Elderly Canadians Residing in Long-term Care Hospitals: Part I. Medical and Dental Status

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A b s t r a c t

Background: Oral diseases and conditions have been identified as a significant problem for elderly residents of long-term care (LTC) hospitals in developed countries, yet little recent information is available for the Canadian population.

Objective: To describe the medical, dietary, oral microbial, oral hygiene and dental status of elderly Canadians living in LTC hospitals in Vancouver and surrounding communities.

Methods: A sample of 369 elderly dentate hospital residents (mean age 83.9 years, 281 women [76.2%]) were examined, and their medical status and medications, oral status and type of hospital were documented. Oral hygiene practices and diet (specifically intake of refined carbohydrates) were evaluated. Subjects with xerostomia and subjects taking medications with hyposalivary side effects were identified, and salivary Streptococcus mutans and Lactobacillus were cultured.

Results: The mean plaque index was 1.3; men had a higher plaque index than women and residents of extended care hospitals had a higher plaque index than those in intermediate care hospitals. The mean bacterial score per millilitre of saliva was 9.7×10^5 colony-forming units (CFU) for Streptococcus mutans and 1.6×10^5 CFU for Lactobacillus. On average, each subject had 6.3 sound teeth, and 9.3 teeth had been restored.

Conclusions: Although almost half of the subjects had visited a dental office in their community within the past 5 years, the elderly hospital residents in this study had few remaining teeth and suffered from poor oral hygiene. Prevention strategies (such as diet, oral hygiene and antimicrobial agents) rather than dental interventions (such as restorations and extractions) alone may be needed to control oral diseases in this susceptible population.

MeSH Key Words: Canada; dental care for aged; health status; oral health

The elderly population includes increasing proportions of dentate and partially dentate people, which suggests that this group will have an increasing need for dental services.[1-3] Gingivitis and periodontitis increased with the number of retained teeth in a cross-sectional study of elderly subjects.[4] Xerostomia as a result of a direct physiological change (because of Sjorgren's syndrome or radiation to the salivary glands, for example) or secondarily as a side effect of medications has been associated with increases in caries in elderly people.[5] Medications may directly reduce salivary flow and thus reduce the buffering capacity to such an extent that caries occur even with a normal diet. Alternatively, medications may create a perception of dry mouth, leading the person to seek relief by sucking or chewing confectionery products containing sugars, which indirectly increases the risk of caries.[6] Older subjects, women in particular, reportedly take more medications and experience more root caries.[7]

Salivary and plaque samples can be used to detect the presence and numbers of *Streptococcus mutans* and *Lactobacillus* and thus identify elderly subjects at high risk of caries.[8] Higher salivary levels of *S. mutans* and *Lactobacillus* have been associated with increased prevalence of coronal and root caries in elderly multiracial populations.[9]

Hospitalized elderly subjects are at considerable risk of dental diseases and conditions, yet they experience greater barriers to receiving dental care than their independent counterparts.[10] Such barriers to dental care include cost, lack

of perceived need for care, transportation problems and fear.[10] In addition, a lack of interested dental professionals, a lack of facilities to treat patients within the hospital setting, and complicated psychological and social factors are impediments to dental care.[11]

The implications of poor oral health in older adults go beyond the mouth. Quality of life, as measured by psychological well-being and life satisfaction indices, has been associated with oral health.[12] Specifically, the significance of oral health to older adults relates to 3 interacting themes: comfort, hygiene and overall health.[11]

This paper describes the medical, dietary, oral microbial, oral hygiene and dental status of dentate residents of intermediate and extended long-term care (LTC) hospitals in Vancouver and surrounding communities.

Methods

The baseline information for 369 elderly dentate subjects enrolled in a longitudinal clinical trial testing the effectiveness of antimicrobial mouth rinses (0.2% fluoride and 0.12% chlorhexidine) in protecting teeth from caries was used in this study. A total of 39 LTC hospitals in the Vancouver area (5 extended care facilities accounting for a total of 63 subjects and 34 intermediate care facilities accounting for a total of 306 subjects) participated in this study, which took place from 1998 to 2000. The intermediate care hospitals offered full-time care, supervision, nursing and recreational activities. The extended care hospitals provided full-time nursing care with medical supervision and were usually associated with an acute care hospital, offering a secure environment for residents with cognitive and behavioural problems. Hospital administrators were asked to identify potential subjects, people with natural teeth who could tolerate an oral examination and use a mouth rinse without difficulty. Residents who were edentulous, severely medically or mentally compromised, or unable to provide consent were excluded. Three hundred and fifteen (85.4%) of the subjects were able to give their own consent; for the rest, consent was obtained from the subject's legal guardian (usually a close relative). A dentist reviewed the medical charts and physician-diagnosed medical conditions, and prescribed medications were recorded. The subjects were interviewed, with the help of relatives and care providers, to obtain information about oral hygiene practices and use of professional dental services.

