



ORIGINAL ARTICLE

General health status of Dutch elderly receiving implant-retained overdentures: A 9-year big data cross-sectional study

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Abstract

Background: Very little information is available on the general health of elderly who are provided with an

implant-retained overdenture (IOD).

Purpose: The general health status of three groups of elderly (≥ 75 years) were compared: those with a natural dentition (ND), those treated with an implant-retained overdenture (IOD), and those wearing a conventional denture (CD).

Materials and methods: Data on healthcare costs were obtained from records of Dutch health insurers that are collected by Vektis. Data on general health (chronic diseases, medication use, and polypharmacy) were acquired for elderly patients with a ND, an IOD, and a CD in 2009 and 2017. Data on the general health of elderly who received an IOD were also acquired from 2010 through 2016.

Results: On average, the general health of elderly who received an IOD was comparable to general health of elderly with a ND and was better than the general health of elderly with a CD (lower prevalence of diabetes, cardiac disease, and hypertension). The general health profile of elderly receiving an IOD was consistent during all years.

Conclusions: The general health of elderly with a ND or IODs is better than those with CDs.

KEYWORDS

aging, big data, cross-sectional study, dental implants, elderly, general health, implant-retained overdenture

1 | INTRODUCTION

Edentulous patients often experience functional and psychosocial problems related to their conventional dentures (CD) due to an impaired load-bearing capacity and poor retention. Placing dental implants to retain a removable overdenture is regarded the first choice of treatment for resolving such denture-related problems.^{1,2}

Placing implants to retain an overdenture is regarded a safe, reliable treatment option with high survival rates (>95%), even in studies with a follow-up upto 20 years.³⁻⁵ Moreover, mandibular implant-retained overdentures (IOD) show better retention and stability than CDs, thereby enhancing chewing ability and bite force.^{6,7} This has a positive effect on patient satisfaction and quality of life,⁸⁻¹¹ resulting in a cost-effective treatment strategy, despite the high fabrication

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costs.^{12,13} In line with the increased oral function and patient satisfaction, improvements in nutritional status, social wellbeing, and eventually general health can be expected as well.

Although many studies have been published on oral functioning of patients with IODs, data on the relationship between IOD treatment and general health and nutritional status remains scarce. Previous studies on nutritional status suggested that IODs have a positive effect on nutritional status,^{14,15} but no conclusive evidence is available yet.^{10,16,17} Thus far, only one study focused on the impact of IODs on general health in elderly.¹⁸ This cross-sectional study showed that community-dwelling elderly wearing an IOD reported less frailty, better general health, and better physical function than elderly wearing CDs. This difference in health status between IOD and CD wearers was studied in elderly ≥ 75 years of age. Although the results of that study suggest that elderly with an IOD have better general health on average than elderly with CDs, it is hard to draw definitive conclusions, as we do not know if these differences are already present when the dental implants are placed. Therefore, the aim of our study was to assess the general health status of edentulous elderly (≥ 75 years) at the time that they received an IOD as well as to compare their health status with the health status of edentulous elderly with a CD or ND. The general health status of these three groups in 2009 was compared with the health status of matching groups in 2017. Additionally, the health status of new IOD wearers was assessed annually between 2010 and 2016 to determine whether the average health status of new IOD wearers was consistent over a longer period as well as to determine whether there were age-related differences between elderly aged 75-85 and ≥ 85 years.

2 | MATERIALS AND METHODS

This study was performed in collaboration with Vektis, an organization that warehouses the data on all health care declarations in the Netherlands.

2.1 | Health status of elderly with a natural dentition, conventional denture, or implant-retained overdenture

Three groups of elderly (≥ 75 years) were distinguished by oral status: elderly with a ND, edentulous elderly who received a CD (first or replaced denture), and elderly who were treated with dental implants to support an IOD. The latter two groups of elderly received the corresponding dental treatments in 2009 or 2017. All groups were categorized by oral status based on dental insurance declarations recorded in the Vektis database.

For these three groups the following variables were collected:

- Medical conditions: Asthma, cancer, high cholesterol, diabetes, cardiac disease, hypertension, kidney disease, Parkinson's disease, and rheumatoid arthritis. The diagnosis was based on prescribed medication derived from a pharmacy-based cost group model¹⁹; the use

What is known:

- Previous research suggests better general health in elderly with IODs compared with elderly with CDs.

What this study adds:

- The general health of elderly with a ND or IODs is better than elderly with CDs.

of a specific type of prescribed medication was used as a marker for chronic conditions.

