

On the relations between dietary habits, nutrients, and oral health in women at the age of retirement

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Norlén P, Steen B, Birkhed D, Björn A-L. On the relations between dietary habits, nutrients, and oral health in women at the age of retirement. *Acta Odontol Scand* 1993;51:277-284. Oslo. ISSN 0001-6357.

Intake of energy, nutrients, food items, and various oral health-related factors were studied in 116 women about 5 months before the age of their occupational retirement. The results were analyzed with oral health aspects as both independent and dependent variables. Edentulous women had higher intake of fat and higher coffee consumption than dentate ones, and dentate subjects with 1-20 teeth had higher body mass index than those with ≥ 21 remaining teeth. Individuals with high intake of energy and carbohydrates had more decayed tooth surfaces than those with low, but different intakes of other nutrients were not reflected in the studied tooth variables. Daily consumers of sweet beverages and sugar in coffee/tea had more decayed tooth surfaces than non-consumers. Nineteen of the 116 women with 'inadequate' diet did not differ from the others with regard to any of the studied tooth variables. Women with self-assessed chronic oral dryness had higher intake of energy, protein, iron, thiamine, and vitamin D than those without this problem. Smoking habits were reflected in the DMFS index but not in any of the other studied oral health-related variables. It was concluded that intake of energy- and sugar-rich products, frequencies of intakes, and oral dryness seem to be of greater importance for oral health than intake of specific nutrients, at least in this specific cohort. □ *Caries prevalence; food items; oral dryness; periodontal disease; smoking habits*

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Dietary habits are influenced by many different factors of social, medical, and cultural origin. Adequate nutrition is, throughout life, important for psychologic and physiologic well-being and for resistance to disease and optimal healing. In general, it can be assumed that dietary habits are quite stable in healthy adult people. For that reason, dietary habits and nutrients may be one explanatory factor for the individual variation of oral health in elderly populations (1-5).

The validity of the methods chosen to obtain reliable dietary data is of great importance, since many factors influence the results. Difficulties in obtaining reliable data on, for instance, stated intake frequency of various cariogenic food products are well known. Equally, the oral health variables should be well defined and not subjected to

personal judgement. Different methods may be one explanation why studies on relationships between diet and oral health have shown contradictory results (5).

There are two aspects of dietary habits and nutrients relative to oral health. Less suitable dietary habits may influence the oral health in a negative manner, and an impaired oral health with, for instance, chewing difficulties, oral dryness, and so forth may affect the intake of some essential nutrients and food products (6). Therefore, it might be justified to relate oral health, designed both as dependent and independent variables, to dietary habits and nutrients.

The aim of the present study was to analyze relationships between some oral health-related factors and dietary habits and intake of energy and nutrients in a group of women at the age of retirement.

Materials and methods

Population

During 1985–86, a comprehensive medical, nutritional, psychologic, and dental study of women retiring from work outside the home was carried out in Malmö, Sweden. The study included all municipally employed women living in Malmö, Sweden, born in 1921–23 and with established dates of retirement between 1 December 1985 and 31 January 1987. According to Swedish law, the date of retirement can be individually chosen between the ages of 63 and 65. All women about to retire within 7 months were included. Those who had been working for less than 10 h per week or had been on sick leave during the past 6 months were excluded. Altogether 165 women fulfilled these criteria. Most of the women worked in health and social services. They were invited to participate, free of charge, in a medical, nutritional, psychologic, and odontologic examination conducted at Värnhem Hospital, Malmö, a geriatric university hospital.

Further details regarding participation and non-responders have been given by Steen et al. (7) and Norlén et al. (8). Results of the nutritional study have been reported by Steen et al. (9), the dental studies by Norlén et al. (8, 10), and the medical and psychologic studies by Östberg in 1992 (11).

Dietary interview and definitions

A detailed interview was performed by a dietitian. The method used was the dietary history, first described by Burke (12), and later modified for elderly people by Steen et al. (2). For each food item the subjects were asked about the frequency of consumption and about the amount/size of each portion. The answers were double-checked throughout the interview. The variables included in the analyses are shown in Table 1. The average duration of the interviews was 50 min.

