Oral status and Prosthetic Treatment Needs in Functionally Impaired and Elderly Individuals

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Purpose: The purpose of this cross-sectional study was to describe the oral status and prosthetic treatment needs of dependent, functionally impaired individuals and dependent elderly individuals in comparison with the general population. Materials and Methods: A total of 355 subjects, sampled from the register of increased financial support for dependent and functionally impaired individuals in the north of Sweden, were examined. The variables were number of teeth, Eichner Index, type and condition of prostheses, and treatment needs. Statistical analyses were carried out using an independent samples t test for means and chi-square tests for proportions. Comparisons were made with the results of an earlier study (EPI-Norr) of 908 patients from the general population in the same county. Results: The study group had fewer teeth compared with the general population (20% edentulous in the study group vs 7% in the general population: P < .001), as well as more dentures and fewer tooth- and implant-supported prostheses. A total of 42% of the dentures in the maxilla and 51% of the dentures in the mandible were in poor condition. There was no difference in complications from dental implants between the groups. Conclusion: The results of this study suggest that since the Swedish system for financial support enables dental care to the patient groups in question, the situation is probably better in Sweden than in many other countries. As more accentuated differences can be assumed between these population groups in other countries, these findings are also interesting from an international perspective. Int J Prosthodont 2018;31:494–501. doi: 10.11607/ijp.5491

Oral status in a population is often described by tooth loss, which is monitored in many countries and reported in epidemiologic studies.¹ However, most reports are based on results from the general population in the developed world, while data from other groups and developing countries are lacking.¹ It is not known if the trend for declined prevalence of tooth loss in the general population in developed countries²–³ is true for vulnerable patient groups, such as dependent, functionally impaired individuals and dependent elderly individuals, since they rarely participate in studies and are seldom visible in statistics. As it is the end-stage of dental disease, tooth loss is a marker of dental health. It reflects an individual's history of dental disease, its treatment,¹ patient and dentist attitudes, the availability and accessibility of dental services, and the treatment philosophies of dental care.¹,⁴,⁵ The consequences of tooth loss for the individual may be severe, with an impact on chewing capacity and nutrition, as well as implications for psychosocial areas of life.⁶–⁸ Furthermore, it is associated with cognitive decline and mortality.⁹–¹⁴ From this perspective, tooth loss is an important variable to study not only as it relates to different ages in different geographic regions, but also and especially in population groups in which tooth loss can add limitations to an already impaired life situation. Furthermore, it is important to study how tooth loss has been treated by different types of tooth replacements in vulnerable patient groups.

Treatment of tooth loss can restore normality.⁸,¹⁵ However, treatment need is a multifaceted concept and can be expressed as normative, perceived, expressed, sociodental, and realistic.¹⁶–¹⁸ Another approach is formulated by Narby et al, who consider treatment need as a construct of society that is developed in the interaction between the patient and the dentist, with gatekeeping processes between need and demand and between demand and utilization. Weak patients are disfavored in this process.¹⁹,²⁰ In addition, according to the disability paradox,²¹–²⁴ individuals with chronic conditions often consider their quality of life quite good in spite of severe physical limitations, which may influence their perceived treatment needs and demands.

In the present study, the target group was dependent individuals and dependent elderly with different types of functional impairments. The subjects lived in nursing homes, group housing facilities, or in other

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The uniting factors in this group were dependence and entitlement to receive financial support for dental care, which is regulated by law and gives individuals with chronic diseases and functional impairments the right to dental care at a low cost in Sweden. The purpose was to describe oral status and prosthetic replacements and to define prosthetic treatment needs in dependent, functionally impaired individuals in comparison with the general population. The hypothesis was that the study group had worse oral status, more dentures, and higher prosthetic treatment needs than the general population.

