



## Scientific Research Report

## Age- and Time-Related Trends in Oral Health Care for Patients Aged 60 Years and Older in 2007-2017 in Public Oral Health Services in Helsinki, Finland

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## ABSTRACT

**Background:** Population aging will likely have an impact on oral health care trends. The aim of this study was to describe age- and time-related trends in oral health care in people ages 60 and older in Public Oral Health Services (POHS) in Helsinki, Finland.

**Materials and methods:** Material for the study comprised the electronic documentation of oral health care procedures performed on patients 60 years and older ( $N = 282,143$ ) in POHS during 2007-2017. Patients were aggregated into 5-year age groups. The 5 most common treatment categories, restorations, periodontal treatment, extractions, endodontics, and prosthetics, were selected for analysis. Changes by time (calendar year) and differences by age group were shown as percentages and percentage points; corresponding trends were assessed by applying linear regression models to the data.

**Results:** The attendance rate for these patients increased from 14.5% in 2007 to 23.1% in 2017, with the total number of visits increasing by 76.4% in the 11-year period. The average number of visits per patient decreased from 3.5 visits in 2007 to 3.0 visits in 2017. In 2007, 60.5% of patients received restorative treatment and 41.3% received periodontal care. In 2017, the corresponding figures were 55.5% and 49.8%, respectively. The older the patient, the fewer the visits and restorative, periodontal, and endodontic treatments and the greater the rate of tooth extractions and prosthetics.

**Conclusion:** A declining age group-related trend was recognized for restorative, periodontal, and endodontic treatments. Owing to ongoing population growth, POHS will be facing huge challenges in providing treatment for all individuals seeking services.

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## Introduction

The rapid growth of older age groups presents a new set of challenges for the oral health care system, reflected as an increased need for treatment. According the Survey of Health, Ageing and Retirement in Europe, the overall cross-sectional annual attendance rates of oral health services among older individuals in selected European countries vary from 23% in Poland to 82% in Denmark and Sweden, whereas the corresponding rate in the United States is 66%.<sup>1</sup> Unfortunately, the

US figure is not fully comparable with the 1-year European rates because of different study protocols.

In the 2000s, the population in Finland increased by just over 6% to 5.5 million by the end of 2019. During the same period, the number of people ages 65 and older increased by 7.3 percent.<sup>2</sup> The elderly population needing complicated treatment fills a dentist's workday. Oral and general health problems are known to manifest with age, although the majority of the older population can access the services without problems.<sup>3,4</sup> Regardless of the country, frail elderly citizens living in long-term care facilities have difficulty accessing dental care, and, in general, it appears that all Europeans use dental services less frequently as they age.<sup>1,5-7</sup>

In western countries, restorative procedures dominate the treatment provided by dentists to older adults. In

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Denmark, a recent study showed that after oral health examination 90% of 64- to 65-year-olds received restorations. Nearly 50% received periodontal treatment, 36% oral surgery, and 25% endodontic treatment in 2005-2009.<sup>8</sup> From 1992 to 2007 in the United States, extractions and root canals were provided less frequently than restorative treatment in older age groups. Among individuals older than 60 years of age, the mean number of restorative treatment procedures was approximately 1 per year.<sup>9</sup>

In 2009, based on Medical Expenditure Panel Survey data from the United States, about one-fifth of older adults had at least 1 restorative treatment and nearly 4% had an endodontic procedure.<sup>10</sup> In Finland, the predominance of restorative treatment is evident; in 2000, of individuals aged 65 years and older, 59% reported recently receiving restorative, 68% periodontal, 20% oral surgical, and 12% root canal treatment.<sup>11</sup> Also, according to a study on oral health care provided by Public Oral Healthcare Services (POHS) in 2009 in Finland, the 3 most common treatment procedures for patients 65 and older were restorations, examinations, and periodontal treatment. Restorative treatment comprised almost half of these procedures.<sup>12</sup>

In this study, we evaluated the impact of aging on the oral health care of people aged 60 and older during 2007-2017 in POHS in Helsinki, Finland. Our aim was to identify trends of oral health care provided by POHS for older adults by age and year of visit over an 11-year period. We hypothesized that the number of patients ages 60 years and older had increased substantially during 2007-2017 and that the trend in oral health care was related to age group and time because of the change in the number of patients in different age groups.

