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# General health, dental status and perceived dental treatment needs of an elderly population in Istanbul

**Yasar Ozkan**[1], **Mutlu Özcan**[2], **Yasemin Kulak**[3], **Ender Kazazoglu**[3] and **Ayla Arikan**[3]

[1]Department of Oral and Maxillofacial Surgery, Faculty of Dentistry, Marmara University, Istanbul, Turkey; [2]Clinic for Fixed and Removable Prosthodontics and Dental Materials Science, Center for Dental and Oral Medicine, University of Zürich, Zürich, Switzerland; [3]Department of Prosthodontics, Faculty of Dentistry, Marmara University, Istanbul, Turkey

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**General health, dental status and perceived dental treatment needs of an elderly population in Istanbul**

**Background:** Comprehensive data on the oral health status and dental treatment needs of the elderly population in Turkey are deficient.
**Objectives:** This pilot study determined the general and dental health status, perceived medical and dental treatment needs of an elderly population dwelling in residential homes in Istanbul.
**Method:** Subjects at three different residential homes, namely one belonging to the state and two supported by foundations in Istanbul ($N$=121, female: 63 and male: 58) were involved in this study. A detailed questionnaire was prepared and dental examinations were conducted. Information was collected related to age, education levels, financial status, current physical functional status, general health, mental health, previous dental history, current dental status, oral hygiene practices and denture hygiene of these elderly people. The prevalence of edentulism, the presence and type of dental prostheses, dental and denture status and denture cleanliness were further evaluated.
**Results:** The three most prevalent reported general health problems were associated with genito-urinary problems (24%) followed by cardiovascular (18%) and respiratory problems (14%) varying significantly between genders, with males suffering more from cardiovascular problems than females ($p < 0.05$). Females showed significantly higher gastrointestinal and orthopaedic problems than males ($p < 0.05$). Females were more frequently edentulous than males but denture hygiene was significantly better in females than in males ($p < 0.05$). Brushing frequency did not significantly increase denture hygiene ($p = 0.6$). More than one-third of the subjects had not been to the dentist within the previous 5–10 years, mainly due to lack of demand, followed by the cost of the dental care and fear. More than two-thirds of denture-wearing subjects wore their dentures only during eating.
**Conclusions:** There was significant perceived dental treatment and care need for the sample population of elderly studied.

**Keywords:** ageing, edentulousness, elderly people, oral and general health status.

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## Introduction

In 1990, the population of the world was estimated to be around five billion people with 75% of them living in less industrialised rural countries[1,2]. In Turkey, the population of 65 years of age and older is expected to constitute 7.5 million (12.5%) of the total Turkish population by the year 2010[3]. Presently, one of the major problems in dentistry is the dental care of the elderly patients. In order to solve a similar problem, most of the developed countries have investigated dental and general health status of their elderly[4,5]. Although the health care and dental needs of the elderly are known in developing countries, there are no studies or a worldwide system to organise social services according to the needs and demands of the patients. On the other hand, while oral disorders are rarely life-threatening, they can have a significant impact on the social and physiological well-being of elderly people[6]. It is


 

often assumed that improved oral health will improve the quality of life[6]. In older adults, this becomes more significant because many of these subjects have substantial disabilities and handicaps that could impair oral care[4]. This situation may consequently lead to poor oral health or development of oral diseases in the elderly that could become an important public health issue.

Although interest in geriatric dentistry has increased in the dental profession worldwide [7–19], comprehensive data on the oral health status and dental treatment needs of the elderly population in Turkey are deficient[20,21]. As a result, there is a need for epidemiological studies evaluating the oral health status of older adults and for comparing it with other cross-cultural studies. Based on the resulting information, it may be necessary in the future to ascertain whether or not the conditions observed in the elderly population are on the rise or are part of a cohort phenomenon[5]. The objectives of this pilot study therefore were to investigate the general and dental health status and the perceived dental needs of an elderly population dwelling in residential homes in Istanbul.

## Materials and methods

### *Subjects*

There are altogether three residential homes in Istanbul, one belonging to the state and two supported by private foundations and study participants were recruited from them. A total of 121 subjects, 63 of which were female and 58 male, were involved in this study. Only subjects of 65 years of age or older and those who could communicate were included in the study.

In the residential home belonging to the state, the subjects had no social or health insurance. On the other hand, the state residential home supplies fundamental services such as food, hygiene and cleaning. Occasionally, food support is available from the neighbours in the district. The other two residential homes supported by private foundations supply minimal social insurance. The residents pay their salaries to the foundation and in return receive the services.

