

# Factors affect on implementation of home dental care

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## Research article

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# Abstract

**Background** In Japanese super aging society, there is a need to establish home dental care service supply system. Current situation of home dental care should be analyzed. **Methods** A cross-sectional survey was conducted using a self-administered postal questionnaire distributed to all members of Iwate Dental Association. Implementation of home and nursing home dental care, number of staffs of dental clinic and the contents of dental home care were analyzed. For the analysis, correspondence analysis, item response theory, and zero-inflated model were used. **Results** Among 354 dental clinics, 187 (52.8%) were implemented home dental care and 195 (55.1%) were implemented nursing home dental care. Dental clinics handle home dental care by part-time workers. Denture treatment and oral care was the common treatment of dental home care. **Conclusion** More than half of the dental clinics were not managed the home dental care. Infrastructure improvement is necessary for the sufficient supply of dental home care service.

## Background

Japan is now a super-aged society. The number of people aged 65 and over was 35 million 675 thousand in February 2019. It was 28.2% of the total population [1]. The life expectancy of a 65-year-old man was 19.57 years and that of a woman was 24.43 years [2]. According to a national survey conducted every five years, the number of remaining teeth in the age group from 65 to 69 was 21.9. It was 10.7 in the age group over 85 years old. The number of remaining teeth in the elderly is increasing [3]. For these people, dental care and oral care are essential to promote their healthy life and quality of life. Therefore, the demand for home dental care will increase.

The number of dentists in Japan was 104,533 in 2016 [4]. Of these, 89,166 (85.3%) worked at the dental clinic. The number of Japanese dental clinics was 69,592 in 2014 [5]. According to these statistics, one dentist needs to care for 400 elderly people, and one dental clinic needs to care for 512 elderly people. The average number of dentists in one dental office was 1.28.

The estimated number of outpatients receiving home medical care was 156.4 thousand per day. 14.4 thousand patients received home medical care by hospital, 101.5 thousand patients by medical clinics, and 40.6 thousand patients by dental clinics. Of the 40.6 thousand patients, 31.5 thousand were over 65 years of age [6]. Only 0.09% elderly people over the age of 65 used home dental services in one day. It may indicate that the home dental care service supply system is not sufficient.

Primary dentists contributed to the subjective well-being of the elderly [7], but dentists experienced barriers in several areas: lack of knowledge [8], inadequate training and experience [9,10], practical circumstances [8], lack of proper equipment [9,10], loss of time from private practice [11].

Therefore, it is necessary to analyze the current situation of home dental care. In this study, we analyzed the relation between scale of the dental clinic and the implementation of dental care at home and nursing homes. In addition, the content of home dental treatment was analyzed.

# Methods

## Study population

This study was a cross-sectional survey conducted using a self-administered postal questionnaire. The questionnaire was distributed to all 609 members of the Iwate Dental Association

## Questionnaire

The questionnaire consisted of 61 main categories including demographic factors, scale of dental clinic, implementation of home dental care, medical dental collaboration, and availability of services provided to members by the Iwate Dental Association.

Of these items, the following items were used in the analysis. implementation of home dental care, frequency of visit and content of home dental care, places to visit home dental care (home and nursing homes) and number of dental staff in clinic.

## Data analysis

Cross tabulation was carried out for frequency of place and contents of visiting dental care. By this crosstabulation, correspondence analysis was carried out. The result was graphically illustrated as biplot [11]. Under the Item Response Theory (IRT) approach three-parameter logistic model were applied [12-15]. Item difficulties, item discriminations, guessing and item information were calculated. Item response curve and item information curves were illustrated.

Mean Number of dental staffs were calculated against with or without implementation of visiting dental care. Zero-inflated negative binomial model employs two components. The first component is governed by a binary distribution that generates structural zeros. A negative binomial distribution that generates counts governs the second [16, 17].