## Methods

### Approval

The City of Helsinki Department of Social Services and Healthcare approved the study protocol. Ethics approval was not needed because the data are a register-based entity with no links to an individual patient's identity.

### Background

In Finland, all inhabitants are entitled to use POHS, which are administered by each municipality for its own residents. POHS promote oral health care of the general population without any segregation based on income.<sup>13</sup> Dentists of POHS are paid monthly but receive additional compensation according to the number of treatments provided. POHS cover all fields in dentistry, and adult patients pay a fee for each service and visit; these fees, however, are considerably less than those in the private sector. In 2011, more than half of persons ages 65 years and older reported having visited a dentist in the past year; 21% visited a public dentist and 35% visited a private dentist.<sup>14</sup>

### Data collection

Our data included recordings from the electronic database on all patients ages 60 years and older ( $N = 282,143$ ) who visited POHS in Helsinki during 2007-2017. Data of treatments and

visits are based on individual detailed recordings made at each appointment and saved in an electronic database using official codes that are uniform to all service providers. In Finland, the National Institute for Health and Welfare maintains the list of nationally used codes with written definitions for each code. The main categories for oral health care treatment codes are examinations, prevention (intensified procedure done separately with or without other oral health care), periodontal treatment (nonsurgical procedures of varying stages of periodontal diseases), restorations (direct restorative procedures, ie, no inlays, onlays, overlays, or prosthetic crowns), endodontics (pulpal and root treatment procedures), therapy of temporomandibular disorders, orthodontics, prosthodontics (procedures for fixed and removable dentures and repairs), surgical treatments procedures, sedation and anaesthetics, radiography, and miscellaneous treatments. Based on the individual recordings, the Helsinki POHS administration provided us with the aggregated data used here. Population data for Helsinki were gathered from Statistics Finland.<sup>2</sup>

The aggregated data included the number of all patients and of those in various treatment categories, defined by oral health care codes according to the treatments received. The 5 most common categories (ie, restorations, periodontal treatment, extractions, endodontics, and prosthetics) were selected for analyses in this study. The number of all elderly people ( $N = 282,143$ ) included all those with at least 1 visit to POHS. Similarly, the number of patients separately for each treatment category included all individuals with at least 1 treatment procedure in that category. For aggregation, data of patients and population were categorized into 5-year age groups of 60-64, 65-69, 70-74, 75-79, 80-84, 85-89, 90-94, and 95+ years, and patient-based original electronic recordings of the visits and treatment measures were then aggregated for these patient categories separately for each of the 11 calendar years in 2007-2017. In the analyses, the 2 oldest age groups were combined to form 1 group of 90 years and older.

### Data analyses

We defined indicators of the use of services separately for each age group and year. Attendance rates (%) refer to the number of visiting patients per number of Helsinki inhabitants. Rates (%) of patients receiving various treatment categories refer to numbers of such patients per all patients. Mean number of visits were calculated per number of patients. We assessed the changes from 2007 to 2017 as percentage change in absolute numbers and as percentage points (ie, differences between the rates).

We evaluated the roles of time (calendar year) and age group in the trends of oral health care by means of linear regression modelling. The age group-based data met the criteria for using linear regression. Assumption of the observations was tested with scatter points, and only the oldest age group had outliers when all other groups showed clear linearity. The results of linear regression modelling provide regression coefficients ( $\beta$ ), which describe trend slopes, and the calculation of  $R^2$ , which shows the proportion of the variance for a dependent variable that is explained by independent variables. Analyses were performed with Survo MM software (version 3.4.1; Survo Systems, Helsinki, Finland).