- Medication use: The following types of medications for elderly patients were recorded: antithrombotics, bisphosphonates, inhalation corticosteroids, antihypertensives, and antidepressants. The use of five or more medications (polypharmacy) of the previously described drugs was also recorded.
- Socioeconomic status (SES) by municipality of residence: SES was based on data provided by the Netherlands Institute for Social Research.²⁰ Variables to determine SES were the average income, percentage of individuals with low income, percentage of individuals with low education level, and percentage of unemployed individuals. Based on the SES scores, municipalities were ranked into three groups: the 30% of municipalities with the lowest scores were ranked as low SES, the 30% with the highest scores were ranked as high SES, and the remaining 40% were ranked as middle SES.

2.2 | Health status of elderly treated with implant-retained overdentures between 2009 and 2017

To assess whether the results of the elderly with IODs in 2009 and 2017 were not coincidental, Vektis collected data on the health status of elderly that received an IOD between 2010 and 2016. Between 2009 and 2016 all elderly who received an IOD were assessed annually. To identify possible age-related differences between elderly receiving IODs, two subgroups based on age were formed (75-85 years and ≥ 85 years).

2.3 | Statistics

Descriptive statistics were used to report prevalence of chronic diseases, polypharmacy, medication use, and SES. Statistical differences were calculated between elderly with different oral status using Chi-square tests. Chi-square tests were also used to determine statistically significant differences over time (2009-2017) between "younger" (75-85 years) and "older" (85 years and over) elderly receiving an IOD. SPSS IBM Statistics version 23.0 (SPSS, Chicago, Illinois) was used for statistical analysis of the results.

TABLE 1 Demographic characteristics, chronic diseases and medication use among elderly categorized by oral status in 2009 and 2017

	2009			P-value ^d between oral status	2017			P-value between oral status
	ND ^a N = 143 199 N (%) ^e	CD ^b N = 18 420 N (%)	IOD ^c N = 6503 N (%)		ND N = 237 450 N (%)	CD N = 17 787 N (%)	IOD N = 4631 N (%)	
Demographic characteristics								
Age								
75–85 years	127 017 (89%)	14 824 (81%)	6090 (94%)	≤0.001	205 111 (86%)	13 585 (76%)	4230 (91%)	≤0.001
≥ 85 years	16 182 (11%)	3596 (19%)	413 (6%)	≤0.001	32 339 (14%)	4202 (24%)	401 (9%)	≤0.001
Total	143 199 (100%)	18 420 (100%)	6503 (100%)		237 450 (100%)	17 787 (100%)	4631 (100%)	
Socioeconomic status								
Low	34 846 (24%)	5413 (29%)	1784 (28%)	≤0.001	70 671 (30%)	6134 (35%)	1505 (32%)	≤0.001
Middle	56 101 (39%)	7658 (42%)	2806 (43%)	≤0.001	96 300 (40%)	7544 (42%)	2083 (45%)	≤0.001
High	52 252 (37%)	5349 (29%)	1913 (29%)	≤0.001	70 479 (30%)	4109 (23%)	1043 (23%)	≤0.001
Total	143 199 (100%)	18 420 (100%)	6503 (100%)		237 450 (100%)	17 787 (100%)	4631 (100%)	
Chronic conditions								
Asthma	5152 (4%)	815 (4%)	308 (5%)	≤0.001	9180 (4%)	832 (5%)	222 (5%)	≤0.001
Cancer	95 (<1%)	18 (<1%)	9 (<1%)	0.044	96 (<1%)	27 (<1%)	18 (<1%)	≤0.001
Cardiac disease	18 914 (13%)	4019 (22%)	882 (14%)	≤0.001	22 982 (10%)	3086 (17%)	521 (11%)	≤0.001
Diabetes	12 665 (9%)	2581 (14%)	723 (11%)	≤0.001	22 190 (10%)	2694 (15%)	592 (13%)	≤0.001
High cholesterol	21 294 (15%)	2425 (13%)	1137 (18%)	≤0.001	54 129 (23%)	4055 (23%)	1158 (25%)	0.002
Hypertension	74 063 (52%)	10 296 (56%)	3339 (51%)	≤0.001	120 984 (51%)	10 465 (59%)	2463 (53%)	≤0.001
Kidney disease	571 (<1%)	127 (<1%)	31 (1%)	≤0.001	560 (<1%)	84 (<1%)	36 (1%)	≤0.001
Parkinson's disease	1398 (1%)	230 (1%)	83 (1%)	≤0.001	2374 (1%)	178 (1%)	70 (2%)	≤0.001
Rheumatoid arthritis	948 (<1%)	143 (1%)	49 (1%)	0.154	2174 (1%)	232 (1%)	74 (2%)	≤0.001
PRESCRIBED MEDICATION								
Antithrombotics	62 236 (44%)	9498 (52%)	2900 (45%)	≤0.001	106 724 (45%)	9929 (56%)	2255 (49%)	≤0.001
Antihypertensives	85 518 (60%)	12 303 (67%)	3794 (58%)	≤0.001	140 808 (59%)	12 264 (69%)	2797 (60%)	≤0.001
Antidepressants	12 528 (9%)	2054 (11%)	690 (11%)	≤0.001	22 187 (9%)	2059 (12%)	549 (12%)	≤0.001
Bisphosphonates	14 135 (10%)	1866 (10%)	656 (10%)	0.478	15 842 (7%)	1374 (8%)	248 (5%)	≤0.001
Corticosteroids	14 782 (10%)	2713 (15%)	885 (14%)	≤0.001	22 879 (10%)	2286 (13%)	561 (12%)	≤0.001
Polypharmacy	11 898 (8%)	2390 (13%)	542 (8%)	≤0.001	18 707 (8%)	2351 (13%)	396 (9%)	≤0.001