Materials and Methods

Study Design

This study was designed in 2015 as a cross-sectional descriptive study based on clinical examinations of a group of dependent, functionally impaired and dependent elderly individuals in Norrbotten, the northernmost county in Sweden. The results will be presented in different publications according to the type of analyzed data reported. The study protocol was approved by the Regional Ethical Review Board in Umeå. Written informed consent was obtained from the subjects. Subjects with cognitive decline were assisted by an advocate. Comparisons were made with data from the EPI-Norr study, an epidemiologic study of oral health in the general population conducted in the same geographic region in 2011.

Sampling

Sampling for this study was done in strata, based on age groups in the register of increased financial support in urban and rural areas in four geographic regions in the county (Fig 1a). Sample size estimation was based on mean number of teeth in a previous register study from the same geographic regions. To detect a difference of two teeth in the variable mean number of teeth between this study and the EPI-Norr study with a power of 80% and a significance level of 0.05, 352 subjects were needed in the study group.

The participants in the EPI-Norr study had been sampled randomly from the civil register for Norrbotten County, from both urban and rural areas, resulting in 350 participants from each of the four regions (Fig 1b). Both regular and non-regular dental visitors were included in the study group, as well as in the EPI-Norr sample.

Recruitment

The subjects in this study were selected from a randomly arranged list. Information was sent to the subjects by letter before they were invited by telephone for an appointment to a dental clinic near them. The next person on the list was approached if the first could not be reached or could not participate, and the enrollment process continued until 355 subjects had agreed to participate. Subjects who were not able to come to a clinic were offered an examination in their home. Inclusion criteria were that the subject was entitled to the financial support system for dependent and functionally impaired individuals, was 20 years or older, and was able to cooperate in an oral examination. In the event the last criterion was not met, there had to be an advocate who was regarded as knowledgeable with respect to the patient’s situation and needs. Exclusion criteria were that the subject could not cooperate in an oral examination, or that there was no advocate who could be expected to represent the subject sufficiently well. Additionally, if the examiner had a relation to the subject, this also meant that the subject was excluded. Of those subjects who could be reached, 30% did not want to participate or were not healthy enough to participate.
In the EPI-Norr study, the enrollment process had been carried out in the same way as for the participants in the present study. Of the 1,400 subjects who had been invited to participate, data were lacking in 35% due to health problems. In both the present study and the EPI-Norr study, some of the subjects could not be reached because they had died or migrated after sampling.

Study Group Participants

The participants in the present study were functionally impaired, and the majority lived in nursing homes or in group housing. To separate different functional impairments, the subjects were divided into the same categories as in the financial support system:

- Elderly in nursing homes.
- Persons with Certain Functional Impairments, which applies to people who have intellectual disabilities, autism, or a condition resembling autism; considerable and permanent mental impairment; some other lasting physical or mental impairment that is clearly not due to normal aging; and who have an extensive need for help in daily life as a result of these disabilities.
- Dependent, functionally impaired home-care patients, with the same needs as for the elderly.
- Independent individuals with extensive need for dental care due to illness or functional impairments.

The subjects in this study were between 20 and 101 years of age. In the EPI-Norr study, the subjects were aged 35, 50, 65, 75, and 85 years. In comparisons between the studies, the present study was divided into age groups intended to match those in the EPI-Norr study as closely as possible.

Procedure

An oral examination that followed the same protocol as in the EPI-Norr study, including x-rays for dentate subjects, was carried out by one of the authors (A.L.), who also had contributed as one of the examiners in the EPI-Norr study. For subjects who were not examined in a dental clinic, supplemental information was obtained from the subject's dental records. The collected variables for this study were: number of teeth; Eichner Index with and without removable prostheses in place; and presence, type, and condition of dental prostheses. The Eichner Index is an expression of the number of support zones in the dentition. The prostheses were classified as complete or partial dentures (removable prostheses); tooth-supported crowns and fixed partial dentures were classified as tooth-supported prostheses; and implant-supported and implant-retained prostheses (overdentures) were classified as implant-supported prostheses. The condition of each prosthesis was classified as good, acceptable, or poor. Treatment needs were defined as realistic treatment needs; ie, the treatments that would have been realized in a real clinical situation. The treatment needs were assessed by the examiner together with the subject and were specified for different kinds of prostheses.

