Impact of medical and life-style factors on number of teeth in 68-year-old men in southern Sweden

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The aim of the present study was to investigate the impact of general health and life-style factors on the number of remaining teeth in 68-year-old men living in the city of Malmö, Sweden. The study included 483 men (participation rate, 78%). Poor self-assessed health, frequent medical attendance, diabetes, and oral dryness were related to fewer remaining teeth. Number of teeth was negatively correlated to concentrations of triglycerides and alkaline phosphatases in serum and to glucose in blood but positively correlated to serum urea. Various dietary variables including consumption of sucrose-containing products and nutritional quality were not related either to number of teeth or to prevalence of edentulousness. Smoking and high consumption of coffee or alcohol were associated with fewer remaining teeth. Multiple logistic regression analyses showed that social class, frequency of dental attendance, smoking, and serum concentrations of triglycerides and urea had an independent effect on number of teeth. □ *Blood components; dietary factors; epidemiology; general health; oral health*

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Epidemiologic studies of elderly subjects, carried out during recent decades in Sweden, indicate an improved dental health in terms of increased numbers of remaining teeth (1–6). Thus, the percentages of edentulous persons in 70-year-old cohorts in the city of Göteborg, Sweden, decreased from 51% in 1972 to 32% in 1983 (3). During almost the same 10-year period, the mean numbers of teeth in corresponding age cohorts increased from 8.5 to 11.8 in the community of Jönköping, Sweden (5).

Adults in low socioeconomic groups, at low educational levels, and with irregular dental attendance are reported to have fewer remaining teeth and to be edentulous more often than others (2, 6–9). Additionally, access to and utilization of dental health care at young ages can be anticipated to have a prolonged impact on dental status. Thus, the cumulative result of deterioration of the dentition during lifetime can be observed with considerable variation in the number of remaining teeth in elderly people.

Even though most elderly people in Sweden are healthy and live in their own homes (10), aging is associated with increased sickness and medication, which may be hazardous to oral health (2, 7, 11). Individuals with poor general health, with chronic diseases, or taking prescribed medications have been reported to have impaired dental conditions (2, 7, 9, 12, 13). Furthermore, hyposalivation, induced by several diseases and drugs, is known to increase the risk for dental caries and other oral diseases (2, 11, 14–17). Several life-style factors, such as dietary habits (18–21), nutrition (2, 22, 23), smoking (1, 3, 4, 9, 12, 19, 22, 24–29), and alcohol consumption (9, 22, 24, 30), are likewise reported to be associated with an increased risk of developing caries and periodontal disease.

An opportunity to study the relative impact on dental health of various diseases and metabolic disorders, as reflected in blood analyses, and also of general health and life-style factors, was given in a comprehensive cross-sectional study, 'Men born in 1914', in the city of Malmö in southern Sweden. Thus, the aim of the present study was to investigate the impact of these factors and some social factors on the number of remaining teeth in 68-year-old men.

Materials and methods

The study period was September 1982 to December 1983. Data on social, medical, and life-style variables were generated from the study 'Men born in 1914' (31) and have kindly been put at our disposal by the Department of Community Health Sciences, Malmö General Hospital. These data were combined with data on dental status. The design and results of the social, medical, and nutritional parts of the study (31–36) and a descriptive odontologic study (37) have been published elsewhere.

Study design

All male residents born during even months in 1914 and living in the city of Malmö, Sweden, in 1982 were eligible for the study. The cohort was selected from

Table 1. Social, medical and life-style variables studied in relation to number of remaining teeth

Social factors
Social class, marital status, education level
Dental care habits and self-assessed dental/denture treatment need
Medical factors
Self-assessed health, utilization of medical care, diagnosed disease, medication
Oral dryness
Concentrations of blood and serum components
Body mass index (BMI)
Life-style factors
Intake of energy and nutrients
'Inadequate' diet
Meals and main meals per day
Intake of sugar and sugar-rich products
Coffee/alcohol consumption
Tobacco use

the continuously updated County Council Population Register in Malmö. The inclusion criteria were met by 621 men.