**Results**

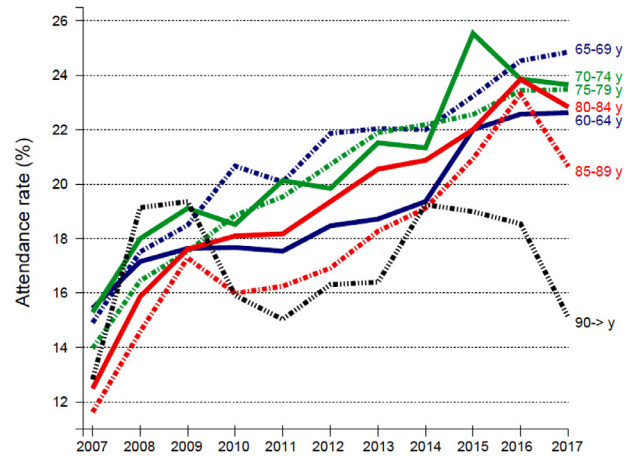
A total of 282,143 people ages 60 years and older visited the Helsinki POHS during 2007-2017. The number of patients ages 60 and older doubled across the 11 years studied, from 16,315 in 2007 to 33,618 in 2017. The total number of inhabitants increased by almost one-third (Table 1).

Attendance rates for age groups younger than age 85 years showed almost linearly increasing trends from 2007 to 2017, while in the 2 oldest groups rates fluctuated widely (Figure 1). The average number of visits per patient decreased from 3.5 visits in 2007 to 3.0 visits in 2017. The total number of visits ages 60 and older to POHS during the 11 years was almost 935,000.

The most common treatment types received by elderly people were restorative and nonsurgical periodontal treatment (Figure 2). In 2007, 60.5% of patients received restorative treatment and 41.3% received periodontal care. In 2017, the corresponding figures were 55.5% and 49.8%. Proportions of patients receiving tooth extraction ranged by year between 20.8% and 23.5%, endodontic care between 6.3% and 11.1%, and prosthetic care between 5.9% and 8.5%.

Table 2 shows age- and time-related trends of patients' overall use of POHS and use of specific treatments. Across the 11 years, an increasing trend in attendance and periodontal treatments and a decreasing trend in visits and endodontic and prosthetic treatments were evident. No impact was observed on trends of restorative treatments and tooth extractions over time. Patient's age group was consistently significant as a predictor in each service category analysed here. The older age group the patient belonged to, the fewer visits, restorative, periodontal, and endodontic treatments and the greater the rate of tooth extractions and prosthetics. In Table 2 the R<sup>2</sup> values showed how either age group or time, or both, could explain a great part of the variation in patient rates within treatment types.

Rate trends by age groups are illustrated for restorative treatments in Figure 3 and for periodontal treatment in



**Fig. 1 – Attendance rate (%) of inhabitants ages 60 years and older in each age group making at least 1 visit in the year in question. Across the 11 years, the number of inhabitants was approximately 1.4 million and the number of POHS patients 282,000. POHS = Public Oral Healthcare Services.**

Figure 4. Across the 11 years, age-specific rates of patients receiving restorative treatment showed a decrease for those 80 years of age and younger, remained steady for 80- to 84-year-olds, and increased strongly for those ages 85 years and older (Figure 3). By contrast, the rates of patients receiving periodontal treatment showed clear increasing trends for each age group, whereas the differences between the age groups narrowed only slightly (Figure 4).

**Discussion**

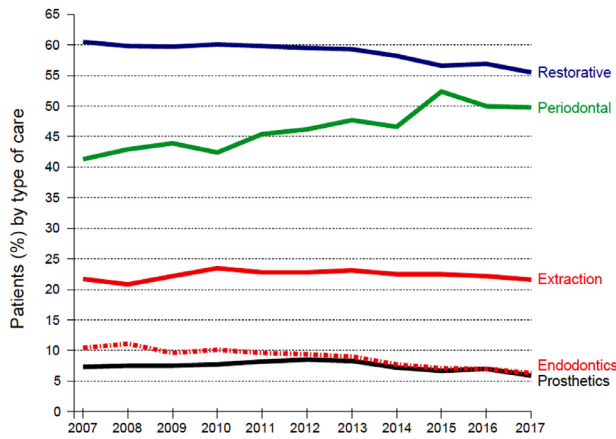
For this study, we gathered a large number of electronic patient registry entries of oral health care treatments in