Analysis of IRT were performed by the R software with ltm and irtoys library. Analysis of zero inflated model was performed by glm, AER, glm2, pscl, and MASS library. Other analysis including descriptive statistics and correspondence analysis were conducted with IBM SPSS Statistics version 24 (IBM Inc., Tokyo, Japan).

## Ethics statement

The study was carried out in compliance with the principles of the Helsinki Declaration. Informed written consent for publication was obtained from each subject when the questionnaires were returned. The

study was approved by the Ethics Committee of Tsurumi University, School of Dental Medicine (approval number: 1730).

## Results

The questionnaire was distributed to all 609 members of the Iwate Dental Association and 354 were returned (recovery rate 58.1%). Of 187/354 (52.8%) dental clinics, home dental care implemented, and 195/354 (55.1%) implemented in nursing home dental treatment.

Table 1 shows the annual number of dental treatment by a dental clinic that performed at home, nursing home, and both home and nursing home. Denture treatment was most abundant (201/354: 57.1%), followed by oral care (119/354: 33.8%). Less than 25% performed dental caries (87/354: 24.7%), periodontal disease (83/354: 23.1%), and oral surgery including extraction (71/354: 20.1%). The relationship between each treatment and implemented place was graphically presented as a biplot analyzed by correspondence analysis. Denture treatment located between home and nursing home. Oral care centrally located between home, nursing home, and both home and nursing home. From Caries and Oral Surgery were located away from home.

The characteristics of these treatments were analyzed by a three parameter logistic model of the item response theory (IRT) approach. The model is shown in Table 2. The item response curve and item information curve are shown in Figure 2. The guessing for denture treatment was 0.18, continuing across the Y axis. It had very high item information. The caries treatment and periodontal treatment showed similar patterns. The item response curve of oral care shifted to the left from these two items. Oral surgery, including tooth extraction, shifted to the right.

The scale of the dental clinic, including human resources, may affect the implementation of home dental care. As a descriptive analysis, the number of dental staff was compared by the implementation of home dental care. As shown in Table 3, the number of dental hygienists and dental assistants had a major impact on the implementation of home dental care. Figure 3 shows a histogram of the number of visiting dental home care per year. Number of visits varied widely, ranging from 0 to 187 at home and 0 to 1951 at nursing homes. For statistical modeling, a zero-inflated models was applied. The results are shown in Table 4. The zero-inflated negative binomial model uses two components. The first component is managed by a binary distribution that produces zeros.

The second component is negative binomial distribution that generates the count. In the case of dental home care, the implementation largely depended on the number of part-time dental hygienists and the number of visits did not depend on the number of dental staff. In contrast, when visiting nursing homes, the implantation was negatively related to the number of regular workers of in dental hygienists and assistants. And it was positively related to the number of part-time dental assistant. Number of visits were negatively associated with regular workers in dental hygienists and dental assistants, and positively associated with part-time workers in dental hygienists and dental assistants.

## Discussion

In this study, the contents of dental home care and the relationship between the implementation of dental home care and the number of dental staff were analyzed.

Table 1 shows descriptive statistics on the frequency of dental treatment for the place of implementation. The frequency of each dental treatment was higher in dental clinics that performed both home and nursing home dental care than at home or nursing home alone. Dental clinics visiting both homes and nursing homes may be able to handle a variety of dental treatments.

As shown in Figure 1, dental caries treatment and oral surgery are located far from the dental clinic that visit only home. For caries treatments, mobile-specific devices may be required [9,10]. In some cases, an air turbine is essential for dental caries removal. Oral surgery treatment requires knowledge and experience in monitoring the general health condition. Knowledge about medical diseases is also required. Previous studies have shown that knowledge and experience were one of the barriers to dental home care [8]. These facts suggested that there may be some barriers and limitations to small dental clinics for home dental care.