A detailed questionnaire was prepared in order to collect information related to age, civil status, education levels, financial status, mental health, current physical functional status, general health and how they feel about their health, previous dental history (frequency of visiting a dentist and reasons), current dental status, duration of denture wear, preference of diet, oral hygiene practices (use of floss, brush or both), and denture hygiene and means of maintaining hygiene (soap, tooth paste, water, mouthwash) of these elderly people. The principal investigator conducted all oral examinations. No intra-oral radiographs were made. The prevalence of edentulousness, the presence and type of dental prostheses, dental and denture status and denture cleanliness were further evaluated.

The mental status of the residents was evaluated using a questionnaire described by Kondo *et al.*[22] The dental examination was carried out with a mirror and probe, with the patient sitting in front of a window, under natural light. Patients in closed wards who were not mobile, as well as bedridden subjects, were examined in the wards. During the oral examination, the number of remaining natural teeth, the type of prostheses (complete or partial denture), and the stability and retention of the prostheses were recorded. Subjects were categorised according to their oral status, namely edentulous ones without dentures or with only one complete denture, edentulous with two complete dentures and dentate with or without partial dentures[23].

Patients were checked for state of the teeth and restorations, and state of the soft and hard tissues. The DMF-T index, which represents overall dental status, was calculated for each patient[24]. Parameters relevant to periodontal conditions were not evaluated.

For the evaluation of the state of the existing fixed and removable prostheses and replacement need, two indices were used: the Karlsson's index[25] for the condition of crowns and fixed-dental-prosthesis (FDPs), and the modified Nevalainen's index[26] for the condition of partial and complete dentures. The index to assess the need for replacement of partial and complete dentures developed by Nevalainen *et al.*[26] was modified and used in the clinical evaluation of the dentures for stability and retention. The dentures with poor retention (no resistance to vertical pull and lateral forces – the denture falls out of place) or those with extensive cracks and fractures were considered for renewal or repair.

Denture cleanliness was examined using a plaque-disclosing medium (proflavine monosulphate in 0.3% aqueous solution) to detect the plaque on the fitting surfaces of the maxillary dentures. Based on the quantity of plaque on the denture base, a previously described index was used for classification of denture cleanliness[27]: Excellent: None or only few spots of plaque; Fair: More extended plaque, less than half of the denture base covered by plaque; Poor: More than half of denture base covered by plaque.

*Statistical analysis*

Statistical analysis was performed using SAS System for Windows, release 8.02/2001 (Cary, NC, USA). The data were analysed using analysis of variance (ANOVA) and chi-square tests. $p$ Values less than 0.05 were considered to be statistically significant in all tests.

## Results

*Age and education*

The age of the sample population ranged between 65 and 90 years, of whom 47% were male and 53% were female. Overall, for both males and females, while more than two-thirds of the study group was between 65 and 70 years of age, one-third was between 70 and 80 years and only a few were over 80 years of age (Fig. 1). Thirty-five per cent of the study group were widows, 21% unmarried and 32% married. From the educational standpoint, while one-fifth (21%) of the study population had never been to school (of this population 48% were in the state residential home, 40% in the private ones), more than half had had primary school education (Fig. 2).