One dentist examined each subject's mouth and scored the remaining teeth according to the Silness and Löe plaque index.[13] The diagnosis of dry mouth, specifically a salivary glandular dysfunction (e.g., Sjorgren's syndrome), by a physician or dentist and the use of medications listed in the Canadian Pharmacists Association's *Compendium of Pharmaceuticals and Specialties*[14] as potentially causing

xerostomia were used to identify subjects with potentially deficient salivary flow.

A stimulated salivary sample was obtained for selective culture of *S. mutans* and *Lactobacillus*.[15] The bacterial colonies were identified morphologically, and the results are expressed as the number of bacterial colonies per millilitre of saliva. Bacterial scores of greater than 1×10^6 colony-forming units (CFU) of *S. mutans* and greater than 1×10^5 CFU of *Lactobacillus* per millilitre of saliva were considered high.[16] For the 205 subjects (55.6%) unable to provide a salivary sample, a plaque sample was used to estimate bacterial concentration within the mouth.[15,17]

A 24-hour dietary recall performed by each resident, with the help of the care providers, was used to identify the quantity and frequency of consumption of refined carbohydrates. A frequency of consumption of sugar (refined carbohydrate) greater than 4 in 24 hours was considered high and was defined as placing the subject at risk for caries.[18]

Oral disorders recorded during the examination were brought to the attention of the subject or legal guardian. Ethical approval for this study was obtained from the University of British Columbia Clinical Research Ethics Board.

The Statistical Package for the Social Sciences (SPSS) (SPSS Inc., Chicago, Ill.) was used to analyze the data. Paired 2-tailed *t*-tests were used to verify the examiner's reliability in assessing tooth scores and plaque indices. The results are presented as means and standard deviations (SDs). A paired *t*-test was used to test for significant differences between mean values. Pearson chi-square and Pearson correlation coefficients were used to test for significant relationships between continuous variables. Probability of 5% was defined as significant for all statistical tests in this study.

A random sample of 10 subjects was re-examined after one week to determine the examiner's repeatability in scoring tooth surfaces for plaque. There were no significant differences in individual plaque scores per tooth upon re-examination ($t = 0.355$, df = 9, p [2-tailed] = 0.731). In addition, the author examined the teeth of 10 subjects for plaque; there were no significant differences in individual plaque scores per tooth between the author and the examining dentist ($t = 1.744$, df = 9, p [2-tailed] = 0.115). Plaque and saliva sampling techniques for determining bacterial scores were verified. The Pearson correlation coefficient was 0.46 ($p = 0.02$) for *S. mutans* and 0.62 ($p = 0.001$) for *Lactobacillus* for plaque and saliva samples from 25 subjects.

Results

Medical Status

Most of the subjects (353 or 95.7%) were white; their mean age was 83.9 years (SD 8.8). The study population

Table 1 Most frequent and most significant medical conditions in 369 elderly residents of long-term care hospitals in the Vancouver area

Condition	No. (and %) of subjects
Neurological	218 (59.1)
Cardiovascular	186 (50.4)
Muscles, joints, bone (mostly arthritis, osteoporosis)	153 (41.5)
Behavioural	100 (27.1)
Endocrine	92 (24.9)
Eye and ear	80 (21.7)
Lung	52 (14.1)
Gastrointestinal	41 (11.1)
Cancer	36 (9.8)
Kidney	30 (8.1)
Blood	23 (6.2)
Systemic infection	2 (0.5)

consisted of 281 women (76.2%), whose mean age was 84.5 years (SD 8.6), and 87 men (23.6%), whose mean age was 82.4 years (SD 9.5); 267 (72.4%) of the subjects were older than 80 years.

Medical records revealed that 365 subjects (98.9%) had been diagnosed with at least one significant medical condition (**Table 1**). The mean number of conditions per resident was 3.3 (SD 1.5, range 1–8). Most of the subjects had a neurological condition, but cardiovascular conditions and disorders of the muscles, joints and bone were also common (**Table 1**). The mean number of prescription and non-prescription medications per subject was 5.3 (SD 3.3, range 0–10). Nearly all of the subjects (365 or 98.9%) were taking prescription medications for one or more conditions, and the mean number of prescription medications was 3.4 (SD 1.5, range 0–9). A total of 289 (78.3%) subjects were taking medications with xerostomic side effects.

