right to withdraw were provided and informed consent was obtained. The exclusion criteria included communication difficulties, mobility problems, edentulism, and acute infectious diseases.

2. Methods

To develop the oral health program for the elderly based on PPAP, literature and reports were reviewed using keywords such as "elderly," "seniors," "region," "local government," "community," "Gangwon province," "Gangneung," "health," "oral health," "oral health program," and "oral health project." The relevant content was collected and referenced during the research process. Standardized guidelines and materials, including manuals and clinical record forms, were developed to systematically document the oral health status of older adults. Two oral healthcare service providers were selected as dental hygienists with experience in dental hygiene and clinical practice education. Before the program, the operators calibrated mock participants to ensure standardization and verify consistency, achieving a kappa of 0.896.

The oral healthcare program was conducted in the following order: Dental Hygiene Assessment, Diagnosis and Planning, Implementation, and Evaluation. The assessment included general information (sex, age, education level, family composition, residential area, type of health insurance), systemic disease status (diabetes, cardiovascular disease, respiratory disease, other diseases), oral health behavior (dental visit experience in the past year, reasons for dental visits, toothbrushing habits, use of oral care products), oral health status (the risk of root caries, number of missing teeth, number of natural teeth, number of prostheses, presence of implants), and periodontal status (bleeding on probing [BOP], modified sulcus bleeding index [mSBI], probing depth [PD], clinical attachment level [CAL], Recession). Periodontal health status was measured using periodontal probes of UNC No.15 (Hu-Friedy, Chicago, IL, USA). The mSBI was evaluated as 0 if there was no bleeding when the probe was passed along the gingival margin, 1 if isolated bleeding and spots were visible, 2 if the bleeding form showed a red line on the margin, and 3 if there was a large amount of bleeding.

Based on the collected assessment data, participants' dental hygiene problems were diagnosed, and visit frequencies (once or twice) and major tasks were planned. Participants were selected for the follow-up visit if they possessed a minimum of two teeth exhibiting a PD of 4 mm or greater and CAL of 3 mm or more, or if any single site demonstrated a PD of at least 5 mm. The oral healthcare service provided nonsurgical periodontal treatment (scaling, physical and chemical dental plaque management, etc.) and oral health education (toothbrushing, interdental cleaning, etc.) tailored to the oral health status and behavior of the participants. For participants who visited twice, appropriate oral healthcare was provided during the second visit, and the mSBI was re-measured before the second visit. Participants who completed all stages of the program were evaluated on their willingness to revisit, satisfaction with the service, and program-related requirements.

3. Data analysis

The collected clinical records were entered into Microsoft Excel 2016 (Microsoft Corporation, Redmond, WA, USA) and analyzed using IBM SPSS Statistics 25

(IBM Corp, Armonk, NY, USA) for general characteristics, oral health behaviors, and oral health status using descriptive statistical analysis. To examine the differences in mSBI across visit sessions, we conducted normality and Wilcoxon signed-rank tests.

Results

1. General characteristics of the participants

Among the 32 confirmed participants, 11 were male (34.4%) and 21 were female (65.6%). The majority of participants were in their 60s (59.4%), followed by those in their 70s (34.4%), with a smaller percentage aged 80 years and above (6.3%). Educational attainment varied among the participants: 15.6% had completed elementary education or lower, 21.9% had completed middle school, 28.1% had completed high school, and an equal proportion

Table 1. General Characteristics of the Participants

Category	Number (%)
Total	32 (100.0)
Sex	
Male	11 (34.4)
Female	21 (65.6)
Age	
60s	19 (59.4)
70s	11 (34.4)
≥80s	2 (6.3)
Educational levels ^a	
Elementary education or lower	5 (15.6)
Middle school education	7 (21.9)
High school education	9 (28.1)
≥ College education	9 (28.1)
No response	2 (6.3)
Family composition	
Lived alone	6 (18.8)
Lived with their spouse	21 (65.6)
Lived with their children	5 (15.6)
Region ^a	
Urban area (Dong)	29 (90.6)
Rural area (Eup-Myeon)	1 (3.1)
No response	2 (6.3)
Type of health insurance ^a	
Health insurance	30 (93.8)
Medicaid	0 (0.0)
No response	2 (6.3)

^aIncluding missing data.