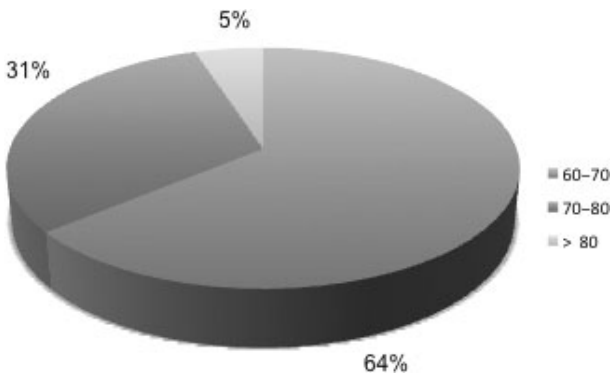


**Figure 1** Age distribution of the subjects.

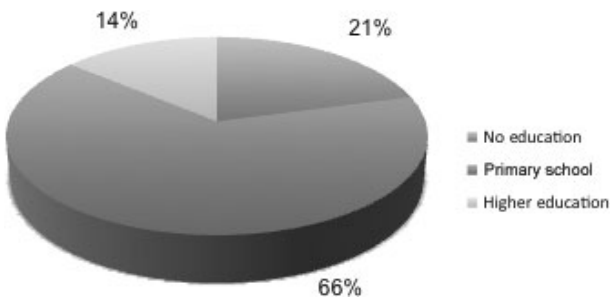


**Figure 2** Education level of the subjects.

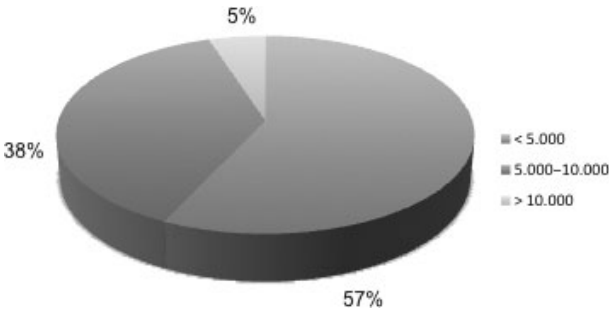


**Figure 3** Distribution of annual income ($) of the subjects.

*Financial status*

More than half of the study group (57%) had an annual individual income of less than $5000 and were receiving income supplements including a shelter allowance. Only a minority had an annual income of more than $10 000 (Fig. 3). Despite the low annual income, more than half (55%) of the subjects reported that their income was just sufficient to meet their needs (of those, 80% were in the state residential home and 20% in the private ones).

*Current physical functional status*

The majority of the subjects (90%) could manage daily physical activities independent of help. Only a few required assistance from a nursing service. On the other hand, 7% were not self-sufficient and therefore required help from a commercial service, especially for heavy housework (Fig. 4).

*General health*

The majority of the surveyed subjects rated their general health as either excellent or good for their age, and the rest were either not or only a little concerned about their health (Fig. 5). Information collected from the medical health histories revealed

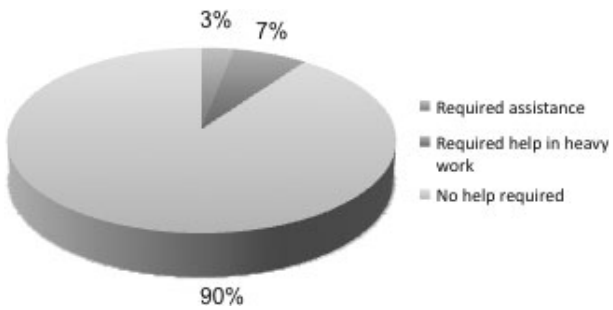


**Figure 4** Self-assessed performance in various daily activities.

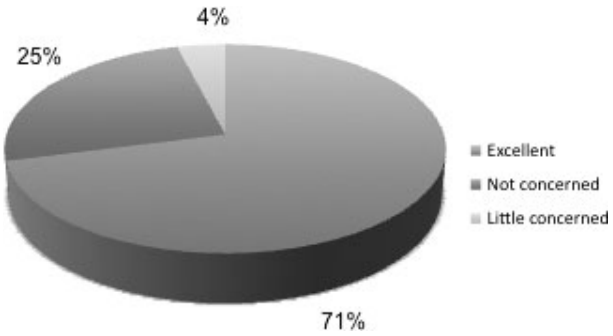


**Figure 5** Self-assessed health status of the subjects.

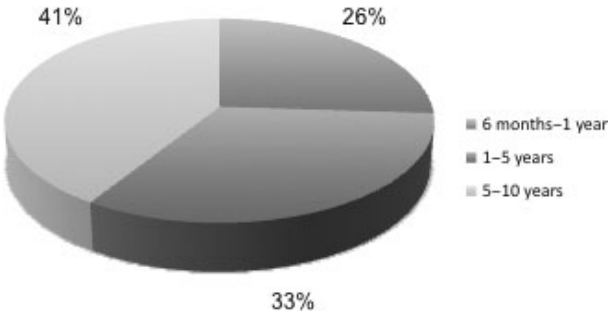


**Figure 6** Frequency of dental visits of the subjects.

**Table 1** General health problems and their distribution in males and females as reported in their medical history.

| *General health problems* | *Male (%)* | *Female (%)* | *Total (%)* |
|---|---|---|---|
| Genito-urinary | 40 (30.4) | 19 (16.2) | 59 (23.7) |
| Cardiovascular | 34 (25.8) | 10 (8.5) | 44 (17.7) |
| Respiratory | 15 (11.4) | 18 (15.4) | 33 (13.3) |
| Sight deficits | 13 (9.8) | 15 (12.8) | 28 (11.2) |
| Orthopaedic | 9 (6.8) | 19 (16.3) | 28 (11.2) |
| Gastrointestinal | 6 (4.5) | 18 (15.4) | 24 (9.6) |
| Neuromuscular disorders | 9 (6.8) | 10 (8.5) | 19 (7.6) |
| Mental disorders | 6 (4.5) | 8 (6.8) | 14 (5.7) |
| Total | 132 | 117 | 249 |