Statistical Analysis

Data were analyzed in SPSS version 24. Comparisons between group means were made with an independent samples t test, and proportions were analyzed with chi-square tests. In all tests, the null hypothesis was that there was no difference between the groups, and a P value less than .05 was used as the limit for significant results. The t test was chosen because even if some variables were skewed, the sample sizes were regarded as large enough to make the t test valid.

Results

A total of 355 subjects (56% women) participated in this study, and 908 (49% women) had participated in the EPI-Norr study. Age distribution is given in Fig 2. As shown in Fig 3, the number of teeth differed between the groups. The mean number of teeth was lower in the study group at all ages, except for in the oldest group (Table 1), and 20% were edentulous, compared with 7% in the EPI-Norr group (P < .001). The dependent subjects with psychiatric impairments had the lowest mean number of teeth in the middle-aged group. In older age groups, elderly study group subjects in nursing homes had the lowest number of teeth.

The presence and type of prostheses varied between this study and the EPI-Norr study, with a trend toward more complete dentures and fewer tooth- and implant-supported prostheses in the study group than in Epi-Norr. In the study group, 15% of the subjects had complete dentures in both arches, compared with only 6% in EPI-Norr (P < .001); 24% of the study group and 14% of the Epi-Norr group had complete dentures in the maxilla (P < .001), and 15% and 6%, respectively, had complete dentures in the mandible (P < .001). There was no difference in the prevalence of partial dentures between the groups. When assessing the condition of the prostheses in the study group, 42% of the complete dentures in the maxilla were in poor condition, 20% were acceptable, and only 38% were in good condition; in the mandible, the proportions were 51% poor, 19% acceptable, and 30% good. The majority of the
tooth-supported and implant-supported prostheses in both arches in the study group were in good condition.

The results of the Eichner Index differed between the groups. In the study group, fewer participants had A scores and more participants had C scores, both with and without removable prostheses in place (Fig 4).

Treatment needs according to removable prostheses were higher in the study group compared with the EPI-Norr group. For tooth- and implant-supported prostheses, the treatment needs did not differ between the groups. The need for referral to a specialist was higher in the study group than in the EPI-Norr group.

Fig 2 Distribution of subjects in age groups in the present study (N = 352, mean age = 64.5 years) and in the Epi-Norr study (N = 908, mean age = 59.2 years). Data from three subjects in the present study are missing.

Fig 3 Number of teeth in this study and in the Epi-Norr study.
Discussion

The results from the study group showed that there were differences in oral status, type of prosthetic replacements, and prosthetic treatment needs between dependent, functionally impaired individuals and the general population. There are several reasons for the impaired oral status among the study group participants. Functional impairments in combination with dependency imply increased risk for dental diseases and tooth loss, and the ability of these individuals to manage dental hygiene and to tolerate dental treatment may be poor. The increased financial support system regulates dental care to dependent individuals and training in oral health care for nursing home personnel. However, there have been problems regarding implementation of the reform and knowledge among nursing personnel. Tooth brushing is considered to be a troublesome activity in nursing home care due to uncooperative residents, and there is a need for oral health care education among nursing personnel.

The higher prevalence of removable prostheses in the study group may be explained by the fact that treatment for dentures can be experienced as less challenging for the patients compared with tooth- or implant-supported prostheses. Moreover, oral hygiene routines are easier to perform with dentures, even for nursing staff. However, dentures can be difficult to use, especially for individuals with functional impairments. In view of this, the differences in prosthesis types between the groups demonstrated in this study are interesting and should be discussed.

The particularly troublesome finding in the study group was that more than 40% of the dentures in the study were missing teeth, indicating a need for more effective dental care and education for nursing home residents.