(28.1%) had attained a college degree or higher (Table 1).

2. Systemic health status

Regarding systemic diseases, 8 participants (25.0%) had none, 14 (43.8%) had one, 4 (12.5%) had two, and 6 (18.8%) had three. The most common systemic disease was hypertension (18 participants, 35.3%), followed by hyperlipidemia (10 participants, 19.6%), diabetes (8 participants, 15.7%), osteoporosis (5 participants, 9.8%), and arthritis (2 participants, 3.9%) (Table 2).

3. Oral health behaviors

In terms of oral health behaviors, the most common frequency of toothbrushing was twice daily (17 participants, 53.1%), followed by three times daily (11 participants, 34.4%) and four times daily (3 participants, 9.4%), while no participants reported brushing zero times a day. Regarding the use of oral care products, 7 participants (21.9%) did not use any, 18 (56.3%) used one type, and 7 (21.9%) used two types. The most commonly used oral care product was dental floss (22 participants, 40.7%), followed by mouthwash (19 participants, 35.2%), interdental brushes (8 participants, 14.8%), and water picks (3 participants, 5.6%) (Table 3).

4. Oral health condition

The oral health status results showed an average of 13.1 teeth remaining in the upper jaw and 13.0 in the lower jaw. The presence of root caries was higher in those without the

root caries (28 participants, 87.5%) than in those with it (4 participants, 12.5%). The most common number of prostheses (crown or bridge) was 1~2 units (10 participants, 31.3%), followed by none (8 participants, 25.0%), 3~4 units (7 participants, 21.9%), and 5 or more units (7 participants, 21.9%). The presence of crown prostheses was higher (19 participants, 59.4%) than their absence (13 participants, 40.6%), whereas the presence of bridge prostheses was lower (11 participants, 34.4%) than their absence (21 participants, 65.6%). Overall, approximately 75% of the participants had at least one prosthesis. Additionally, the presence of implants was more common (17 participants, 53.1%) than their absence (15 participants, 46.9%) (Table 4).

5. Changes in the mSBI according to the visits

Periodontal health status showed that gingival bleeding was present in 24 participants (75.0%) and absent in 8 (25.0%). Gingival redness was present in 12 participants (37.5%), but absent in 20 (62.5%). The presence of

Table 2. Systemic Health Status

Category	Number (%)
Systemic diseases	
None	8 (25.0)
1	14 (43.8)
2	4 (12.5)
≥ 3	6 (18.8)
Types of systemic diseases present (multiple response)	
Hypertension	18 (35.3)
Hyperlipidemia	10 (19.6)
Diabetes	8 (15.7)
Osteoporosis	5 (9.8)
Arthritis	2 (3.9)
Other diseases	8 (15.7)

Table 3. Oral Health Behaviors

Category	Number (%)
Visited a dentist in the past year	
Done	11 (34.4)
Not done	21 (65.6)
Undergone regular check-ups (such as scaling)	
Done	15 (46.9)
Not done	17 (53.1)
Frequency of toothbrushing	
0	0 (0.0)
1	1 (3.1)
2	17 (53.1)
3	11 (34.4)
4	3 (9.4)
Frequency of using oral care products	
0	7 (21.9)
1	18 (56.3)
2	7 (21.9)
Used oral care product (multiple response)	
Dental floss	22 (40.7)
Mouthwash	19 (35.2)
Interdental brush	8 (14.8)
Water picks	3 (5.6)
Other	2 (3.7)

gingival swelling was higher (24 participants, 75.0%) than its absence (8 participants, 25.0%). The absence of clinical attachment loss was higher (20 participants, 62.5%) than its presence (12 participants, 37.5%). The presence of periodontal pockets (4 mm or more) was higher (19 participants, 59.4%) than its absence (13 participants, 40.6%) (Table 4). The mean mSBI decreased from 2.53 at the first visit to 0.94 at the second visit and it was statistically significant ($p=0.005$) (Table 5).