that 249 different health problems were reported (Table 1). The three most prevalent reported ones were genito-urinary problems (23.7%), followed by cardiovascular (17.7%) and respiratory problems (13.3%). These three problems varied significantly between genders ($p < 0.05$), with males suffering more from cardiovascular problems. On the other hand, females showed significantly higher gastrointestinal and orthopaedic problems than males ($p < 0.05$).

Mental health status of the subjects revealed that more than half (67%) of the sample population had intact intellectual functioning, 26% had mild and 7% had more severe intellectual impairment.

### *Previous dental history*

Only 26% of the subjects reported a dental visit within the previous year and 41% of the study group reported a dental visit within the last 5–10 years (Fig. 6). Care was not sought more frequently, principally due to lack of perceived need (55%). Other reasons given included cost of dental care, fear or anxiety about dental treatment.

### *Current dental status*

While 60% of the examined subjects were edentulous, 40% were partially or fully dentate. The frequency of complete edentulousness was significantly higher in females (61%) than in males (39%) ($p < 0.05$). Within the partially dentate portion of the sample, only eight persons (6%) had an FDP as a restorative solution. The use of removable dentures was more common (48%) and 12% were not wearing any kind of dentures. Within the edentulous portion of the sample, 81% were wearing complete dentures while 19% had no dentures at all.

While 28% of the subjects were wearing partial dentures in the partially dentate group, 7% had no partial dentures. Within the partially dentate portion of the study group, 83% were wearing either maxillary partial dentures or mandibular complete dentures, or vice versa. The remaining 17% had no partial dentures. For the 41 partially dentate subjects, prosthodontic or restorative care was needed by 90%. The prostheses of 36 partially dentate patients needed repairs or renewal of their prosthesis due to tooth loss and/or residual roots present in their mouths.

Twenty-six per cent of the denture-wearing subjects had worn their dentures for more than 8 years, of which 91% were made by dentists and 9% by denturists. When the quality of the dentures was evaluated, 85% were found to be inadequate. When the level of education was compared to the frequency of being edentulous, the data showed that 57% had primary school, 36% secondary school and 7% had higher education. Assessment of income level and being edentulous showed that 50% had low, 42% average and 8% had a high income (Table 2).

Among denture-wearers, 72% reported that their dentures were worn only for eating. For preference of diet dietary, 12% of the subjects reported eating hard food, 58% a mixture of hard

**Table 2** Level of education, income and frequency of being edentulous.

| | *No education* | *Primary school* | *Higher* |
|---|---|---|---|
| Edentulousness | 59% | 33% | 8% |
| | Low income | Average income | High income |
| Edentulousness | 50% | 42% | 8% |

and soft food and 30% reported eating only soft food.

### *Oral hygiene practices*

An evaluation of oral hygiene practices of the dentate group revealed the following results: 81% of the study group had never flossed their teeth and 31% brushed their teeth less than once a day.

### *Denture hygiene*

Twenty-six per cent of the denture-wearing subjects cleaned their dentures less than once a day. Most of them cleaned their dentures by brushing with soap or toothpaste and water. Only a few cleaned their dentures by soaking them in a solution. In a smaller group, combined brushing and soaking methods were being practised (Fig. 7). The great majority of the subjects never used a mouthwash whilst only 3% used mouthwashes either daily or weekly. The others either immersed their dentures in water or did not apply any cleaning regimens.

In the 57 females wearing dentures, 23% had excellent, 54% fair and 23% had poor denture hygiene. In the 35 denture-wearing males, only 3% had excellent denture hygiene (Table 3). There were significant differences between genders and their level of denture hygiene ($p < 0.0001$).

In assessing the relationship between denture hygiene and brushing frequency, 38% of the subjects who had excellent denture hygiene brushed their teeth less than once a day. Interestingly, more than two-thirds of the subjects who had poor denture hygiene reported that they brushed their teeth more than once a day (Table 4). Brushing frequency did not significantly increase denture hygiene ($p = 0.6$). When the relationship between education and denture hygiene levels was compared, 20% of the sample whose dentures had poor cleanliness had never been to school, 40% had been to primary school and 40% had experienced higher education.