After a letter of invitation, four appointments were made with each participant: 1) a visit in the home by a research assistant, who interviewed the participants about their medical history and asked for completion of questionnaires on their social situation; 2) an appointment at the Laboratory of Clinical Physiology, Malmö General Hospital, for evaluation of cardiovascular status; 3) a home visit by a nutritionist for a detailed interview on dietary habits; and 4) an appointment at the Department of Community Health Sciences, Malmö General Hospital, for a second interview about the social situation and a questionnaire on smoking habits, alcohol intake, and self-assessed health. In connection with this fourth appointment, all subjects were examined by a physician and a dentist. The oral examinations, which were restricted to 20 min per participant, were performed by one of three calibrated dentists using standard dental equipment. The dental study included questionnaires with questions about dental care habits and self-assessed dental/denture treatment need and a clinical examination. Dental status was recorded with regard to number of remaining teeth and all kinds of removable dentures. A randomly selected subgroup of 30 individuals was re-examined, and the reliability of the dental examinations was analyzed and found to be high (37).

Independent variables

The variables included in the study, divided into social, medical, and life-style factors, are presented in Table 1.

Social factors. Social classification was determined in accordance with the Swedish official system for the economically active population, the so-called SEI classification (38). Classification of economically inactive populations in accordance with this system is based on previous occupation. Three categories were used: social class I = non-manual employees and self-employed professionals and farmers; social class II = 'white-collar workers' on a low or medium level; and social class III = 'blue-collar workers'. Marital status was classified into two categories: married (including people living together) and single (including divorcees and widowers). Three educational levels were defined: 1) those with $\geq$14 years of education, corresponding to high school or university degree; 2) those with 7–13 years; and 3) those with school education $\leq$6 years. Information on dental care habits and self-assessed need for dental treatment was collected by interviews and questionnaires.

Medical factors. Information was obtained on self-assessed health, scored on a scale from 1 (poor) to 8 (excellent), utilization of medical care, diagnosed diseases, medication during the past 2 weeks, and reasons for medication. Perceived oral dryness was scored for participants who claimed that they regularly used sour-sweet candies and/or needed liquid to swallow a food bolus due to dryness in the mouth. Blood was drawn after an overnight fast, and the blood concentration of glucose and folate and the serum concentrations of triglycerides, alkaline phosphatases (ALP), urea, calcium, cholesterol, sodium, potassium, creatinine, albumin, urate, aminotransferases (ASAT and ALAT), and glutamyltransferase (GT) were analyzed using routine methods (39). The height and weight of the participants (indoor clothing without shoes) were recorded. Body mass index (BMI) was calculated as the body weight (kg) divided by the squared height (m^2).

Life-style factors. The respondents were interviewed for 45–60 min on dietary habits, using the dietary history method (40), modified for elderly people (41). This method was considered valid for the study cohort, since the average difference between estimated protein intake and 24-h urinary nitrogen excretion was as low as 3.8% (42). The daily intake of energy, nutrients, and alcohol were calculated using Swedish food table data (43–45). On the basis of minimal daily allowances in the RDA (recommended dietary allowances) (46), an 'inadequate' diet was scored when the daily average intake did not reach one or more of the following minimum requirements: 1) 0.7 g protein/kg body weight; 2) 400 mg calcium; 3) 10 mg iron; 4) 400 µg retinol; 5) 1 mg thiamine; 6) 14 µg riboflavin/kg body weight; and 7) 20 mg ascorbic acid (31). Intake of sugar and various sugar-containing beverages and other sweet products (such as biscuits, chocolates, toffees, and candies) was recorded. Average alcohol consumption was classified into three categories: 1) 1–110 g; 2) 111–250 g; and 3) >250 g of alcohol per week (35). Smokers were defined as those who reported regular smoking of cigarettes, cigars, cheroots, or pipe. 'Occasional' smokers were defined as non-smokers. The validity of alcohol and

Table 2. Description of some medical and life-style variables in the 68-year-old male study cohort ($n = 483$). Reference values are also given

	Mean	SD	Reference values
Medical variables			
Body mass index (kg/m^2)	25.0	3.3	20–25*
S-cholesterol (mmol/l)	6.0	1.1	3.4–8.3†
S-triglycerides (mmol/l)	1.5	0.9	0.6–2.2
fB-glucose (mmol/l)	5.2	1.3	3.5–5.6
Life-style variables			
Energy (MJ)	10.2	2.3	8.8–10.5*
Protein (% of energy intake)	12.5	1.9	10–15
Fat (% of energy intake)	36.5	4.7	30
Carbohydrates (% of energy intake)	45.4	5.7	55–60
Calcium (mg)	900	391	600
Alcohol (g/week)	96.6	147.3	-

* According to Swedish Nutritional Recommendations (SNR) (45).
† According to Klinisk kemi i praktisk medicin (49) (in Swedish).

smoking data has been discussed elsewhere (33, 35). Snuff dippers were defined as those who stated that they presently used snuff (yes/no).