Intake of energy and nutrients was computed, mainly in accordance with food tables. Earlier studies show that the results of the dietary interview in elderly populations, as performed in this study, are valid

Table 1. Diet- and oral health-related variables included in the study

Diet-related variables	
Energy	MJ per day
Nutrients	Protein, fat, carbohydrates, calcium, phosphate, selenium, iron, vitamin A, vitamin D, thiamine, riboflavin, ascorbic acid
Food items	Sweet beverage, biscuits, sugar, marmalade, sweets, coffee, bread, 'müsli', meat, fresh vegetables, fresh fruits, peanuts
Food intake	Meals and main meals per day
	'Inadequate' diet
	Body mass index (BMI)
Oral health-related variables	
Oral health	Number of remaining teeth, DMFT, DMFS, DS, removable dentures, and periodontal pockets ≥ 5 mm
Oral dryness	Self-assessed oral dryness
Smoking habits	Previous or present consumption of cigarettes

(2), on the basis of comparisons between 24-h urinary nitrogen excretion and dietary intake of protein (13).

Body mass index (BMI) was used to express the body weight (kg), divided by the squared body height (m^2).

On the basis of data from the literature (14, 15), the women were defined as having 'inadequate' diet if they did not reach one or more of the following seven minimum requirements: daily intake of 0.7 g protein/kg body weight; calcium, 400 mg; iron, 10 mg; vitamin A, 400 μ g retinol; thiamine, 1 mg; riboflavin, 14 μ g/kg body weight; and ascorbic acid, 20 mg (16).

Oral health examination and interview

All recordings were made by the same examiner (P. Norlén). Missing (M), decayed (D), and filled (F) teeth (T) and tooth surfaces (S), removable dentures, and mesial periodontal pockets (probing depths) ≥ 5 mm were recorded. Missing tooth surfaces were estimated by the 4/5 system in the

DMFS index. Radiographs of the premolar-molar regions were obtained by bitewing technique, using an Eggen film holder (17). Caries was diagnosed and recorded when a manifest lesion (cavity) was found clinically or when found radiographically to be penetrating into the dentin. Previous and present consumption of cigarettes was recorded, and questions were asked about self-assessed oral dryness ('yes', 'occasionally', or 'never') at the time of the examination. A pilot study including 12 women was carried out 1 week before the start of the main study, to train the examiner and check the methods. The oral health-related variables included in the study are shown in Table 1. Further details have been given by Norlén et al. (8).

Statistical methods

Means were compared by using Student's *t* test and analysis of variance (ANOVA). *P* < 0.05 was considered statistically significant. In the analyses the oral-health related variables were designed both as independent and as dependent.

In some analyses with tooth variables as dependent, the population was ranked and divided into quartiles with regard to the individual intake of energy and nutrients. The first quartile comprised individuals with low intake. Subjects with the same intake at the splitting point were placed in the closest lower quartile.

Results

Forty-nine women declined to participate in the clinical examination, but 40 of them agreed to a telephone interview, as reported earlier (8). Thus, the number of individuals participating throughout the whole study was 116 (70.3%).

Results from the nutritional part of this study have been published elsewhere (9) and can be summarized as follows. Most women had acceptable food habits. The average intakes of energy and nutrients were relatively high and above the American Recommended Dietary Allowances (RDA) values, with the exception of vitamin D,

Table 2. Mean intakes of energy, some nutrients, coffee, main meals/day, and body mass index (BMI) in subgroups with regard to numbers of teeth, smoking habits, and self-assessed oral dryness. *P* < 0.05 is denoted by an asterisk