Denture treatment located between the dental clinic that performed the home dental treatment and the nursing home dental treatment. The item response curve for dentures treatment showed that even dental clinics with little consideration for home dental treatment can deal with denture treatment. The slope of the item response curve for denture treatment was steep, and item information of it was very high. It indicated that most dental clinics that can deal with dental caries, periodontal disease, and oral surgery can handle denture treatment. Therefore, denture treatment was the most common treatment for home dental care. The item difficulty of oral care shown in Table 2 was smaller than those of dental caries, periodontal disease, and oral surgery. Oral care was a secondary general home dental treatment. It indicated that some elderly people received only denture treatment without oral care.

As shown in Figure 3, more than half of the dental clinics did not introduce home dental care; 60% for home care and 63% for elderly home care. When dental clinics performed home dental care, the most frequent visit was less than 5 times a year: 26% for home dental care and 19% for nursing home care. It indicates that most dental clinics provide home dental care for one or two patients annually. The Iwate Prefectural Dental Association has assigned home dental treatment to members upon request from a nursing home or local government. Clinics belonging to the Iwate Dental Association must perform home dental care, even if it is not their primary concern. Comparing home dental care with nursing home dental care, the time loss of home dental care is very large. Nursing homes can treat several patients in a single visit. Therefore, as shown in Table 3, the implementation of home dental treatment did not depend on the number of dental staff. For dental care in nursing homes, the dental clinic requires a contract with a nursing home, and the dental clinic is obliged to visit the nursing home regularly. Therefore, dental care in nursing homes requires an infrastructure that includes dental staff.

With a zero-inflated model, the implementation of home dental care depended on dental hygienists and dental assistants. Number of regular workers of dental hygienist and dental assistant negatively associated with the implementation of home dental care. It indicated that home dental care can be implemented not by full-time job workers. Many dental clinics handled home dental care by part-time workers rather than regular workers.

Home dental care can be implement not by full time jobs.

As shown in Figure 3, more than half of dental clinics did not implement home dental care and nursing home; 60% for home care and 63% for nursing home care. If dental clinics implemented the home dental care, less than 5 times visits per year were most abundant: 26% for home dental care and 19% for nursing home care. It indicated that most of the dental clinic implemented home dental care for one or two patient per year. Iwate dental association assigned home dental care for members when asked by the nursing home or municipal office. The clinics that belong to the Iwate dental association must implement home dental care even if it was not their major concern. When compared home dental care and nursing home dental care, loss of time is very large for home dental care. For nursing home care, several patient can be care by one visit. Therefore, as shown in Table 3, implementation of home dental care or not was not depend on the number of dental staff. For the nursing home dental care, dental clinics need the contract with nursing home, and dental clinics obligated to visit nursing home regularly. Therefore, infrastructure including dental staff is necessary for the nursing home dental care.

By the zero-inflated model, implementation of home dental care depend on the dental hygienist and dental assistant. Number of regular workers of dental hygienist and dental negatively associated with the implementation of home dental care. Home dental care can be implement not by full time jobs. The results indicated that many of the dental clinics handle home dental care by part time workers and not by regular workers.

In conclusion, more than half of the dental clinics were not managed the home dental care infrastructure improvement is necessary for the sufficient supply of dental home care service.

## **Declarations**

### **Ethics approval and consent to participate**

The Ethics Committee of Tsurumi University School of Dental Medicine approved this study (approval number, 1730), which proceeded in accordance with the Declaration of Helsinki. The participants were included after informed written consent was obtained and data were anonymized before analysis.

### **Consent to publish**

Not applicable.

## Availability of data and materials

All relevant data are administrated by Iwate Dental Association. Data can be provide if the reasonable request.

## Competing interests

The authors declare that they have no competing interests.

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The funding body did not play any roles in analysis, and interpretation of data.

## Authors' Contributions

YN wrote the manuscript. HD, HM & TS designed the research study and coordinated data collection. YN, EK, AY, OR & NH performed the data management and statistical analyses. NH, HM, HD & TS provided technical advice and critically reviewed the manuscript. All authors were involved in project management and contributed to the drafting of the journal article. All authors read and approved the final manuscript.