Statistical analysis

Data are presented as proportions of individuals or, when appropriate, as means and standard deviations (SD). Chi-square tests were used to compare the number of individuals in different subgroups. Differences between group means were tested by analysis of variance (ANOVA). Correlations were evaluated by means of Spearman rank coefficients corrected for ties. To evaluate the independent effect of variables that showed significant association with the number of teeth, all such variables were included in a multiple logistic regression, including social class and marital status as confounders (47, 48). Odds ratios and their 95% confidence intervals (CI) for having ≤ 12 teeth versus >12 teeth were calculated. All variables were entered into the logistic regression model as dummy variables, continuous variables after being ranked into quintile groups on the basis of the distribution of each variable. When subjects were ranked into groups, individuals with splitting point values were placed into the nearest lower group. All tests were two-tailed, and p values ≤ 0.05 were considered statistically significant. P values >0.05 are not denoted in the tables.

Results

Participants and non-participants

Of the 621 men who satisfied the study criteria, 11 men had died after the selection and 500 (81%) participated in the basic medical study and were thereby eligible for the present investigation. Some of them declined to participate in the odontologic study for various reasons, resulting in 483 men (78%) participating in both the oral and medical parts, and 481 in the nutritional part as well.

Ninety-four of those declining to participate in the basic study accepted an interview about their social, medical, and dental situation. These interviewed non-participants more often belonged to a lower social class, had a lower educational level, and were more often single, and a higher percentage ate only two or fewer main meals per day than the participants. The non-participants had been hospitalized more frequently and more often perceived that they were in poor health than the participants (31). A larger proportion of non-participants than participants were edentulous (36% versus 24%; $p < 0.05$), but the self-assessed dental/denture treatment need was similar in the two groups (24% and 30%, respectively).

Main findings in the study group

One-hundred-and-thirteen participating men (23.4%) were edentulous and wore dentures, and one (0.2%) was edentulous but wore no denture. Forty-seven per cent of the dentate participants had removable dentures in one or both jaws. The mean number of remaining teeth was 15.0 ± 7.4 (mean $\pm$ SD) in dentate persons and 11.4 ± 9.1 when edentulous participants were included. Fifty-seven per cent of the participants were frequent dental attenders (≥ 1 visit/year), and 30% stated a need for dental/denture treatment at the time of the examination. Sixty men (13%) experienced a dry-mouth problem.

On an average, the 68-year-old men in the study cohort were on the border of being slightly obese (32, 45), had medium high cholesterol and triglyceride values for their age, and normal blood glucose concentrations (Table 2) (49). Almost 92% of the 460

Table 3. Number of teeth (mean ± SD) in dentates and prevalence of edentulousness by social class, educational level, marital status, frequency of dental visits, and assessed dental/denture treatment need

	Dentates (n = 369)			Edentulous (n = 114)		
	n	No. of teeth	P value*	n	%	P value†
Social class						
I	63	19.4 ± 6.1	<0.001	8	11.3	<0.001
II	142	15.5 ± 7.2		30	17.4	
III	163	12.7 ± 7.2		76	31.8	
Educational level						
≥14 years	19	20.6 ± 5.4	<0.001	2	9.5	<0.01
7–13 years	305	15.1 ± 7.4		85	21.8	
≤6 years	45	11.7 ± 7.3		26	36.6	
Marital status						
Married	301	15.4 ± 7.5	<0.05	85	22.0	
Single	68	13.3 ± 7.1		29	29.9	
Visit to dentist						
≥1/year	275	16.7 ± 6.9	<0.001	7	2.5	<0.001
<1/year	23	13.1 ± 6.9		8	25.8	
Emergency	70	9.0 ± 6.3		99	58.6	
Dent. treat. need						
No	259	16.3 ± 7.2	<0.001	74	22.2	
Yes	106	12.1 ± 7.1		39	26.9	