Only 53 subjects (14.4%) were on a special diet. Self-reporting of additional dietary sugar intake revealed a minimum of 0 and a maximum of 15 exposures to sugar per day (mean 4.2, SD 2.8); 173 (46.9%) of the subjects had diets high in sugar. Tobacco and alcohol consumption was low: 6 (1.6%) of the residents admitted to smoking tobacco and 5 (1.4%) to consuming alcohol regularly.

Bacterial Scores

A total of 139 saliva and 205 plaque samples were obtained. The mean *S. mutans* score was 9.7×10^5 CFU per milliliter of saliva and the mean *Lactobacillus* score was 1.6×10^5 CFU per millilitre of saliva. The 2 bacterial scores were significantly correlated ($R = 0.457$, $p < 0.01$). The *Lactobacillus* scores were also correlated with the plaque index ($R = 0.191$, $p < 0.01$).

Oral Hygiene

Most subjects (322 or 87.0%) did not receive assistance with daily oral hygiene; only 44 (11.9%) received help from a care provider and 3 (0.8%) received help from a family member. When asked about their daily oral hygiene practices, most subjects (339 or 91.9%) only brushed their teeth, 8 (2.2%) also used a mouth rinse, 4 (1.1%) also flossed, and only 5 (1.4%) brushed, flossed and rinsed daily. Fifteen subjects (4.1%) used no toothpaste, 5 (1.4%) used a non-fluoride toothpaste, and the others used a fluoride toothpaste when brushing. Of the 13 subjects who used a mouth rinse daily, 8 (2.2%) used a fluoride mouth rinse and 5 (1.4%) used an over-the-counter product of their own choosing; none used a chlorhexidine mouth rinse. Forty-two other subjects (11%) used an over-the-counter product to occasionally freshen their breath. Thirteen subjects (3.5%) admitted to not performing any daily oral hygiene.

The mean plaque index per subject was 1.3 (SD 0.9, range 0–3). Only 29 (7.9%) of the subjects had clean mouths (plaque index of 0), whereas 244 (66.1%) had mildly poor oral hygiene (plaque index greater than 0, but less than 2), 76 (20.6%) had moderately poor oral hygiene (plaque index greater than 2, but less than 3), and 20 (5.4%) had extremely poor oral hygiene (plaque index of 3). Two hundred and seventy-three subjects (74.0%) had a plaque index per individual tooth of at least 1 on more than half of their teeth, 96 (26.0%) had a plaque index of at least 2 on more than half their teeth, and 22 (6.0%) had a plaque index of 3 on more than half their teeth. In a comparison of subjects less than 85 years of age with those 85 years of age and older, there was no difference in susceptibility to plaque accumulation. Men had poorer oral hygiene than women (mean plaque index for men 1.6 [SD 0.9] and for women 1.3 [SD 0.9], $t = 8.169$, $p < 0.001$). The residents of extended care hospitals had poorer oral hygiene than those residing in intermediate care hospitals (plaque index 1.9 [SD 0.9] and 1.2 [SD 0.8], respectively, $t = -9.807$, $p < 0.001$). The percentage of teeth with gingival recession was 11.4% (SD 5.9, range 0–27).

Dental Status

The mean number of teeth per subject was 16.4 (SD 7.1, range 3–31), with a mean of 7.0 in the maxilla and 9.4 in the mandible. Of the 6,055 teeth documented, 2,328 (38.4%) were sound and 3,443 (56.9%) were restored. The majority of subjects (269 or 72.9%) had teeth remaining in both dental arches; 6 (1.6%) were completely edentulous in the mandible and 94 (25.5%) were completely edentulous

Table 2 Number of missing teeth (excluding third molars)

Teeth	Jaws; mean no. of missing teeth ± SD	
	Maxilla	Mandible
Incisors	2.4 ± 2.5	0.7 ± 1.4
Premolars	2.3 ± 1.6	1.4 ± 1.4
Molars	2.5 ± 1.5	2.7 ± 1.3
Total	7.2 ± 4.8	4.8 ± 3.0