## Acknowledgements

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# Tables

**Table 1 Frequency of place and contents of home dental care**

		Home	Nursing home	Home and nursing home	Total	P-value
Denture	-	10	5	4	152	<0.001
	+	52	49	100	201	
Dental caries	-	53	39	41	266	<0.001
	+	9	15	63	87	
Oral surgery	-	56	44	49	282	<0.001
	+	6	10	55	71	
Periodontal disease	-	45	43	49	270	<0.001
	+	17	11	55	83	
Oral care	-	39	28	34	234	<0.001
	+	23	26	70	119	
Others	-	59	54	98	344	0.014
	+	3	0	6	9	

P-values were calculated by  $\chi^2$  tests.

**Table 2 Results of three parameter logistic model for the contents of home dental care**

	Discrimination	Difficulty	Guessing
Denture	25.47	0.26	0.18
Dental caries	4.26	0.68	<0.001
Oral surgery	3.22	0.90	<0.001
Periodontal disease	4.18	0.72	<0.001
Oral care	2.99	0.45	<0.001
Others	15.47	2.34	0.01

Parameters were estimated by maximum likelihood estimation using following formula:

$a_i$ : discrimination parameter

$b_j$ : difficulty parameter,

$c_j$ : guessing parameter

**Table3 Number of dental staffs against with or without implementation of home dental care**

		Home dental care					
		Home			Nursing home		
		-	+	P-value	-	+	P-value
Dentist	Regular	1.20+/-0.49	1.35+/-0.71	0.024	1.27+/-0.57	1.28+/-0.66	0.948
	Part time	0.30+/-0.74	0.37+/-0.86	0.424	0.28+/-0.74	0.40+/-0.87	0.078
Dental hygienist	Regular	1.16+/-1.12	1.52+/-1.53	0.030	1.19+/-1.30	1.50+/-1.38	0.017
	Part time	0.36+/-0.74	0.44+/-0.77	0.191	0.34+/-0.73	0.46+/-0.78	0.082
Dental assistant	Regular	1.27+/-1.22	1.59+/-1.29	0.009	1.29+/-1.28	1.58+/-1.24	0.007
	Part time	0.33+/-0.72	0.37+/-0.79	0.927	0.33+/-0.77	0.37+/-0.73	0.204

P-values were calculated by Mann Whitney U tests. Number of regular attendees of dental hygienist and dental assistant were statistically significant.

**Table 4 Zero-inflated model for number of home dental care predicted by human resources**

		Dental care					
		Home			Nursing home		
Count model (Negative Binominal, log link): Number of visiting per year							
		Estimate	SD	P-value	Estimate	SD	P-value
(Intercept)		0.97	0.42	0.021	3.30	0.48	<0.001
Dentist	Regular	0.39	0.27	0.146	0.05	0.26	0.864
	Part time	-0.07	0.31	0.811	0.04	0.23	0.858
Dental hygienist	Regular	0.003	0.14	0.981	-0.53	0.15	<0.001
	Part time	0.63	0.27	0.019	0.74	0.22	0.001
Dental assistant	Regular	-0.10	0.16	0.527	-0.54	0.17	0.001
	Part time	-0.05	0.25	0.857	1.44	0.34	<0.001
Zero-inflation model: Implementation or not							
		Estimate	SD	P-value	Estimate	SD	P-value
(Intercept)		-79.94	66121	0.999	0.98	1.00	0.325
Dentist	Regular	81.22	66121	0.999	0.42	0.86	0.625
	Part time	52.45	33061	0.999	0.05	0.32	0.864
Dental hygienist	Regular	-47.58	33061	0.999	-1.33	0.44	0.003
	Part time	-0.36	0.68	0.599	-0.12	0.28	0.668
Dental assistant	Regular	-84.12	66121	0.999	-1.16	0.49	0.018
	Part time	-59.05	33061	0.999	0.75	0.37	0.041
AIC		1344.597			1467.303		