^aND, natural dentition.

^bCD, conventional denture.

^cIOD, implant-retained overdenture.

^dP-value indicates whether age, socioeconomic status, chronic conditions and prescribed medication significantly differ between elderly with different oral status (ND, CD, and IOD).

^ePercentage of ND, CD, and IOD subjects that have a certain socio economic status or suffer from a certain chronic condition, use a certain drug.

3 | RESULTS

3.1 | Oral status: Natural dentition, conventional denture, or IOD

Table 1 presents demographic characteristics, chronic conditions, medication use and healthcare consumption of elderly categorized by oral status. Almost all variables were statistically significant between the groups with different oral health status, which is a consequence of the large study population (>100 000 elderly). This often results in statistically significant outcome that may not be clinically relevant.²⁰

Therefore, we focused on clinically relevant differences between groups, defined as ≥5% difference in prevalence.

Elderly with IODs were more frequently aged between 75 and 85 than elderly with a ND or CD. Also, elderly with IODs or CD had more frequently low SES than elderly with a ND. With regard to systemic disease, clear differences were found in the prevalence of cardiac disease, hypertension, and diabetes between the groups. Elderly with CDs had higher prevalence of cardiac disease (Figure 1), hypertension (Figure 2), and diabetes (Figure 3) than elderly with a ND or IODs. Furthermore, polypharmacy, and the use of antithrombotic and antihypertensive drugs was highest in elderly with CDs.