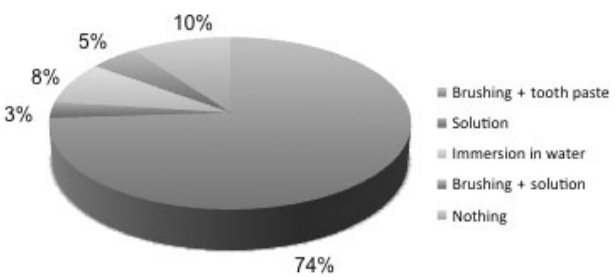


**Figure 7** Distribution of denture hygiene practices.

**Table 3** Denture hygiene classification according to gender.

| | *Denture hygiene* | | |
|---|---|---|---|
| | *Excellent (%)* | *Fair (%)* | *Poor (%)* |
| Male | 3 (9) | 5 (14) | 27 (77) |
| Female | 13 (23) | 31 (54) | 13 (23) |

**Table 4** Denture hygiene and brushing frequency.

| | *Denture hygiene* | | |
|---|---|---|---|
| | *Excellent (%)* | *Fair (%)* | *Poor (%)* |
| Brushing habits | | | |
| Less than once | 38 | 19 | 8 |
| Once | 12 | 56 | 15 |
| More than once | 50 | 24 | 78 |

## Discussion

Studies assessing both the medical and oral health of older adults are not common. In this study, the most frequent medical issues reported were cardiovascular and genito-urinary problems for males and orthopaedic, genito-urinary, gastrointestinal and respiratory problems for females. Although the percentages were not as high as those in this study, in previous reports similar trends were seen primarily for cardiovascular diseases followed by orthopaedic and gastrointestinal problems[5,12,28].

With respect to the current dental status findings, this study population presented with 60% edentulism in those over 65 years of age. This figure is similar to a British study almost three decades ago where the rates of edentulism ranged between 54% and 61%[7]. Other data from Australia, Denmark, Scotland, Norway and Ireland from two decades ago indicated higher edentulism rates

ranging from 75% to 80%[1]. Nevertheless, in Western Europe, the rate of edentulism has changed significantly during the last decade ranging between 35% and 40% of the population[16,29–33]. When compared with these figures, our findings are considerably lower. However, the pattern of edentulism is changing radically with projected reductions in edentulism throughout the industrialised world over the next 20–30 years[34–36]. It is expected that there will be edentulous patients in future. For example in Canada,[37] and the UK[38] this will last for another 30–40 years, but the number of people without teeth is expected to fall over the next three decades to only 4% of the UK population[34]. On the other hand, in a study on Japanese elderly people, the authors expected that the impaired nutritional status related to poor oral health might harm general health, the life expectancy of frail elderly and eventually affect the demographic shifts in edentulism[36].

Generally, the percentage of the rate of edentulism in older populations has often been used as an indicator of dental status[39–41]. In a previous survey performed almost two decades ago, 80% of the Turkish population over 65 years of age was found to be edentulous[20]. Although it cannot be generalised, there seems to be a clear trend for less edentate subjects with the increasing age in this population. This may reflect general improvements of dental care delivery services in Turkey over the last decade. Although not performed in residential homes but at university settings, similar trends were observed in this population[21]. On the other hand, dental visits were not very common and approximately no more than a quarter of the surveyed subjects had been to a dentist during the previous year. Interestingly, more than half of the studied population did not feel the need or urge to visit a dentist, although their dental conditions were not ideal. This indicates clearly that dental treatments were not within their priorities. Notwithstanding, costs and dental fear played major roles in neglecting visits to the dentist. The reasons why dental care is not sought more frequently are generally complex and involve many factors. Among these are differences between perceived and real need, lack of mobility and accessibility to care, fear of dentistry and high cost[17–19]. This survey showed that the value an older adult individual places upon dental care seems to be less than other factors.

The median income of the Turkish population is approximately $6000 according to the latest report by UNICEF. With regard to the income of the residents surveyed, it can be stated that almost half of the subjects fell under the average income level. In a Canadian survey, the rate of dental visits within the past 1–2 years was between 52% and 70% when the survey was reported almost 10 years ago[37]. Other studies have shown that as a population ages, visits to physicians increase, while those to dentists tend to decrease[16–18]. This pattern of care utilisation has been attributed to the increased risk of chronic systemic diseases and increased rate of edentulousness associated with ageing[17]. In 1977, a US national Health Interview Survey reported that 63% of the general population had made one or more visits to the dentist that year whereas from non-institutionalised persons older than 65 years of age, only 34% had made such a dental visit[1]. There could be two reasons for this in that either the teeth play less importance or the denture therapy does not require frequent visits to the dentist.