No. of teeth	n	Energy (MJ)		Fat (g)		Iron (mg)		Thiamine (mg)		Vit. D (µg)		Coffee (cups)		Main meals (per day)		BMI (kg/m ²)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
0	14	8.6	1.8	96.4	27.8	16.0	3.6	1.6	0.6	3.8	1.8	5.3	1.9	1.1	0.5	26.1	5.0
1-20	47	8.5	2.2	78.0*	19.0	15.2	3.7	1.5	0.4	3.0	1.4	4.7*	1.9	1.2	0.4	26.8	3.8
>20	55	8.6	1.7	82.1	23.2	15.7	3.3	1.5	0.4	3.0	1.5	4.1	1.9	1.2	0.5	25.1*	3.5
Smoking																	
Yes	29	8.7	2.3	79.1	19.5	15.5	3.9	1.5	0.4	2.8	1.4	4.7	2.0	1.0	0.2	25.3	3.4
No	87	8.5	1.7	83.2	23.7	15.5	3.4	1.5	0.4	3.2	1.6	4.4	1.9	1.3	0.5	26.1	4.0
Oral dryness																	
Chronic	13	9.9	3.2	77.6	18.3	17.7	5.2	1.8	0.6	4.1	1.5	4.0	1.7	1.3	0.5	26.4	3.7
Never/occ.	103	8.4*	1.6	82.8	23.2	15.2*	3.2	1.5*	0.3	3.0*	1.5	4.6	2.0	1.2	0.5	25.9	3.9

which was low, and ascorbic acid, which was very high compared with the RDA. The proportions of energy from protein, fat, and carbohydrates were acceptable, although that from fat was slightly above the Swedish recommended value of <35 energy%.

The methods chosen for the clinical oral examination were checked together with 2 other dentists in a pilot study, including 12 women.

The population comprised 102 dentate and 14 edentulous women.

Oral health as an independent variable

The number of remaining teeth, smoking habits, and oral dryness related to various dietary variables are shown in Table 2. Only the variables showing statistical significances are included. Edentulous subjects had higher intake of fat than dentate ones ($p < 0.05$). They also consumed more cups of coffee/day than those with ≥ 21 remaining teeth ($p < 0.05$). Dentate women with 1–20 remaining teeth had higher BMI than those with ≥ 21 remaining teeth ($p < 0.05$). Smokers had a lower daily intake of main meals than non-smokers ($p < 0.05$). Women with chronic oral dryness had a higher intake of energy, protein (data not shown), iron, thiamine, and vitamin D ($p < 0.05$) than the others.

The presence of mesial periodontal pockets (probing depths) ≥ 5 mm was not related to the intake of energy, nutrients, or food items.

Women with removable dentures ($n = 46$) had a more frequent intake of coffee than the others (5.0 versus 4.2; $p < 0.05$) but did not differ from the others with regard to the intake of other food items, energy, nutrients, or smoking habits.

Smokers did not differ from non-smokers with regard to the intake of energy, nutrients, food items, or mouth dryness.

Oral health as a dependent variable

The differences among the tooth variables in the extreme groups (1st and 4th quartiles) with regard to the individual intake of energy and nutrients were analyzed (Table 3). Women with high intake of energy had a significantly higher mean number of decayed tooth surfaces than women with low intake. The differences between the tooth variables in the quartiles with high and low daily intakes of protein/kg, fat, and carbohydrates were not statistically significant. However, women with a high average intake of carbohydrates (4th quartile) had significantly more decayed tooth surfaces than those in the other three quartiles (5.3 versus 3.1; $p < 0.01$). Analyses concerning the intakes

Table 3. Mean numbers of teeth and DMFT in the total group ($n = 116$) and mean numbers of DMFS and DS of the dentate participants ($n = 102$) in groups with low (1Q = 1st quartile) and high (4Q = 4th quartile) intakes of energy, protein/kg, fat, and carbohydrates. $P < 0.05$ is denoted by an asterisk

	Total ($n = 116$)						Dentate ($n = 102$)				
		<i>n</i>	No. of teeth		DMFT		<i>n</i>	DMFS		DS	
			Mean	SD	Mean	SD		Mean	SD	Mean	SD
Energy (MJ)	1Q	29	16.5	9.2	24.8	2.8	26	94.7	21.3	2.7	3.0
	4Q	29	18.1	9.4	25.4	2.9	25	94.0	19.2	5.6*	4.7
Protein/kg (g)	1Q	29	17.8	8.4	24.5	2.8	26	92.3	19.0	3.0	3.2
	4Q	28	19.0	8.5	25.4	3.0	25	93.5	16.5	4.4	4.0
Fat (g)	1Q	29	17.1	8.4	24.9	2.8	26	93.9	19.9	4.0	4.3
	4Q	29	16.6	10.4	25.1	3.0	25	88.3	17.1	4.0	3.6
Carbohydrates (g)	1Q	30	18.1	9.6	24.7	3.1	27	90.6	23.6	3.0	3.0
	4Q	29	17.4	10.5	24.8	3.2	25	89.4	18.2	5.0	4.8