SD = standard deviation

Table 3 Subject characteristics and dental status by sex

Variable	Sex; mean ± SD	
	Men (*n* = 88)	Women (*n* = 281)
Age (years)	82.4 ± 9.5	84.5 ± 8.6
No. of remaining teeth	17.0 ± 7.5	16.2 ± 7.0
No. of missing teeth	15.1 ± 7.5	15.8 ± 7.0
Plaque index[a]	1.6 ± 0.9	1.3 ± 0.9
No. of teeth with recession	11.0 ± 6.7	11.5 ± 5.6
No. of sound teeth (noncarious, unrestored)	1.0 ± 1.9	1.1 ± 1.8
No. of teeth with cast restorations	2.6 ± 3.7	2.6 ± 3.7
No. of restored teeth		
Coronal and root	9.4 ± 6.7	9.3 ± 6.1
Coronal	9.0 ± 6.4	8.8 ± 6.0
Root	2.6 ± 3.3	2.9 ± 3.1
No. of sound surfaces		
Coronal and root	67.6 ± 37.7	68.9 ± 34.7
Coronal	48.3 ± 29.2	47.4 ± 25.8
Root	19.2 ± 16.2	21.4 ± 14.2

SD = standard deviation
[a]Statistically significant difference in scores

in the maxilla. The mean number of missing teeth differed between jaws and within jaws (**Table 2**).

Dental Restorations and Prostheses

A quarter (90 or 24.4%) of the residents wore one complete denture (5 [1.4%] a mandibular denture and 85 [23.0%] a maxillary denture). Removable partial dentures were worn by 93 (25.2%) of the subjects: 14 (3.8 %) wore both maxillary and mandibular partial dentures, 32 (8.7%) wore only maxillary partial dentures, and 47 (12.7%) wore only a mandibular removable partial denture.

On average, each subject had 6.3 sound teeth and 8.8 (SD 6.0, range 0–26) restored teeth, and the mean number of restored roots per subject was 2.8 (SD 3.2, range 0–17). More than half (196 or 53.1%) of the subjects had crowns (overall mean 2.6, SD 3.7, range 0–18 crowns per subject). Fixed partial dentures were present in 79 (21.4%) of the subjects. The majority of fixed partial dentures (112) replaced teeth in the maxillary anterior region (40 or 36%), followed by the mandibular posterior (34 or 30%), the maxillary posterior (29 or 26%), and the mandibular

Table 4 Subject characteristics and dental status by long-term care hospital type

Variable	Type of facility; mean ± SD	
	Intermediate care (*n* = 310)	Extended care (*n* = 59)
Age (years)	83.8 ± 8.7	85.0 ± 9.5
No. of remaining teeth	16.5 ± 7.1	16.1 ± 7.2
Missing teeth	15.5 (7.1)	16.0 (7.2)
Plaque index[a]	1.2 ± 0.8	1.9 ± 0.9
Teeth with recession	11.9 (5.8)	8.3 (5.0)
No. of sound teeth (noncarious, unrestored)	1.1 ± 1.8	0.6 ± 1.9
Teeth with cast restorations	2.6 (3.7)	2.6 (3.6)
Restored teeth (coronal and root)	9.5 (6.2)	8.5 (6.0)
Restored teeth (coronal)	8.9 (6.1)	8.3 (5.8)
Restored teeth (root)	3.1 (3.3)	1.1 (1.9)
Sound surfaces (coronal and root)	70.5 (35.5)	58.4 (33.2)
No. of sound coronal surfaces	48.0 ± 26.4	45.6 ± 28.2
No. of sound root surfaces	22.5 ± 14.7	12.7 ± 12.0

[a]Statistically significant difference in scores

anterior (9 or 8%). There were no differences in the numbers of remaining teeth and restored teeth between men and women (**Table 3**) or between extended care and intermediate care populations (**Table 4**).

Dental Services

Almost half (179 or 48.5%) of the residents had seen a dentist at least once within the previous 5 years and 14 (3.8%) had seen one within the previous year. Eighty-two (45.8%) of the subjects who had attended a dentist had received a professionally applied topical fluoride treatment. As a result of this study, a total of 253 (68.6%) of the residents were referred to a dentist, mostly for treatment of dental caries (244 or 96.4%), periodontal disease (5 or 2.0%) and other conditions (infection, inflammation, lesions, prostheses) (4 or 1.7%).

Discussion

The selection of relatively healthy subjects (both physically and mentally) who personally consented to undergo a dental examination and participate in a clinical trial of mouth rinses has obvious limitations. These individuals were probably more interested in dental services than subjects who did not participate and in fact had frequently accessed dental services within the community, as evidenced by the number of restorations documented. Therefore, this study population may have included a higher proportion of people who had retained greater numbers of teeth and received more restorations than the typical LTC population.