**Table 1 – Attendance rate (%) and number of visits to POHS among the population segment ages 60 years and older in 2007-2017.**

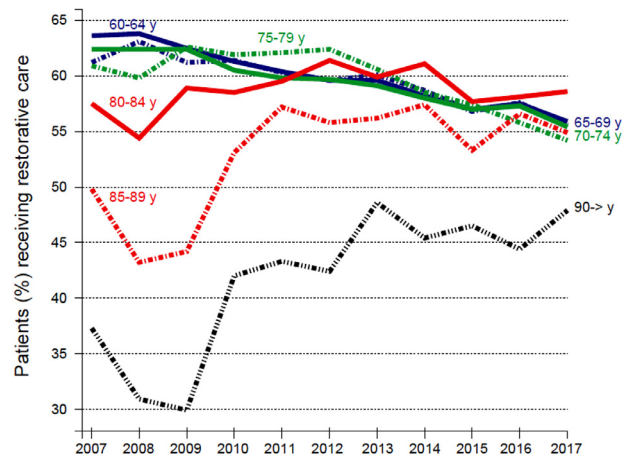
Year	Population, n	Patients, n	Attendance, %	No. of visits	Visits per patient
2007	112,652	16,315	14.5	56,493	3.5
2008	116,818	19,910	17.0	69,312	3.5
2009	120,726	21,811	18.1	76,229	3.5
2010	124,118	22,919	18.5	78,231	3.4
2011	126,851	23,681	18.7	81,395	3.4
2012	129,079	25,413	19.7	86,665	3.4
2013	131,626	26,949	20.5	90,652	3.4
2014	134,008	27,947	20.9	89,957	3.2
2015	136,231	31,114	22.8	102,259	3.3
2016	138,516	32,466	23.4	103,667	3.2
2017	145,749	33,618	23.1	99,633	3.0
<b>Total</b>	<b>1,416,374</b>	<b>282,143</b>	<b>19.9*</b>	<b>934,493</b>	<b>3.3*</b>
Change in 11 years	+33,097	+17,303	8.6 pp	+43,140	-0.5
	+29.4%	+106.1%		+76.4%	

Change is shown as absolute numbers, percentages, and percentage points. POHS, Public Oral Healthcare Services.

\* Age-standardized estimate.



**Fig. 2 – Rates (%) of patients according to type of treatment received by year among all patients ages 60 years and older (N = 282,143) in 2007-2017.**



**Fig. 3 – Rates (%) of patients by age group and time receiving at least 1 restorative treatment procedure among all patients aged 60 years and older (N = 282,143) in 2007-2017.**

Public Oral Health Services in Helsinki for those ages 60 and older during 2007-2017. Data include those who visit dental clinic themselves, with or without an escort, and those who live in long-term residences. We investigated attendance rate, visits per patient, type of treatment, and age- and time-related trends in oral health care.

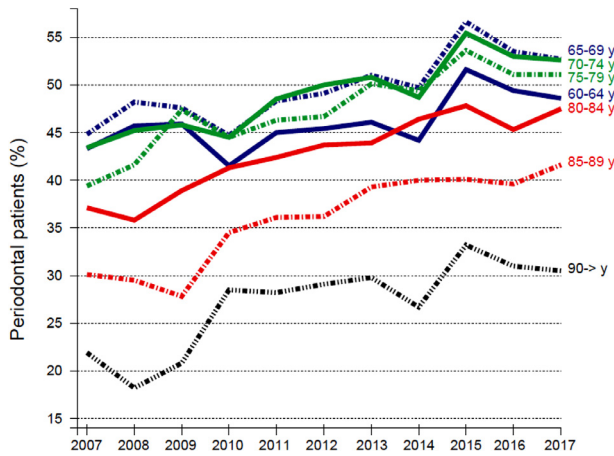
Restorative measures were the most common type of treatment during 2007-2017 for patients 60 years of age and older. During the study period, this treatment option increased particularly in the oldest age groups. At the same time, the gap in proportion receiving restorative services between older and younger age groups narrowed considerably