Table 4. Oral Health Condition

Category	Value
Average of teeth remaining	
Upper	13.1±3.70
Lower	13.0±3.10
Presence of root caries	
Absent	28 (87.5)
Present	4 (12.5)
Number of prostheses (crown, bridge)	
0	8 (25.0)
1 ~ 2	10 (31.3)
3 ~ 4	7 (21.9)
≥ 5	7 (21.9)
Crown prostheses	
Absent	13 (40.6)
Present	19 (59.4)
Bridge prostheses	
Absent	21 (65.6)
Present	11 (34.4)
Implant prostheses	
Absent	15 (46.9)
Present	17 (53.1)
Gingival bleeding	
Absent	8 (25.0)
Present	24 (75.0)
Gingival redness	
Absent	20 (62.5)
Present	12 (37.5)
Gingival swelling	
Absent	8 (25.0)
Present	24 (75.0)
Clinical attachment loss	
Absent	20 (62.5)
Present	12 (37.5)
Periodontal pockets (≥ 4 mm)	
Absent	13 (40.6)
Present	19 (59.4)

Values are presented as mean±standard deviation or n (%).

6. Satisfaction survey results

Of the participants, 76.0% strongly agreed and 24.0% agreed that the program led to positive changes in oral health status and behaviors. Regarding satisfaction with the program's content and its contribution to enhancing the oral health of local elderly individuals, 96.0% strongly agreed and 4.0% agreed. In terms of willingness to participate in future sessions and recommend oral health services to others, 92.0% strongly agreed and 8.0% agreed (Table 6). Subjective feedback encompassed sentiments such as the desire for the program to become a staple in elderly care, appreciation for its thorough and approachable instructions compared to hospital education, and recommendations for its annual recurrence.

Discussion

1. Interpretation

Gangwon Province has become a super-aged society with over 20% of its population aged 65 years and above, with 16 out of 18 regions, including Gangneung City, classified as super-aged societies. This study aimed to develop a customized oral healthcare program for local seniors based on the PPAP, and to evaluate the oral health status of older adults in Gangneung City.

2. Key results and comparison

An oral health program was conducted for 32 older adults in Gangneung. Most participants resided in urban areas (Dong) with relatively good accessibility to Gangneung-Wonju University, while only one participant (13.1%) was from a rural area (Eup-Myeon). According to the 2022 Gangneung Community Health Statistics, the chewing difficulty complaint rate among those aged 65

Table 5. Changes in the Modified Sulcus Bleeding Index According to the Visits (n=17)

Category	Mean±SD	p-value
Modified sulcus bleeding index		
1st	2.53±3.10	0.005
2nd	0.94±1.71	

The data were analyzed using Wilcoxon signed-rank test. SD: standard deviation.

Table 6. Satisfaction Survey Results (n=25)

Category	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Mean±SD
Positive changes in oral health status and behaviors attributable to the program	0 (0)	0 (0)	0 (0)	6 (24.0)	19 (76.0)	3.72±2.04
Program content	0 (0)	0 (0)	0 (0)	1 (4.0)	24 (96.0)	3.88±2.09
Program contribution to improving the oral health of local elderly individuals	0 (0)	0 (0)	0 (0)	1 (4.0)	24 (96.0)	3.88±2.09
Participation in the next session of the program	0 (0)	0 (0)	0 (0)	2 (8.0)	23 (92.0)	3.84±2.08
Intention to recommend the program	0 (0)	0 (0)	0 (0)	2 (8.0)	23 (92.0)	3.84±2.08

Values are presented as n (%), otherwise indicated.
SD: standard deviation.

years and above in Gangneung was the highest in Jumunjin-eup (31.5%) and lowest in Gyeongpo-dong (9.9%)¹⁰. The rate of toothbrushing after lunch was slightly lower in rural areas (56.9%) than in urban areas (62.9%). Similarly, there were differences in oral health variables between urban areas with relatively good accessibility and rural areas with poor accessibility within Gangneung. Previous studies have shown that the medical needs of rural residents are stronger than those of urban residents, and that there is a significant demand for various health promotion services¹⁶. Therefore, an oral healthcare program focusing on medically underserved seniors in rural areas is required. Maintaining and expanding public-private cooperation is essential to achieve optimal oral health for all¹⁷, and a PPAP model has been recommended for managing oral health in underserved populations¹⁸.