* ANOVA.
† Chi-square test.

probands answering the question about perceived health felt 'very' or 'fairly healthy' (range, 5–8), and only 7 (2%) felt 'very ill' (range, 1–2) at the time of the examination. Forty-six per cent did not take any prescribed medication. In general, the average intake of energy and nutrients was well above the recommended daily allowances (44–46), but large variations were observed (32) (Table 2). 'Inadequate' diet was scored in 95 (20%) of the respondents; 54 of them had 'inadequacies' of more than one of the seven selected nutrients. The proportion of men with intakes below the minimal recommendations was 12% for protein, 8% for calcium, 6% for thiamine, 10% for riboflavin, 1% for ascorbic acid, and none for iron or vitamin A.

Social factors related to number of teeth

The results are presented in Table 3. Social class, educational level, and marital status, along with the habits and needs of dental treatment, all had an impact on the number of teeth. Thus, participants in a lower social class, at low education level, and those with less frequent dental attendance were more often edentulous and had fewer teeth, if dentate, than others. Further, dentate individuals living alone and those reporting need for dental treatment had on an average fewer remaining teeth than others.

Medical factors related to number of teeth

The results are presented in Table 4. The 39 individuals with a poor self-assessed health (scores 1–4) had on an average fewer remaining teeth (8.2 ± 8.5 versus 11.7 ± 9.1; $p = 0.02$) than the others (scores 5–8). This was explained by a higher proportion of participants with poor health being edentulous than among those stating a good health, since the number of teeth in dentates did not differ significantly between those stating 'poor' or 'better' health. The prevalence of edentulousness was higher ($p < 0.001$) among those attending a physician at least four times during the preceding year than among less frequent attenders, but in dentate participants the number of remaining teeth was unrelated to the number of visits per year. Men with diabetes (n = 24) had significantly fewer teeth (7.2 ± 8.1

Table 4. Number of teeth (mean ± SD) in dentates and prevalence of edentulousness by various medical variables

	Dentates (n = 369)			Edentulous (n = 114)		
	n	No. of teeth	P value*	n	%	P value†
Perceived health						
Range 5–8 (good)	327	15.2 ± 7.4		95	22.5	<0.05
Range 1–4 (poor)	24	13.3 ± 7.0		15	38.5	
Visits physician						
<4 latest year	293	15.1 ± 7.4		74	20.2	<0.01
≥4 latest year	76	14.6 ± 7.8		40	34.5	
Diabetes						
No	354	15.1 ± 7.4		105	22.9	
Yes	15	11.5 ± 7.4		9	37.5	
Oral dryness						
No	325	15.1 ± 7.4		88	21.3	<0.01
Yes	37	13.9 ± 7.0		23	38.3	

* ANOVA.
† Chi-square test.

Table 5. Correlation between number of teeth and concentrations of selected blood components in the total cohort ($n = 483$). Z and r values are corrected for ties

	Spearman correlation		
	Z	r	P value
S-triglycerides	−2.31	−0.11	<0.05
fB-glucose	−2.08	−0.1	<0.05
S-ALP*	−3.04	−0.14	<0.01
S-urea	2.02	0.09	<0.05

* ALP = alkaline phosphatase.

versus 11.7 ± 9.1; $p < 0.05$) than non-diabetics. However, the number of teeth in dentates and prevalence of edentulousness showed no significant differences between diabetic and non-diabetic men.

The questions on perceived oral dryness were answered by 473 participants, and 60 of these (13%) were classified as having a dry-mouth problem. These 60 individuals had on an average fewer remaining teeth (8.6 ± 8.7 versus 11.9 ± 9.0; $p < 0.01$) than the others, mainly due to a higher proportion edentulous subjects among the 'dry-mouth' participants.

No statistically significant relations were found between number of teeth and other medical factors in terms of diagnosed chronic diseases or amount or type of medication (diuretics, hypertensives, tranquilizers, and analgetics) or BMI (data not shown).