It was striking to note that a group of subjects could survive without using or having a denture. The concept of a shortened dental arch in partially edentate subjects could be one explanation for functioning well enough without a denture. However, it was also interesting to note the same trend in edentulous subjects. Based on these results, it cannot be stated that dentures are not needed because 72% of the denture-wearing subjects reported that they would wear their dentures only for eating. On the other hand, obviously wearing no dentures except during eating hours did not impair their other social activities or their quality of life. Marcus *et al.*[38] noted that 19% of the studied population had no dentures. Kuc *et al.*[37] made similar observations in a Canadian cohort and Samaranayake *et al.*[19] in a Scottish cohort where this figure was 17% and 20% respectively.

In the present study, the quality of the dentures was not ideal, namely they required repairs or renewal from 90% of the partially dentate subjects due to tooth loss and/or presence of residual roots. In some studies it has been demonstrated that edentulous subjects have inadequate dentures ranging between 31% and 80%[5,32,37]. In the present study, 85% of the evaluated complete dentures were found to be inadequate. These values for treatment need are similar to that found in two Canadian studies that found 67–81% of older adults were in need of dental treatment[13,14]. It is very difficult to identify whether this was due to biological and physiological changes in the mouth or was a consequence of malpractice during denture construction. Nevertheless, this figure indicates a situation worse than those of other studies. It can be also attributed to lack of

compulsory visits to the dentist in Turkey as it was noted that more than one-third of the subjects had not been to the dentist within the last 5–10 years.

The survey showed statistically significant differences in the edentulousness rates between males and females, with the rate being higher for the latter. This finding is similar to that of earlier surveys[8–11] where higher prevalence of edentulism among women in all age groups was also reported. These figures however differ from the findings of Marcus *et al.*[38] where edentulousness rates did not show significant difference between genders. As this study is considered a pilot study for an ongoing larger-scale survey, biological factors relating to tooth loss in females require further research. Interestingly, denture hygiene was significantly better in females than in males. In fact, similar hygiene habits could also have been expected for their natural teeth, but females were still more frequently edentulous than males. Again some biological factors could be considered when correlating dental care and loss of teeth with the differences in genders. In the larger study medicine intake and saliva compositions are being taken into account. The collected data provide preliminary information for a more comprehensive study on the general and oral health status of older people in Turkey.

Usually education and the socio-economic level of subjects are related to the status of oral health[30]. Through education, financial stability and the availability of dental insurance, individuals may become more increasingly concerned with their oral health[30]. Those who have attained higher levels of education are more likely to have greater financial opportunity to place a higher priority on dental health and individuals with greater financial resources usually have better access to dental care. However, the need for dental care was also observed in higher educated subjects with average to high income. Almost one-third of the subjects claimed that they could not afford dental care. It should also be noted that in Turkish society, residential homes are usually solutions for subjects who have no relatives and also who cannot afford living alone. This reflects the fact that studies and conclusions derived from these are, by design, only valid for people living in such conditions. General statements therefore cannot be made for the whole elderly population.

When oral and denture hygiene practices were evaluated, there was a distinct discrepancy between the information provided by the patients and denture hygiene level detected by the professionals. It was clearly evident that hygiene practices were not performed adequately. This could also be attributed to the large variety of oral hygiene habits and attitudes due to physical capability, manual dexterity, motivation, awareness and educational background of the residents, together with the medical and dental supervision and care available[18]. Authorities and nursing staff showed a lack of understanding of the oral hygiene needs of the elderly, especially for the denture wearers. As no assistance was offered from the nursing staff for oral hygiene, the subjects were responsible for the hygiene of their dentures themselves. Regular oral care and recall sessions with periodical demonstrations could be provided for the residents and for the care staff. Simple measures such as improved hygiene protocols with respect to denture care and increased awareness of the staff in the oral problems of the elderly may help improve the quality of dentures in such cohorts. Furthermore, oral health programmes should be implemented with an emphasis on routine preventative and maintenance in addition to curative care. The nursing and the medical staff in particular should be informed via appropriately designed educational materials and other resources specific to the oral health needs of older adults, as suggested previously[28].

In order to provide dental care services, improve the existing ones to meet these needs and investigate the needs *per se* could only be realised with such surveys. Only then could innovative delivery programmes be established to minimise the considerable dental costs required. One way of improving care for the elderly is to ensure that health care workers understand the importance of regular dental care, oral and denture hygiene. Therefore, governments and foundations should immediately review their dental health care systems.