The mean number of prescribed medications was higher than reported in several recently published studies from around the world, but the percentage of residents taking

Table 5 **Summary and comparison of data in various studies**

Variable	This study	Other studies
Mean no. of medical conditions	3.3	3.5 (Guivante-Nabet and others[20])
Mean no. of medications	5.3	2.8 (Galan and others[19]) 6.4 (Knabe and Kram[21])
% of residents taking medications with xerostomic side effects	78	77 (Guivante-Nabet and others[20])
% of residents performing their own daily oral hygiene	87	98 (Frenkel and others[22]) 49–76 (Kossioni and Karkazis[23])
% of residents not receiving or performing daily oral hygiene	4	59 (Knabe and Kram[21])
% of residents with moderately poor oral hygiene	76	82 (Frenkel and others[22])
% of residents with extremely poor oral hygiene	45	47 (Lee[24])
Mean no. of remaining teeth	16.4	16.6 (Guivante-Nabet and others[25]) 15.5 (Galan and others[26]) 14 (Lee[24]) 11.9 (Hawkins and others[27]) 11.6 (Frenkel and others[22])
Mean no. of sound coronal (root) surfaces	47.7 (20.9)	40.02 (40.74) (Guivante-Nabet and others[25])
Mean no. of restored coronal (root) surfaces	29.4 (3.98)	27.13 (1.15) (Guivante-Nabet and others[27])
% of residents attending a dentist in the past year	3.9	31 (Hawkins and others[27]) 46 (Galan and others[26]) 13.1 (Frenkel and others[22])
% of residents requiring dental treatment	68.6	100 (Galan and others[26]) 45.7 restorative care (Hawkins and others[27]) 55.7 prosthodontic care (Hawkins and others[27])

medications with xerostomic side effects was similar (**Table 5**). The categorization of medical conditions varies between published studies, which prevented realistic comparisons.

The LTC hospital residents in this study were responsible for their own oral hygiene; similar conditions have been reported for other countries (**Table 5**). The majority claimed to brush their teeth with fluoride toothpaste. The use of mouth rinse was low, and use of rinses containing fluoride or chlorhexidine was rare. Galan and others[26] reported that 30% of younger residents (< 75 years) and 66% of older residents (> 75 years) of senior housing centres in Winnipeg used mouth rinses.

Only 29 (7.9%) of the subjects had clean mouths (plaque index of 0), whereas 96 (26.0%) had a plaque index of at least 2 on more than half their teeth. In a study of 118 dentate residents in Avon, two-thirds of the buccal and lingual tooth surfaces were covered in plaque,[22] which implies poor oral hygiene. If one considers a plaque index greater than 2 as poor oral hygiene, then only 26.0% of the population in the present study are at risk. This number is considerably less than the 47% of 713 elderly residents with poor oral hygiene reported by Lee.[24]

The number of remaining teeth per elderly hospitalized resident in this study was similar to that reported for a French population,[25] but higher than for other populations (**Table 5**). More teeth were retained in the mandible than the maxilla, as was the case in the study by Guivante-Nabet and others.[20] The number of missing molars was similar in the maxilla and mandible, but the number of missing anteriors and premolars was higher in the maxilla. In a high percentage of subjects who were missing teeth, the teeth were replaced by either fixed, removable partial or complete dentures. The mean number of restored teeth was 9.3, considerably higher than the 3.4 (SD 4.3) reported by Hawkins and others.[27]

The mean number of sound and restored coronal surfaces was similar to that reported by Guivante-Nabet and others;[25] however, the mean numbers of sound and restored root surfaces was approximately half those of the French study.

Almost half of the residents had attended a community dentist at least once within the previous 5 years. However, the number of residents attending a dentist in the previous year (14 or 3.8%) was considerably lower than reported by others (**Table 5**). Two-thirds of the residents were subse-

quently referred for dental care, almost exclusively for the treatment of dental caries, a higher proportion than that reported by Hawkins and others[27] but lower than that reported by Galan and others.[26] In the latter study residents who had not attended a dentist within the previous year also had greater treatment needs.

Conclusions

Overall, the elderly LTC hospital residents in this study suffered from poor oral health, although almost half had visited community dentists within the previous 5 years. A lack of assistance with daily oral hygiene, a high risk of xerostomia induced by medication and the consumption of a diet high in sugar were associated with high plaque levels and susceptibility to gingivitis, periodontitis and caries. Barriers to professional care must be removed and prevention strategies formulated to reduce the risk of oral disease in this population. Prevention of oral disease in the elderly requires early intervention, education of health professionals in the identification of patients at risk, and implementation of preventive programs.[28] ✦

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