**Table 2 – Trends across 11 years in attendance, visits, and rates of patients receiving each type of treatment explained by means of 7 separate linear regression models.**

Models (M1-M7) Explanatory factors	Regression coefficient ( $\beta$ )	Standard deviation	t	P
M1: Attendance rate				
Time (year)	0.757	0.062	12.21	<.001
Age group	-0.099	0.020	-5.05	<.001
R <sup>2</sup> = 0.838				
M2: Visits per patient				
Time (year)	-0.024	0.010	-2.49	.02
Age group	-0.024	0.003	-7.83	<.001
R <sup>2</sup> = 0.691				
M3: Restorations: rate of patients				
Time (year)	0.001	0.193	0.00	n.s.
Age group	-0.493	0.061	-8.08	<.001
R <sup>2</sup> = 0.685				
M4: Periodontal treatment: rate of patients				
Time (year)	1.062	0.167	6.36	<.001
Age group	-0.647	0.053	-12.26	<.001
R <sup>2</sup> = 0.720				
M5: Tooth extractions: rate of patients				
Time (year)	0.128	0.068	1.87	n.s.
Age group	0.236	0.022	10.95	<.001
R <sup>2</sup> = 0.791				
M6: Endodontic treatment: rate of patients				
Time (year)	-0.344	0.032	-10.74	<.001
Age group	-0.267	0.010	-26.32	<.001
R <sup>2</sup> = 0.957				
M7: Prosthetic treatments: rate of patients				
Time (year)	-0.116	0.041	-2.82	.01
Age group	0.062	0.013	4.80	<.001
R <sup>2</sup> = 0.544				

t (t-value), an intermediate step for P-value; n.s., not significant.

Patients (n = 282,143) ages 60 and older were treated in Helsinki Public Oral Healthcare Services in 2007-2017. Positive regression coefficients ( $\beta$ ) indicate an upward trend and negative regression coefficients indicate a downward trend.



**Fig. 4 – Rates (%) of patients by age group and time receiving at least 1 periodontal treatment procedure among all patients ages 60 years and older (N = 282,143) in 2007-2017.**

during the 11-year period. Such a change indicates that elderly people have increasingly more remaining teeth in need of restorative care, which is also consistent with the negative coefficient for age.<sup>15</sup> Restorative care had, however, a time-related upward trend and an age-related downward trend.

The second most common treatment type, nonsurgical periodontal treatment, had an increasing trend by year in POHS over the 11-year period, although the trend had a downward relation to age. The result is in line with a recent Norwegian study considering older age groups.<sup>16</sup> In their study, however, the inspection period was only 1 year, and almost all age groups were included.

In England over a 6-year period from 1999 to 2005, periodontal treatment per patient showed an increasing trend.<sup>17</sup> A similar age-dependent, decreasing trend was found in endodontics in the present study. We also found that the proportion of patients older than 60 years with tooth extractions remained quite stable during the observation years, although extractions showed an age-related increasing trend: the older the patients were the greater proportion of them underwent tooth extractions. In addition, prosthodontics showed an age-related increasing trend. In a previous Finnish study, the upward trend was seen in an increase of prosthetic procedures, especially removable dentures and repairs.<sup>18</sup> The verified oral health care age- and time-related trends support our hypothesis of trend differences between age groups. It is possible that age of the patient contributes to the decision-making process for treatment in oral health care.<sup>19</sup>

Over the 11-year period, our study revealed ever-increasing numbers of older adults visiting POHS in Helsinki. This manifested as a 106% increase in the number of patients ages 60 years and older during 2007-2017, which is a trend common in other European countries as well.<sup>1</sup> A similar trend has been observed for all of Finland, as 21% of those ages 65 years and older reported having visited a public dentist in 2011, compared with 11% in 2000.<sup>14</sup>