## Conclusions

From the survey of the studied population, the following could be concluded.

**1** The three most frequent general health problems were genito-urinary problems followed by cardiovascular and respiratory problems, varying significantly between genders, with males suffering more from cardiovascular problems. Females showed significantly higher gastrointestinal and orthopaedic problems than males.

**2** Females were more frequently edentulous than males, but denture hygiene was significantly better in females than in males.

**3** There was a distinct discrepancy between the information provided by the patients related to

their denture-cleaning habits and denture hygiene levels detected.

**4** More than one-third of the subjects had not been to the dentist within the last 5–10 years, mainly due to the lack of need, followed by the cost of the dental care and fear.

**5** More than two-thirds of the denture-wearing subjects wore their dentures only during eating.

## References


1. **Ettinger RL.** Demography and dental needs: an international perspective. *Gerodontology* 1993; **10:** 3–9.
2. **Pack ARC.** Dental services and needs in developing countries. *Int J Dent* 1998; **48:** 239–247.
3. **Arun O.** Adventure of the elderly individual: possible scenarios on quality aging. *Gaziantep Üniversitesi Sosyal Bilimler Dergisi* 2008; **7:** 313–330. [In Turkish]
4. **Vigild M.** Benefits related assessment of treatment need among institutionalised elderly people. *Gerodontology* 1993; **10:** 10–14.
5. **Galan HL.** *Dental-Medical Status and Dental Treatment Needs of a Population of Community-Dwelling Older Winnipegers*. University of Manitoba, Canada, 1992. Doctorate Thesis.
6. **Allen FP.** Assessment of oral health related quality of life. *Health Qual Life Outcomes* 2003; **1:** 40.
7. **Rein M.** Social class and the utilization of medical care services. A study of British experience under the National Health Service. *Hospitals* 1969; **43:** 43–54.
8. **Bice TW**, **Rabin DL**, **Starfield BH *et al.*** Economic class and use of physician services. *Med Care* 1973; **11:** 287–296.
9. **Norheim PW.** The use of dental services in a population in northern Norway. *Acta Odontol Scand* 1979; **37:** 285–292.
10. **Hunt RJ**, **Beck JD**, **Lemke JH *et al.*** Edentulism and oral health problems among elderly rural Iowans: the Iowa 65+ rural health study. *Am J Public Health* 1985; **75:** 1177–1181.
11. **Weintraub AT.** Dental needs and dental service use patterns of an elderly edentulous population. *J Prosthet Dent* 1985; **54:** 526–531.
12. **Valkonen T**, **Nikander T.** Demographic changes in the aged populations of four Nordic countries. *Yearbook of Population Research in Finland*, Chapter XXV. 1987: 9–18.
13. **Locker D**, **Leake JL**, **Hamilton M *et al.*** The oral health status of older adults in four Ontario communities. *J Can Dent Assoc* 1990; **56:** 215–217.
14. **Slade GD**, **Locker D**, **Leake JL *et al.*** The oral health status and treatment needs of adults aged 65+ living independently in Ottawa-Carleton. *J Can Public Health* 1990; **81:** 114–119.
15. **Drake CW**, **Beck JD**, **Crause RC.** Dental treatment needs in an elderly population. *J Public Health Dent* 1991; **51:** 205–211.
16. **Ainamo A**, **Osterberg T.** Changing demographic and oral disease patterns and treatment needs in the Scandinavian populations of old people. *Int J Dent* 1992; **42:** 311–322.
17. **Ettinger RL.** Attitudes and values concerning oral health and utilization of services among the elderly. *Int J Dent* 1992; **42:** 373–384.
18. **Pietrokovski J**, **Azuoles J**, **Tau S *et al.*** Oral findings in elderly nursing home residents in selected countries: oral hygiene conditions and plaque accumulation on denture surfaces. *J Prosthet Dent* 1995; **73:** 136–141.
19. **Samaranayake LP**, **Wilkies CM**, **Lamey PJ *et al.*** Oral disease in elderly in long term hospital care. *Oral Dis* 1995; **1:** 47–51.
20. **Saydam G**, **Oktay İ**, **Möller I.** *Analysis of Oral Status in Turkey*. University of Istanbul, Istanbul, 1990. Doctorate Thesis.
21. **Kulak-Ozkan Y**, **Kazazoglu E**, **Arikan A.** Oral hygiene habits, denture cleanliness, presence of yeasts and stomatitis in elderly people. *J Oral Rehabil* 2002; **29:** 300–304.
22. **Kondo N**, **Kazama M**, **Suzuki K *et al.*** Impact of mental health on daily living activities of Japanese elderly. *Prev Med* 2008; **46:** 457–462.
23. **Ramon T**, **Grinshpoon A**, **Zusman SP *et al.*** Oral health and treatment needs of institutionalized chronic psychiatric patients in Israel. *Eur Psychiatry* 2003; **18:** 101–105.
24. **Lamy M**, **Mojon P**, **Kalykakis GL *et al.*** Oral status and nutrition in the institutionalized elderly. *J Dent* 1999; **27:** 443–448.
25. **Karlsson G**, **Teiwik A**, **Lundström A *et al.*** Costs of periodontal and prosthodontic treatment and evaluation of oral health in patients after treatment of advanced periodontal disease. *Community Dent Oral Epidemiol* 1995; **23:** 159–164.
26. **Nevalainen MJ**, **Rantanen T**, **Narhi T *et al.*** Complete dentures in the prosthetic rehabilitation of elderly persons: five different criteria to evaluate the need for replacement. *J Oral Rehabil* 1997; **24:** 251–256.
27. **Budtz-Jorgensen E**, **Bertram U.** Denture stomatitis II. The effect of antifungal and prosthetic treatment. *Acta Odontol Scand* 1970; **28:** 283–306.
28. **Mcdermot RE**, **Hoover JN**, **Gaucher C.** Self reported medical conditions and drug use among elderly dental patients. *J Can Dent Assoc* 1990; **56:** 219–221.
29. **Suominen-Taipale AL**, **Alanen P**, **Helenius H *et al.*** Edentulism among Finnish adults of working age, 1978–1997. *Community Dent Oral Epidemiol* 1999; **27:** 353–365.
30. **Osterberg T**, **Carlsson GE**, **Sundh V.** Trends and prognoses of dental status in the Swedish population: analysis based on interviews in 1975 to 1997 by Statistics Sweden. *Acta Odontol Scand* 2000; **58:** 177–182.
31. **Walls AW**, **Steele JG.** Geriatric oral health issues in the United Kingdom. *Int Dent J* 2001; **51:** 183–187.