## Figures

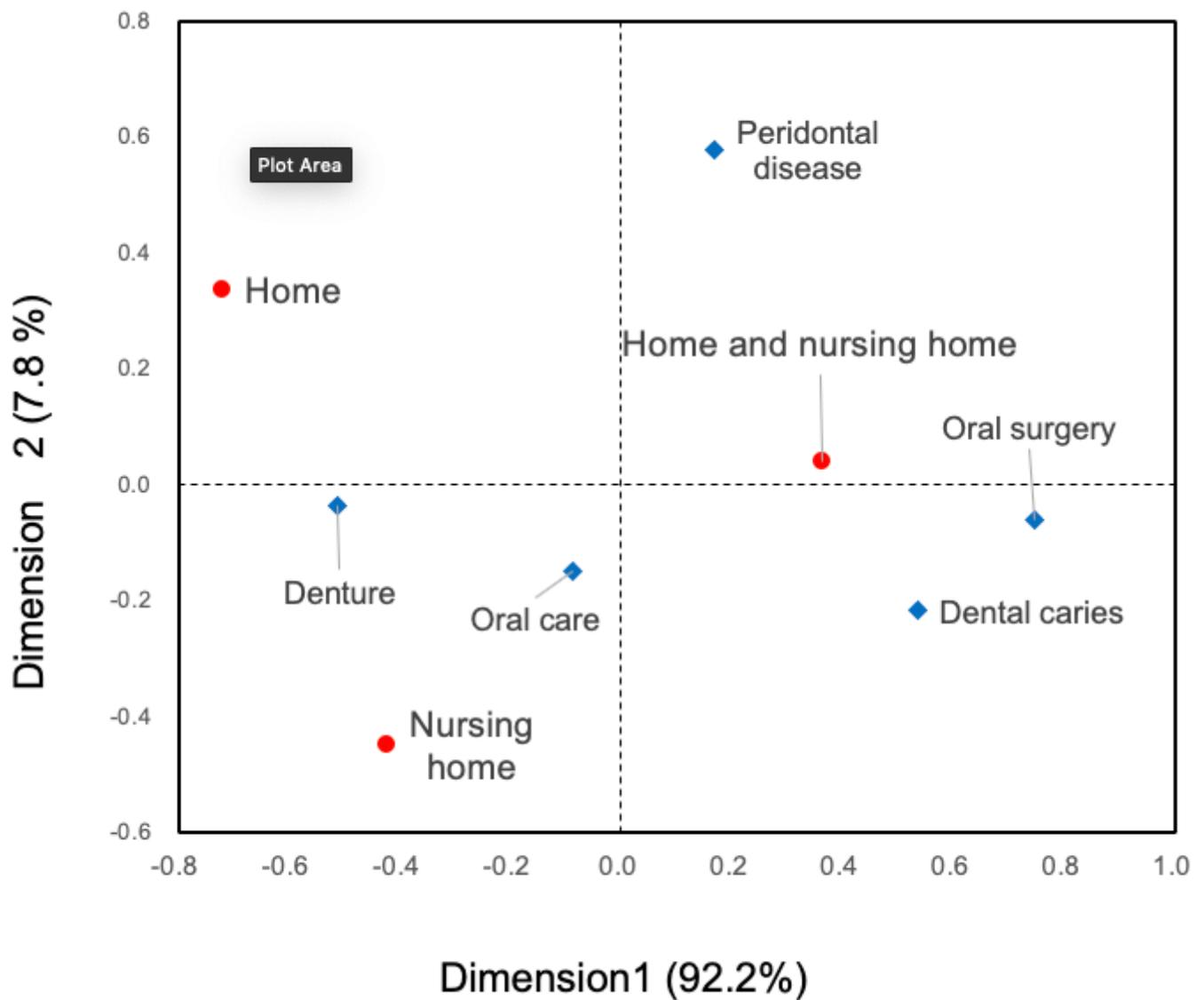