Although the increase in the attendance rate in POHS was visible in all age groups 60 years and older, the most common oral care service user was in the 65 to 69 age group. Persons in

this age group who are reaching or have just reached the common retirement age, 65 years of age in Finland, may want to participate in subsidized oral health care after the use of private sector services during their active working years. The finding was confirmed in a recent Finnish nationwide study reporting an obvious increase in patients 65 years of age and older in POHS, the trend being more apparent among dentate people.<sup>14,20</sup> Also in Sweden, the 65 to 84 age group comprised the most regular dental care attenders.<sup>21</sup> The interview study in specific European countries and in the United States revealed that older Swedes and Americans were more likely to use oral health care than persons between 51 and 64 years of age.<sup>1</sup>

When analysed by calendar year, we found that the attendance of people younger than 85 years of age showed an almost linearly increasing trend from 2007 to 2017, while in the 2 oldest age groups, the rates fluctuated from year to year. The trend of an increase in attendance of older patients is supported by a recent Finnish study, although the age groups were younger and the observation time shorter than in our study.<sup>14</sup> It is possible that the resources of public oral health care have not been able to respond to the increased need for care. Simultaneously, the attendance rate and visits per patient showed an age-related downward trend, which is in accordance with dental coverage numbers in European countries.<sup>1</sup> An older patient may have logistical problems with making regular visits to a dentist.<sup>6,21,22</sup> This might result in more treatment procedures per visit or provision of a service-mix in POHS, as suggested in the literature.<sup>23</sup>

The main strength of this study is the large comprehensive data covering oral health care procedures of all target-age patients treated at the largest POHS unit in Finland over an 11-year period. Data were recorded using uniform standardized codes for treatment provided.<sup>12</sup>

However, the nature of our data entails limitations. The aggregated data hide all individual variation because the observation unit is an age group and not individual patients. Consequently, this means higher R<sup>2</sup> values in explaining changes in treatment rates and further comparisons at the individual level were not possible. The additional limitation is that the data included no information regarding an individual patient’s medical condition or gender, housing status, or socioeconomic situation. The further limitation is that we could not categorize people into dentate or edentate groups. Regarding dentition status, we are aware that because edentate patients visit a dentist more rarely, their impact on the estimates would have been marginal.<sup>14</sup>

Because of the huge demographic change at the population level, it is essential to identify ongoing health care trends to generate hypotheses for further research. Through electronic health records, we gained valuable knowledge about ongoing oral health care trends with an aggregated patient population of the oldest age groups. This kind of study design is commonly used to study group-specific effects such as a public health intervention aimed at a group.<sup>24</sup> Our data of POHS visitors were categorized into 5-year age groups. Some reports and studies might use a broader age categorization than ours or merge the oldest age groups, hampering comparisons with our results.<sup>4,8</sup> Also reports with a similar

categorization exist.<sup>1</sup> Additionally, to our knowledge, there are few studies on oral health care trends among the old to oldest age groups.<sup>16,25</sup>

Consensus reports have increased the awareness of overall benefits of oral health as an essential component of healthy aging.<sup>17,22,26</sup> Dentists' main task is to maintain oral health because healthy natural dentition contributes markedly to general health and quality of life at all ages.<sup>27,28</sup> In this study, all oral health procedures investigated had different age peaks, except for restorative treatment, which was the most common oral health treatment in POHS in all age groups. According to our results, the prevailing practice in adult oral care, regardless of the age of the patient or the treatment needed, is restorative treatment. Further studies are needed to monitor oral health and ongoing health care trends to support healthy aging.

## Conclusions

Our study showed ever-increasing numbers of older adults using POHS in Helsinki over the 11-year period. Restorative treatments predominated in all age groups. Individuals aged 85 years and older were characterized by lower attendance rates. Age-related trends were seen in oral health care for people aged 60 and older, with restorative, periodontal, and endodontic treatments showing a declining trend for older age groups. Because the challenges that POHS will face in the coming years, only evidence-based effective treatment with an emphasis on oral health and disease prevention should be provided.

## Conflict of interest

None disclosed.

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