32. **Müller F**, **Nitschke I.** Oral health, dental state and nutrition in older adults. *Z Gerontol Geriatr* 2005; **38:** 334–341.
33. **Osterberg T**, **Carlsson GE.** Dental state, prosthodontic treatment and chewing ability – a study of five cohorts of 70-year-old subjects. *J Oral Rehabil* 2007; **34:** 553–559.
34. **Steele JG**, **Treasure E**, **Pitts NB** ***et al.*** Total tooth loss in the United Kingdom in 1998 and implications for the future. *Br Dent J* 2000; **189:** 598–603.
35. **Sheiham JG**, **Steele W**, **Marcenes G** ***et al.*** Prevalence of impacts of dental and oral disorders and their effects on eating among older people; a national survey in Great Britain. *Community Dent Oral Epidemiol* 2001; **29:** 195–203.
36. **Minakuchi S**, **Takaoka S**, **Ito J** ***et al.*** Factors affecting denture use in some institutionalized elderly people. *Spec Care Dent* 2005; **26:** 101–105.
37. **Kuc IM**, **Samaranayake LP**, **van Heyst EN.** Oral health and microflora in an institutionalized elderly population in Canada. *Int J Dent* 1999; **49:** 33–40.
38. **Marcus PA**, **Joshi A**, **Jones JA** ***et al.*** Complete edentulism and denture use for elders in New England. *J Prosthet Dent* 1996; **76:** 260–266.
39. **Allen PF**, **McMillan AS.** A longitudinal study of quality of life outcomes in older adults requesting implant prostheses and complete removable dentures. *Clin Oral Implants Res* 2003; **14:** 173–179.
40. **Jonathan A**, **Ship O.** Oral health in the elderly – what's missing? *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2004; **98:** 625–626.
41. **Anastassiadou V**, **Heath MR.** The effect of denture quality attributes on satisfaction and eating difficulties. *Gerodontology* 2006; **23:** 23–32.

*Correspondence to:*
Prof. Dr. med. dent. Mutlu Özcan, Clinic for Fixed and Removable Prosthodontics and Dental Materials Science, Center for Dental and Oral Medicine, University of Zürich, Plattenstrasse 11, CH-8032 Zürich, Switzerland
Tel.: +41 44 6345600
Fax: +41 44 6344305
E-mail: mutluozcan@hotmail.com