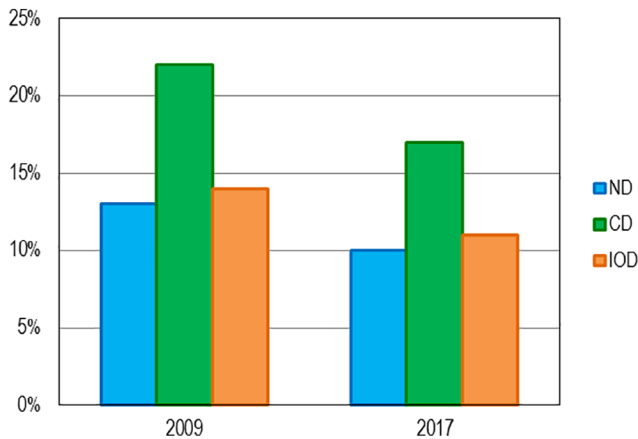


FIGURE 1 Cardiac disease among elderly with different oral status

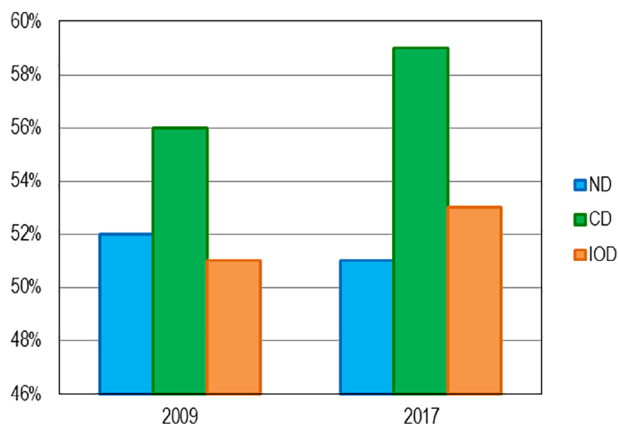


FIGURE 2 Hypertension among elderly with different oral status

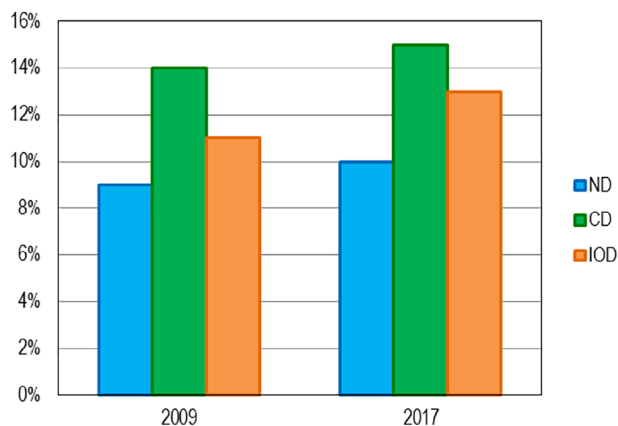


FIGURE 3 Diabetes among elderly with different oral status

3.2 | Health status of elderly treated with an IOD between 2009 and 2017

Characteristics of elderly who received IODs between 2009 and 2017 are shown in Table 2. Implants are mostly (90%) placed in elderly

before the age of 85. Medication use and the presence of chronic health conditions of elderly aged 75-85 and over 85 corresponded with these variables in the general aging population with the exception of diabetes and high cholesterol. The prevalence of diabetes was lower among elderly over 85 who received an IOD.

4 | DISCUSSION

The general health of elderly who received an IOD and elderly with a ND appears to be better than patients wearing CDs. In our study, this finding was fairly consistent over time. Placing dental implants to support an IOD is a more common treatment in elderly between 75 and 85 than in elderly aged ≥ 85 years. Common general health conditions such as cardiac disease, hypertension, and diabetes are less prevalent among elderly patients receiving dental implants to retain an IOD than patients wearing CDs.

This 9-year cross-sectional study confirmed the observations of Hoeksema and colleagues¹⁸ that elderly with a ND and elderly who received an IOD had better general health on average than elderly wearing CDs. At least part of this difference in general health status between these two groups is probably because the average age of elderly who received an IOD for the first time was lower on average than that of CD wearers. However, it is still unknown whether this positive difference continues over time or the average general health of IOD wearers gradually approaches that of CD wearers. This is an issue that requires further research.

With regard to conditions affecting general health, the prevalence of cardiac disease and hypertension was lower on average in elderly with a ND and IOD wearers than in CD wearers. In elderly with a ND or IOD, the prevalence figures for cardiac disease and hypertension were within the same range as prevalence figures for these diseases in the general population in the Netherlands, while compared with the general population the prevalence of diabetes was significantly lower in elderly who were provided with an IOD.²¹ However, diabetes was less prevalent in elderly who received an IOD than in the general elderly population. The overall prevalence of diabetes in Dutch elderly (≥ 75 years) is about 25%, while in our study the prevalence in elderly who received an IOD was 5%-14%, and was lowest in the very old. A possible explanation for this discrepancy is that patients or their caregivers were more reluctant about implant placement in diabetic elderly. This might be due to the general belief that the risk of implant failure is higher in diabetic subjects due to impaired wound healing, despite a recent study showing that controlled diabetes should not be regarded as a contraindication for implant placement.²²

A limitation of the study is the potential bias with regard to the inclusion of elderly with a ND; this figure was lower than would have been expected for the general population in Netherlands. This discrepancy is inherent to the Vektis database, which contains all the insured primary and specialist healthcare costs in the Netherlands. Most of the costs (>90% of each treatment) of CDs and IOD treatment are covered by obligatory healthcare insurance, while for elderly with a ND, most dental treatment costs are not covered by this

TABLE 2 (Continued)