Table 5 shows the results of the correlation analyses in the total cohort between number of teeth and concentrations of blood components for which statistically significant associations were found. Thus, weak but statistically significant negative correlations were found between numbers of remaining teeth and concentrations of both triglycerides and ALP in serum and glucose in blood, whereas a weak positive correlation was found between number of teeth and the concentration of urea in serum. Thus, non-significant correlations were found between number of teeth and total cholesterol, calcium, sodium, potassium, kreatinine, albumin, urate, ASAT (aspartate aminotransferase), ALAT (alanine aminotransferase), GT (glutamyl-transferase) in serum and folate in blood.

Table 6. Life-style factors related to number of teeth in dentates and to prevalence of edentulousness

	Total,	Dentates ($n = 369$)				Edentulous ($n = 114$)		
	n*	n†	Mean	SD	P value‡	n	%	P value§
'Inadequate' diet								
No	386	301	15.1	7.4		85	22.0	
Yes	95	67	14.5	7.8		28	29.5	
Vitamins								
Regularly	57	50	15.9	7.9		7	12.3	
Never	402	302	14.7	7.3		100	24.9	
Coffee (cups/day)								
0	18	16	15.0	8.1		2	11.1	
1–2	55	44	18.0	6.2	<0.001	11	20.0	
3–6	310	231	15.2	7.4		79	25.5	
≥7	98	77	12.5	7.3		21	21.4	
Alcohol (g/week)								
0–110	342	264	15.4	7.3	<0.05	78	22.8	
111–250	99	71	14.7	7.9		28	28.3	
>250	41	33	12.5	7.2		8	19.5	
Smoking								
Never	88	77	17.6	6.4	<0.001	11	12.5	<0.05
Former	223	166	15.3	7.4		57	25.6	
Current	171	125	13.0	7.6		46	26.9	
Years of smoking								
0	88	77	17.6	6.4	<0.001	11	12.5	<0.01
1–10	29	24	16.2	7.7		5	17.2	
11–40	180	137	15.2	7.3		43	23.9	
>40	183	128	12.9	7.6		55	30.1	
Snuffing								
No	450	341	15.2	7.4		109	24.2	
Yes	30	25	12.3	6.7		5	16.7	

* Number of participants answering the questions.
† Number of dentate participants.
‡ ANOVA.
§ Chi-square test.

Life-style factors related to number of teeth

The results are presented in Table 6. The number of remaining teeth in dentates or the prevalence of edentulousness did not differ between groups stratified by various dietary variables, such as number of meals, frequency of sucrose-rich snack products, the score 'inadequate diet', or regular supplementation with vitamins, nor did the average intake of energy or nutrients differ between groups with various number of teeth (data not shown). Among dentate coffee consumers, an increased consumption of coffee was significantly related to a lower number of teeth left ($p < 0.001$). No difference was seen in use of sucrose between 'high' and 'low' consumers of coffee. Dentate participants consuming 0–110 g alcohol per week had more remaining teeth than those drinking >250 g alcohol per week (15.4 ± 7.3 versus 12.5 ± 7.2; $p < 0.05$). The proportions of edentulous men were similar among high and low consumers of coffee or alcohol.

Eighteen per cent of the participating men had never smoked, 46% were former smokers, 36% were current smokers, and 6% were snuff dippers. Among current smokers the median consumption was 10 cigarettes per day, 5 cigars per day, or 50 g pipe tobacco per week. The number of teeth was strongly related to smoking, measured both as present habit and total exposure time. Thus, men who had never smoked had on an average two teeth more than former smokers ($p < 0.01$), who had two more teeth than current smokers. Further, a lower prevalence of edentulousness was found among those who had never smoked compared with both current and former smokers. No significant differences were found concerning number of teeth in dentates or prevalence of edentulousness between snuff dippers and the others.