Table 1

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>n</th>
<th>T, Mean (SD)</th>
<th>Median</th>
<th>95% CI</th>
<th>P</th>
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<td>29</td>
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<td>S</td>
<td>30</td>
<td>28.7 (2.7)</td>
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<td>E</td>
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<td>30–41</td>
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<td>S</td>
<td>35</td>
<td>27.2 (4.1)</td>
<td>28</td>
<td>0.631–3.489</td>
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<td>E</td>
<td>161</td>
<td>29.3 (2.6)</td>
<td>30</td>
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<td>42–58</td>
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<td>S</td>
<td>64</td>
<td>23.6 (7.5)</td>
<td>26</td>
<td>2.056–5.824</td>
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<tr>
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<td>27.5 (3.2)</td>
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<td>59–71</td>
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<td>S</td>
<td>75</td>
<td>18.1 (9.1)</td>
<td>21</td>
<td>1.451–5.909</td>
<td>.002</td>
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<td>72–78</td>
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<td>175</td>
<td>15 (9.6)</td>
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<tr>
<td>S</td>
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<td>8.4 (9.1)</td>
<td>5</td>
<td>-3.281–2.581</td>
<td>.816</td>
</tr>
<tr>
<td>E</td>
<td>57</td>
<td>8.1 (9.3)</td>
<td>6</td>
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Independent samples t test. CI = confidence interval.
maxilla and 50% of those in the mandible were in poor condition, and only a small portion of the dentures were assessed as good. The dentures of some of the oldest and most fragile subjects were severely worn, chewing capacity was poor, and in some cases the retention was bad, which affected speech and oral motor activity. Most likely, the subjects had lived with poor prosthetic function for many years without any ability to express a need for treatment. Many of these subjects were not healthy enough to undergo dental treatment at the study examination date. If their needs had been observed earlier, they may have been helped with small interventions, such as relining or substitution of teeth in the denture. This observation suggests that the treatment needs of dependent, functionally impaired patients are not met with the same standards as for the general population, even if edentulous individuals are reported to seek less dental care than dentate individuals.35–37 Dentures need continuous maintenance, and as many of the subjects in the present study were unable to express their needs, the nursing and dental personnel ought to have been more aware of the disorders of the prostheses.

The Epi-Norr group showed a higher rate of A scores on the Eichner Index. An A score means more occlusal contacts and probably a better chewing capacity than dentate individuals.38 It is important to note that the Eichner Index does not take oral motor function into account. The subjects in the present study were more exposed to impaired oral motor function due to their functional impairments, which implies that chewing capacity may be even worse than indicated from the Eichner Index. A good oral motor capacity is important for the function of dentures. However, a limitation in this study is that no instrument for more directly estimating chewing capacity was used.

The treatment needs in this study were measured as realistic treatment needs, which are defined as "a combination of the normative need, the self-perceived need, and the expressed demand for treatment, and takes into account the mental and physical state of the individual, as well as ethical considerations."17 Realistic treatment need is intended to be used for planning oral treatment for elderly patients in nursing homes and is based on the clinical situation and the dentist's decision regarding what, if any, treatment will be offered.17 The ethical view plays a major role in this process. Informed consent before treatment should always be obtained from patients who are able to indicate their own needs. For patients who are not autonomous, the dentist and—if possible—a relative or an advocate must decide what is best for the patient. Several studies have reported that the realistic treatment needs among frail elderly and disabled patients are low.17 In spite of this, the results from this study showed higher scores for realistic treatment needs concerning the repair of dentures or making new dentures compared with the general population in the EPI-Norr study. These results are in accordance with Narby's theory of treatment needs19,20 and suggest that the treatment needs of vulnerable patients are not sufficiently addressed.

In recent decades, there has been a substantial increase in treatment with dental implants. In the EPI-Norr study, 14% of the 75-year-olds and 13% of the 85-year-olds had a prosthetic replacement (crown or fixed partial denture) supported by dental implants.26 In the study group, approximately 8% of the subjects over 72 years of age had dental implants to support some prosthetic construction. The question of whether these implants will cause complications with oral hygiene, leading to infections and loss of implants when the patients get older, has been a major concern in the field for some time. In the present study, impaired implant hygiene, as well as impaired dental hygiene, were found; however, there were no severe complications related to dental implants in the study group.