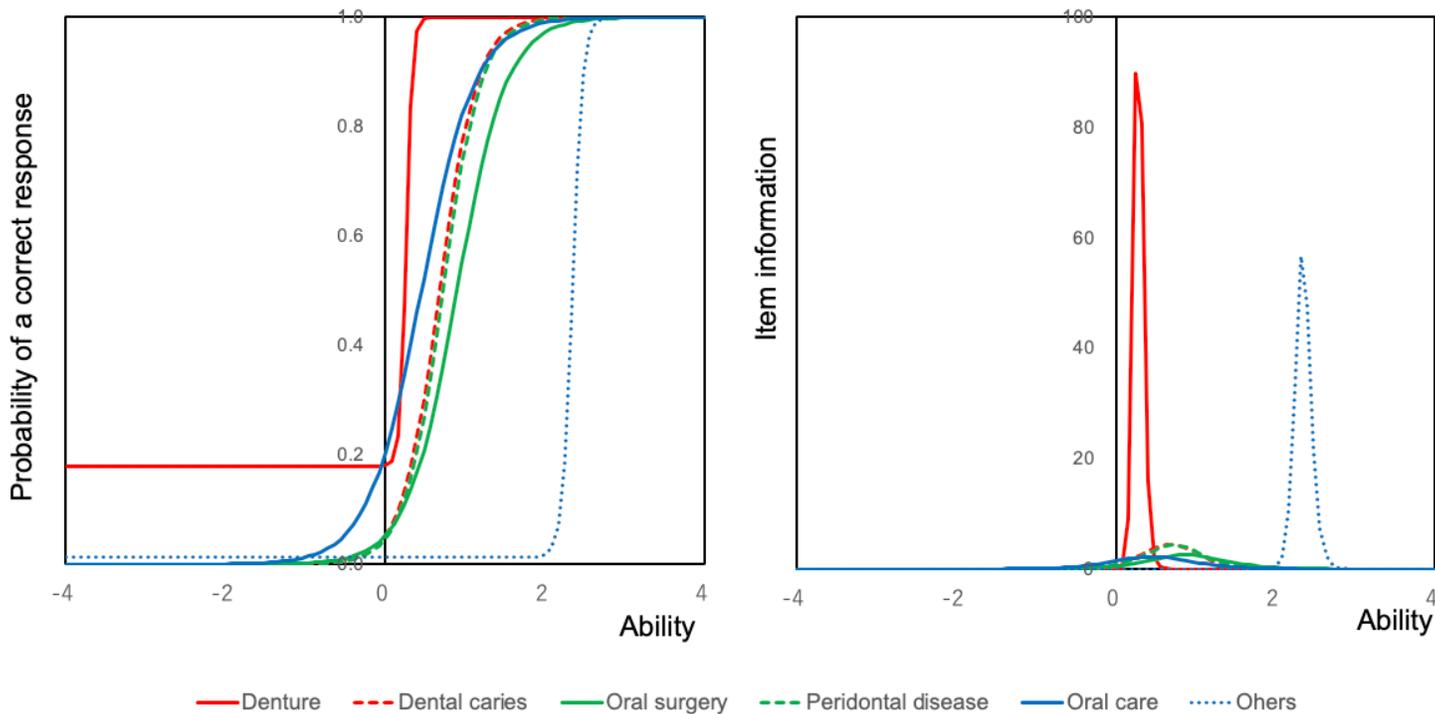