Table 4. Mean numbers of teeth and DMFT in the total group ($n = 116$) and mean numbers of DMFS and DS in the dentate participants ($n = 102$) in accordance with frequency of intakes of various food items. $P < 0.05$ is denoted by an asterisk

	Total ($n = 116$)					Dentate ($n = 102$)				
	<i>n</i>	No. of teeth		DMFT		<i>n</i>	DMFS		DS	
		Mean	SD	Mean	SD		Mean	SD	Mean	SD
Sweet beverage										
Daily	44	17.5	8.6	24.8	3.2	40	94.0	21.0	4.8	4.5
Seldom	72	17.3	9.3	25.0	2.9	62	92.9	18.9	2.8*	2.8
Biscuits										
Daily	48	17.4	8.6	25.3	2.8	43	95.7	19.5	4.2	4.3
Seldom	68	17.3	9.4	24.7	3.2	59	91.6	19.8	3.2	3.2
Sugar										
Non-user	72	18.8	8.3	24.8	2.8	67	92.4	18.9	2.9	3.1
User	44	15.1*	9.8	25.2	3.4	35	95.1	21.2	4.8*	4.5
Sweets										
Daily	33	17.3	9.0	25.6	2.6	30	96.2	21.3	3.8	4.4
Seldom	83	17.4	9.1	24.7	3.2	72	92.1	19.0	3.5	3.4
No. of meals										
≤ 5 /day	75	16.1	9.2	25.4	3.1	65	100.5	22.2	3.6	3.8
> 5 /day	41	19.8*	8.4	24.1*	2.8	37	92.0*	19.7	3.5	3.6
No. of main meals										
< 2 /day	92	17.5	9.0	24.9	3.1	81	98.1	22.1	3.2	3.4
≥ 2 /day	24	17.1	9.4	25.0	2.8	21	95.0	20.2	5.1*	4.6

of iron, calcium, phosphate, selenium, retinol, thiamine, riboflavin, ascorbic acid, and vitamin D in the extreme groups did not show any differences among the tooth variables (number of teeth, DMFT, DMFS, and DS).

Table 4 shows oral health variables in the groups with different intake frequencies of some selected food items, meals, and main meals per day. Women who consumed sweet beverages daily had more decayed tooth surfaces than those who answered that they only occasionally used this type of product. Intake of biscuits and sweets was not reflected in the dental state. Women who never used sugar or honey in coffee/tea had more remaining teeth and less decayed surfaces than daily users of these products. Women who had ≤ 5 main meals + between-meals/day had fewer remaining teeth and higher DMFT and DMFS scores than those with > 5 meals/day. Women with ≥ 2 main meals/day had more decayed tooth surfaces than those with < 2 main meals/day.

Smokers had higher DMFS index (105.1

versus 95.0; $p < 0.03$) than non-smokers but did not differ with regard to the other tooth variables or the intake of energy, nutrients, or food items.

Nineteen of the 116 women (16%) had 'inadequate' diet (according to the definitions given above); 8 of them showed 'inadequacies' for more than 1 of the 7 selected nutrients. None of these two subgroups differed from the others with regard to any of the studied tooth variables.

Smoking habits and oral dryness were not related to the frequency of mesial periodontal pockets ≥ 5 mm.

Discussion

The participants in this study were all women, about the same age, still working, and living in the same city. Their general health may therefore be above the average, since it can be assumed that some women retire because of illness before the age of 63 and were, thus, not included in this study.

The oral health situation in this cohort may also reflect the abundant availability of dental care in the city of Malmö. Most of these municipally employed women worked within the health and social service sector and may have above average awareness with regard to good and bad dietary habits.