As for validity within Sweden, there seem to be no major problems, even though this study was performed in a specific region. The results from EPI-Norr have previously been compared with results from studies in other parts of Sweden, and the proportion of edentulous people seems to be similar in ages below 65 years.

One limitation of this study, however, is that it was not sampled at the same time as the EPI-Norr study, which was conducted in 2011. Another difference between the studies is that age grouping was not defined in exactly the same way. However, since EPI-Norr was a population-based study, and age groups were relatively similar to the age groups in the study group, these differences were not considered to influence the results in any critical way.

Another limitation was that, in contrast to Epi-Norr, a considerable amount of the subjects in this study were examined in their homes, which might have impaired the quality. Intraoral insight was not optimal, and there was no access to x-ray equipment. However, this is also a strength of the study, since it made it possible to include many subjects who were too weak or tired to travel to a dental clinic. This enabled the inclusion of vulnerable patient groups who are not often represented in research. The impaired quality of the home examinations may have resulted in under-registration in the study group and an underestimation of the differences between the study group and the EPI-Norr group. However, a strength is that the examiner had gone through the same calibration procedure as was used in the Epi-Norr study and had access to all data from that study.
The results of this study should be interpreted in relation to the results from the general population. In view of the special conditions in Sweden for dependent, functionally impaired and dependent elderly patients who are entitled to financial support for dental care, there is reason to assume that there are more accentuated differences between these population groups in other countries.

In conclusion, the results of this study showed shortcomings in oral status and dental care of vulnerable patient groups. Oral status was poor compared with the general population, and treatment needs were neglected. This reflects the need for special competence in dentistry for these patients and a need for better cooperation between dentistry and care personnel. The oral health situation is probably better in Sweden than in many other countries, which highlights the relevance of these questions in an international perspective.

Acknowledgments

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References

Literature Abstract

Osseointegration and Foreign Body Reaction: Titanium Implants Activate the Immune System and Suppress Bone Resorption During the First 4 Weeks After Implantation

Osseointegration mechanisms are still not entirely understood; therefore, this pilot study aimed to demonstrate the involvement of the immune system in the process of osseointegration around titanium implants by comparing bone healing in the presence and absence of a titanium implant. A total of 15 New Zealand white rabbits had one osteotomy performed at each of the distal femurs; on one side, no implant was placed (sham), and on the other side a titanium implant was introduced. Subjects were sacrificed at 10 and 28 days for gene expression analysis (three subjects at each time point) and for decalcified qualitative histology (six subjects at each time point); at 10 days, the three subjects for gene expression analysis were part of the six subjects for histology. For gene expression analysis, at 10 days, ARG1 was significantly upregulated around titanium, indicating an activation of M2 macrophages. At 28 days, CD11b, ARG1, NCF-1, and C5aR1 were significantly upregulated, indicating activation of the innate immune system and M1 macrophages, M2 macrophages, group 2 innate lymphoid cells, neutrophils, and the complement system; on the other hand, the bone resorption markers RANKL, OPG, cathepsin K, and TRAP were significantly downregulated around titanium. For qualitative histology at 10 days, new bone formation was seen around both sham and titanium sites, separating bone marrow from the osteotomy/implant site. At 28 days, no bone trabeculae was seen at the sham site, which was healing at the original cortical level, whereas around titanium implants, bone continued into organization of more mature cortical-like bone, forming a layer between the implant and the bone marrow. The presence of a titanium implant during bone healing activates the immune system and displays type 2 inflammation, which is likely to guide the host-biomaterial relationship. At the same time, bone resorption is suppressed around titanium sites compared to sham sites after 4 weeks of implantation, suggesting a shift to a more pronounced bone-forming environment. This suggests two important steps in osseointegration: identification of the titanium foreign body by the immune system and the development of a bone-forming environment that at tissue level translates into bone build-up on the titanium surface and can be perceived as an attempt to isolate the foreign body from the bone marrow space.