Multivariate logistic regression

The following variables, which showed significant associations with dental status, were included in a multiple logistic regression analysis: social class, educational level, marital status, dental care habits, dental treatment need, self-assessed health, frequency of medical attendance, diabetes, perceived oral dryness, concentrations of triglycerides, urea, and ALP in serum and glucose in blood, coffee and alcohol consumption, and smoking habits. When all these variables were included in the model, the following six variables had an independent effect on the number of teeth left (≤12 teeth, $n = 254$ versus >12 teeth, $n = 229$): social class, frequency of dental attendance, smoking habits, and concentration of triglycerides and urea in serum and glucose in blood (data not shown). These six variables were kept in the logistic model (Table 7). The risk of having ≤12 teeth was 3.7 times higher in those belonging to the lowest social class than in those in the highest class. The odds ratio (OR) for having ≤12 teeth was 17.8 for men seeing a dentist on an emergency basis only, and 3.9 for men seeing a dentist less than once a year, compared with those seeing a dentist yearly. Men belonging to the two highest quintiles on the basis of triglyceride concentration had a higher risk of having ≤12 teeth left (OR = 2.2, respectively) than men belonging to the lowest quintile. An opposite trend was seen for urea concentration in serum. The OR for having ≤12 teeth decreased consecutively by increasing quintiles of urea concentration. However, the OR only reached statistical significance in the initial model and not in the reduced model. With regard to the association between the number of teeth left and the glucose concentration in blood, no consistent pattern for the ORs was seen between the five quintiles. Thus, men belonging to the second and fourth quintiles on the basis of glucose distribution had significantly higher risk of having few teeth in the expanded model than men belonging to the lowest quintile. In the reduced model a similar pattern was seen, although only a borderline significance was reached.

Table 7. Odds ratios and their 95% confidence intervals (CI) for having 12 or less teeth, as compared with 13 or more teeth left. Only the six variables having an independent effect on the number of teeth in a multiple logistic regression analysis are presented

	Odds ratio	95% CI
Social class		
I	1.00	
II	2.39	1.10–5.20
III	3.65	1.70–7.83
Visit to dentist		
≥1/year	1.00	
<1/year	3.91	1.69–9.06
Emergency	17.83	9.80–32.42
Smoking		
Never	1.00	
Former	2.60	1.34–5.03
Current	3.02	1.50–6.07
S-triglycerides		
1st quintile (low)	1.00	
2nd quintile	1.17	0.56–2.45
3rd quintile	1.06	0.49–2.26
4th quintile	2.15	0.99–4.67
5th quintile	2.17	0.99–4.75
S-urea		
1st quintile (low)	1.00	
2nd quintile	1.26	0.60–2.67
3rd quintile	0.90	0.43–1.91
4th quintile	0.59	0.28–1.24
5th quintile	0.51	0.24–1.09
fB-glucose		
1st quintile (low)	1.00	
2nd quintile	1.99	0.97–4.07
3rd quintile	1.00	0.46–2.14
4th quintile	2.07	1.01–4.24
5th quintile	1.26	0.57–2.77

Discussion

In the present study of 68-year-old men 78% of the total

sample was examined clinically, but information from interviews could be obtained from additionally 15%. This must be considered a high and acceptable participation rate and is almost the same as in the study of 70-year-olds in Göteborg (2). The prevalence of edentulousness was higher among those who refused to participate in the dental examination than among those who participated, which is in agreement with other studies (1, 7, 50, 51).

Interactions between general diseases, medication, and oral diseases are complex. Pathologic processes and treatment of diseases may be hazardous to oral health by lowering the resistance in the tissues or by disturbing the ecology in the oral cavity. Disorders in the state of general health might also secondarily have an impact on, for example, frequency of dental attendance, oral hygiene, dietary intake, and life style.

The self-assessed general health situation among the 68-year-old men in the present study was relatively good. Almost 92% felt 'very' or 'fairly healthy', which is around 10% higher than reported for a randomly selected male population aged 65 years and more in southern Sweden (7) and in a Danish study (13). This is in accordance with the fact that 46% of the participants in the present study did not use any medication, compared with 30% in the cited Swedish study (7) and 44% in the Danish study (13). Poor self-assessed general health, high number of visits to physicians, and oral dryness were related to fewer teeth in the present study. These results are in agreement with those from several other studies (2, 7, 9, 11, 14, 15).

A battery of blood markers was selected in the main study to screen for various organic diseases or dysfunction in, for example, the kidneys, liver, and thyroid gland and in gastrointestinal, cardiovascular, and bone tissues. The blood substances are also indicators of inflammation, infection, malnutrition, malignant processes, abuse of alcohol or drugs, and metabolic disorders, such as diabetes and hyperlipidemia. The rationale for relating these variables to the number of teeth is twofold. First, they may represent a disease that may compromise dental health. Secondly, some markers, such as the blood lipids, may be regarded as reflectors of 'life-style'. Some of the blood components are also present in saliva and crevicular fluid and may therefore be presumed to correlate to dental state. High levels of glucose, secreted via the salivary glands and the crevicular fluid have, for instance, been considered a risk factor for development of dental caries (2, 11). This was reflected in the present study by the negative correlation between glucose in blood and number of remaining teeth. Increased blood glucose values are frequently associated with increased levels of serum triglycerides. In this study, S-triglycerides, which in part reflect the dietary fat situation, had an independent explanatory effect on the number of teeth, which also has been indicated in the two other studies (2, 11).