When the number of remaining teeth was related to intake of energy and nutrients, the only significant relationship found was the higher intake of fat among the edentulous women than among the dentate ones. The same result was reported in a study of women aged 38–60 years in Gothenburg, Sweden, by Halling et al. (6). However, these authors also reported higher intakes of energy and calcium and lower intake of ascorbic acid among the edentulous women than among those with many remaining teeth (≥ 16). A lower intake of ascorbic acid among the edentulous is in agreement with the findings in a study performed in the United States in 1971–74 (18), in which the 24-h recall method was used. Mäkilä (19) also found a tendency towards lower serum levels of ascorbic acid among edentulous than among dentate participants. Österberg & Steen (16), however, reported no correlations between subgroups according to the Eichner index (including modified Eichner index) and intakes of energy or single nutrients in 70-year-old people.

Österberg & Steen (16) reported a higher proportion of subjects with inadequate diet among the edentulous in their study. This was not confirmed in the present study. The small number of edentulous participants in the present study may explain the discrepancy.

Österberg & Steen (16) could not find any relationship between oral dryness and intake of various food items, which is in agreement with the present study. The higher intake of energy among women who claimed chronic oral dryness in the present study, however, may be due to a choice of food that is easier to chew and digest, often rich in calories. A different choice of specific food items could, however, not be found among the relatively few food items included in the study. The high energy intake may also be one of the explanations for higher intakes of other

nutrients. As reported earlier (8, 10), these women with assessed oral dryness also differed from the others in other ways, such as high drug consumption, feelings of strain and restlessness, presence of definable (diagnosed) disease, different serum and blood levels of some specific substances, and so forth.

When analyzing the effect of dietary habits on oral health, it may be adequate to use the number of decayed tooth surfaces (DS), reflecting the actual caries situation. Dental caries has indeed a multifactorial causality, but the daily number of meals or snacks seems to be the most important factor in the pathogenesis (5). This may also be reflected in the high number of DS found in women with daily consumption of sweet beverages and sugar. The results of this study indicate that high intake of carbohydrates is related to a high number of decayed tooth surfaces. It should be pointed out that only the amount of carbohydrates was examined in this study, not the type or concentration.

Specific food items of the between-meals were not studied separately, but women with more than five daily food intakes had more remaining teeth and lower DMFT and DMFS than the others. One possible explanation may be that those food intakes were of 'good' quality in this cohort, reducing the need for sucrose-rich products between the meals. Another explanation may be that DMFT and DMFS do not reflect the actual caries situation but more the cumulative effect of the disease during the whole lifetime. This may also explain why Papas et al. (20), in a study of 60- to 82-year-olds, did not find any correlation between frequency of food intake and coronal or root decay.

Another study by Papas et al. (21) reported that the DMFS index was significantly inversely correlated to intake of fat, which was also indicated in this study. This correlation was, however, statistically not significant.

Smoking has been reported to have a negative influence on oral health (18, 22–26). The results from the American study mentioned above (18) showed a clear significant relationship between smoking and periodontal disease, and other studies have reported

positive correlations between smoking and caries prevalence (24, 25), loss of teeth (22, 23), prevalence of mucosal lesions (26), and so forth. In the present investigation the women who were current smokers had a higher DMFS index than the non-smokers. Smoking habits, however, did not show any influence on the other tooth variables, including periodontal pockets (probing depths) ≥ 5 mm. One explanation of this discrepancy may be the relatively low consumption of cigarettes among the women in the present study (10).

As for the periodontal disease, the diagnostic method used in this study may be somewhat crude, since it may include treated and comparatively healthy sites.

In conclusion, intake of energy- and sugar-rich products, frequencies of intakes, and oral dryness seem to be of greater importance for oral health than intake of specific nutrients, at least in this specific cohort. Edentulousness seems to be related to the intake of fat. Periodontal disease, as measured in the present study, was not related to the intake of energy, nutrients, various food items, or to smoking habits. Smoking habits showed a weak relationship to oral health in this cohort and were only reflected in the DMFS index.

Acknowledgements.—This study was supported by grants from the Swedish Ministry of Health and Social Affairs, the Commission for Social Research, and the City of Malmö, Sweden. We appreciate the collaboration with Britt Kardell, Kerstin Nilsson, Eva Robertsson, Henrik Östberg, and the friendly staff at Värnhem Hospital, Malmö.

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Received for publication 19 January 1993