Some universities abroad have emphasized that utilizing university and human resources to provide oral healthcare services could serve as an innovative model for improving the oral health status of residents in rural and suburban communities^{19,20}. Furthermore, the effectiveness of providing oral healthcare services through school-based collaboration has also been demonstrated in promoting oral health²¹.

The study participants had relatively high educational levels and good oral health behaviors. More than 50% of them had a high school education or higher, exceeding the national average of 40% for those aged 25 ~ 64 years with higher education in 2022²². Toothbrushing frequency showed that 53.1% of the participants brushed twice daily and 43.8% brushed three to four times daily, indicating

that more than half brushed their teeth two to four times a day. In addition, 55.5% of the participants used oral care products for interdental care, showing that more than half of them recognized the need for interdental cleaning in addition to tooth surface cleaning. According to previous studies that analyzed data from the Korea National Health and Nutrition Examination Survey, the rate of dental floss or interdental brush usage among adults aged 60 years and above was approximately 53.2%, which supports the findings of this study²³.

Previous studies have also shown significant differences in oral health status and behaviors according to the education level of the elderly²⁴, impacting their oral health-related quality of life²⁵. Despite high education levels and good oral health behaviors, the participants still exhibited symptoms of gingivitis and periodontitis and possessed prostheses (crowns or bridges) and implants. More than 75% of participants also had at least one systemic disease, which can increase the risk of oral diseases such as periodontitis and complications during dental treatment²⁶.

Professional dental plaque management, in addition to self-administered oral care, should be appropriately implemented because most elderly individuals have systemic diseases and dental prostheses. Therefore, oral health programs linking systemic health to oral healthcare should be established. The effectiveness of the program was positively evaluated by the reduction in the average mSBI from 2.53 to 0.94 among 17 participants who visited the program more than twice. This suggests that self-dental plaque management methods taught through professional toothbrushing and interdental care by dental

hygienists led to behavioral changes in the participants. Additionally, most of the participants were satisfied with the program, responded positively to its contribution to community seniors' oral health, and expressed a willingness to participate in future sessions.

3. Suggestion

Gangneung residents expressed a need for services to alleviate social service utilization difficulties due to geographic accessibility and to identify and overcome welfare blind spots in collaboration with local residents²⁾. According to Gangneung's regional healthcare plan, managing chronic diseases such as hypertension and diabetes, and elderly healthcare is the most-needed health projects²⁷⁾. Therefore, an oral health program based on a PPAP model utilizing available dental resources needs to be developed further, and this study can provide foundational data for this development.

4. Limitations

This study has a few limitations, as it only targeted community-dwelling seniors in Gangneung, making it difficult to generalize the results to the entire elderly population. Additionally, changes in all indicators related to oral health status and behaviors presented in the study were not measured. Because the participants had to visit the location where the program was implemented program, it was difficult for elderly people in remote rural areas to participate in the program; therefore, the overall oral condition of the participants was good. Nonetheless, this study is impactful in that it evaluated the oral health status and behaviors of older adults in Gangneung based on the PPAP and confirmed that an expert-led oral healthcare program positively impacted the oral health of local seniors.

Notes

Conflict of interest

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

Ethical approval

This article was exempted from the Institutional Bio-

ethics Committee of Gangneung-Wonju National University (GWNU IRB-2023-23).

Author contributions

Conceptualization: Jin-Sun Choi and Hyo-Jin Lee. Data acquisition: Jin-Sun Choi, Hyo-Jin Lee, Hye-Young Yoon, Sun-Jung Shin, Bo-Mi Shin, and Soo-Myoung Bae. Formal analysis: Jin-Sun Choi, Hyo-Jin Lee, Hye-Young Yoon, Sun-Jung Shin, Bo-Mi Shin, and Soo-Myoung Bae. Supervision: Sun-Jung Shin, Bo-Mi Shin, and Soo-Myoung Bae. Writing - original draft: Jin-Sun Choi and Hyo-Jin Lee. Writing - review & editing: Jin-Sun Choi and Hyo-Jin Lee. Data acquisition: Jin-Sun Choi, Hyo-Jin Lee, Hye-Young Yoon, Sun-Jung Shin, Bo-Mi Shin, and Soo-Myoung Bae.

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Data availability

Please contact the corresponding author for data availability.

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