In the present study a positive correlation between urea in serum and number of teeth was found. Daily intake of protein and the balance between synthesis and degradation of protein is reflected in the urea concentration in serum. Urea is known to be one of several pH-raising components in dental plaque in vitro, but no caries-protective effect has been found in clinical studies in man (52). One may speculate that urea secreted via saliva and the crevicular fluid, which is highly related to the serum concentration (53), may affect the de- and re-mineralization of enamel and dentin. However, further studies are required in this field before any conclusions can be drawn. On the basis of the present study, it cannot be ascertained whether the associations are causative or covariations.

Life-style factors and 'health behavior' may be reflected by the body mass index (BMI). Studies in middle-aged (22) and elderly (23) women in the southern part of Sweden and in 25- to 64-year-olds in northern Sweden (54) have shown that obesity is associated with increased prevalence of edentulousness and with lower numbers of remaining teeth. No such association could, however, be seen in this male population. In some studies (22, 23) higher intakes of energy, and especially of fat, have been found among the edentulous than among individuals with many remaining teeth. A lower intake of ascorbic acid among the edentulous has been observed in some studies (19, 22, 55). These findings were not verified in the present study.

The frequency of intake of sugar-rich products was not reflected in the number of remaining teeth in this population, nor was the total number of meals per day. This is in agreement with many other studies trying to correlate dental caries to sugar intake (18, 22, 56). Almost 20% of the subjects were considered to have a nutritionally inadequate diet, a proportion that is in close agreement with other observations (2, 23). The same proportions were found among both dentate and edentulous men.

Smoking was negatively associated with the number of remaining teeth, which is in agreement with many other studies (1, 2, 4, 9, 25). However, still other studies have found no or only a little evidence of a relationship between tobacco use and dental or periodontal state (11, 57, 58). An elderly population is heterogeneous with regard to smoking habits, with large variations in the amount and the duration of exposure, especially among 'former smokers'. The most valid information of associations between dental state and smoking habits may therefore be obtained when analyzing the difference between 'never smokers' and 'current smokers', as in the present study. Moreover, the effects on dental state can be expected to be more marked in an elderly population, with a longer exposure time, than in a younger one, which supports the fact that smoking is a negative factor with regard to dental state. The number of cigarettes smoked per day was, however, not related to the number of teeth in this population. This may be because other factors, such as socioeconomic, education, and

way of life are strongly related to dental health and thus may obscure the influence of weaker factors like smoking.

Studies on the relationship between alcohol consumption and dental health are few. However, in an American study of 18- to 60-year-olds, Krantzler et al. (30) reported correlations among males with regard to tooth loss, carious teeth, and periodontal disease, on the one hand, and alcohol-related indicators, on the other hand. They concluded that 'heavy drinking may contribute to dental pathology'. High consumption of alcohol was associated with low numbers of remaining teeth in the present study as well. However, several studies show a higher prevalence of edentulousness among individuals never consuming alcohol than among consumers (9, 22, 59). These contradictory results indicate that alcohol consumption, analogous to smoking, may cluster with other background factors and confound the analyses.

The main conclusion from the present study is that there are no simple relations between dental state and medical and life-style factors in this elderly male population. A series of events in a long life span obscure the situation. However, the most noticeable results and conclusions may be summarized as follows:

* Questions on self-assessed general health and frequent medical attendance may add valuable information when analyzing the dental state in elderly patients.
* Twice as many edentulous as dentate participants reported oral dryness.
* The concentrations of some blood substances are associated with the dental state, but only triglycerides and urea had an independent explanatory effect on the number of remaining teeth.
* No relations were found between numbers of teeth and dietary factors, except coffee consumption.
* Smoking and high consumption of alcohol were related to fewer remaining teeth.
* A close cooperation between odontology and medicine would be desirable with regard to prevention, oral treatment, research, and education.

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