	2014		2015		2016		2017		P-value	
	75-85	≥85	75-85	≥85	75-85	≥85	75-85	≥85		
	N = 4305 (90%)	N = 472 (10%)	N = 4080 (90%)	N = 474 (10%)	N = 4873 (91%)	N = 511 (9%)	N = 4230 (91%)	N = 401 (9%)		
Chronic diseases										
Asthma	205 (5%)	20 (4%)	191 (5%)	15 (3%)	215 (4%)	30 (6%)	202 (5%)	20 (5%)	0.132	0.849
Cancer	-	-	-	-	9 (<1%)	9 (2%)	18 (<1%)	-	≤0.001	0.396
Cardiac disease	546 (13%)	99 (21%)	498 (12%)	97 (20%)	555 (11%)	120 (23%)	454 (11%)	67 (17%)	≤0.001	≤0.001
Diabetes	524 (12%)	35 (7%)	503 (12%)	32 (7%)	681 (14%)	49 (10%)	547 (13%)	45 (11%)	0.006	0.327
High cholesterol	1019 (24%)	66 (14%)	1016 (25%)	78 (16%)	1252 (26%)	92 (18%)	1081 (26%)	77 (19%)	≤0.001	0.005
Hypertension	2347 (55%)	261 (55%)	2195 (54%)	248 (52%)	2726 (56%)	274 (54%)	2265 (54%)	198 (50%)	0.315	0.110
Kidney disease	9 (<1%)	9 (2%)	10 (<1%)	-	17 (<1%)	9 (2%)	18 (<1%)	18 (5%)	≤0.001	≤0.001
Parkinson's disease	60 (1%)	9 (2%)	51 (1%)	9 (2%)	68 (1%)	9 (2%)	52 (1%)	18 (5%)	0.508	≤0.001
Rheumatoid arthritis	50 (1%)	9 (2%)	56 (1%)	9 (2%)	62 (1%)	9 (2%)	65 (2%)	9 (2%)	0.357	0.280
Prescribed medication										
Antithrombotics	2017 (47%)	264 (56%)	1890 (46%)	257 (54%)	2318 (48%)	300 (59%)	2033 (48%)	222 (55%)	≤0.001	0.005
Bisphosphonates	348 (8%)	37 (8%)	304 (7%)	37 (8%)	313 (6%)	38 (7%)	227 (5%)	21 (5%)	0.377	0.912
Inhaled corticosteroids	552 (13%)	64 (14%)	523 (13%)	43 (9%)	603 (12%)	75 (15%)	526 (12%)	44 (11%)	0.136	0.394
Antihypertensives	2648 (62%)	306 (65%)	2518 (62%)	306 (65%)	3082 (63%)	344 (67%)	2548 (60%)	249 (62%)	0.169	0.467
Antidepressants	495 (11%)	45 (10%)	475 (12%)	54 (11%)	611 (13%)	58 (11%)	504 (12%)	45 (11%)	0.439	0.682
Polypharmacy	398 (9%)	47 (10%)	366 (9%)	54 (11%)	429 (9%)	58 (11%)	367 (9%)	29 (7%)	0.056	0.323

^aP-value <0.05, determined between two subgroups (elderly aged 75-85 and aged 85 and over).

insurance. Patients can optionally acquire supplementary insurance to cover their dental costs, but not all patients do so. Because Vektis only records dental costs that are reimbursed by obligatory or supplementary insurance, elderly without dental insurance are not included in the database. This leads to a lower number of elderly with a ND in the database than in the general population. A possible explanation of this discrepancy is that the general health of elderly with a ND and without dental insurance may be better than the health of those with a ND and with dental insurance. As a result, elderly with reasonable dental health, and often better general health, may decide not to pay for supplementary dental insurance, and would therefore be excluded from the Vektis database.

As a consequence of this big data study most outcomes are statistically significant, but not all are also clinically meaningful. This is a common issue with big data studies.²⁰ There has been some debate in observational studies with big data which differences have actually value for clinical practice.²³ Clinical significance is defined as the smallest meaningful change in an observed effect but this is not defined as a standard value. Therefore, in this study we focused on clinically meaningful differences between elderly patients.

We conclude that the general health of elderly with a ND or with an IOD is better on average than the general health of elderly with CDs. Our study also shows that IOD treatment is more often done in elderly 75-85 years than those ≥ 85 years. Although our study indicates that the health status of elderly with IODs (lower prevalence of diabetes, cardiac disease, and hypertension) is consistently better at the moment of implant placement than that of elderly with CDs, future studies should be performed to determine whether this difference continues over the long term, or whether the general health of these groups tends to converge.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

AUTHOR CONTRIBUTIONS

Mieke H. Bakker: Concept/design, data analysis/interpretation, drafting article, statistics, approval of article. Arjan Vissink: Concept/design, drafting article, critical revision of article, approval of article. Gerry M. Raghoobar: Concept/design, critical revision of article, approval of article. Anita Visser: Concept/design, drafting article, critical revision of article, approval of article.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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