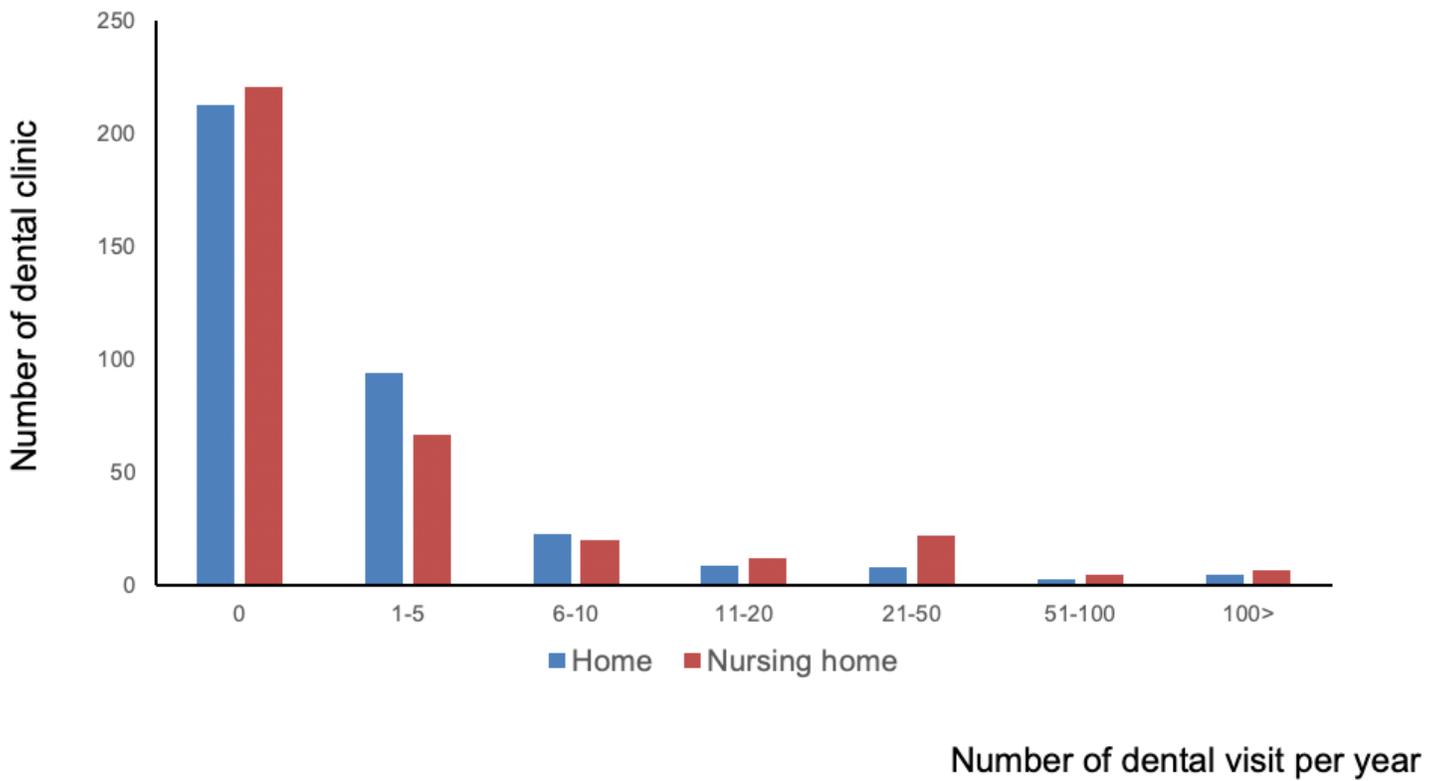
Figure 1

Biplot by correspondence analysis of implemented place and contents of visiting dental treatment. Denture treatment located between at home and nursing home. Oral care centrally located three implementation site. Both at home and nursing home centrally located treatment of dental caries, periodontal disease and oral surgery.



**Figure 2**

Item response curves and item information curves of the home dental care treatment Guessing of denture treatment was 0.18 and it continue to across the Y axis. Denture treatment had very high item information. Dental caries treatment and periodontal disease treatment showed similar pattern. Item response curve of oral care shifted left side from these two items. Oral surgery including tooth extraction shifted for right side.



**Figure 3**

Histogram of the number of dental visit per year Both at home and nursing home showed skewed distribution.