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Dietary patterns and survival in older Dutch women

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ABSTRACT

Background: The need to gain insight into prevailing eating patterns and their health effects is evident.

Objective: This study aimed to identify dietary patterns and their relation to total mortality in older Dutch women.

Design: A principal component analysis of 22 food groups was used to identify dietary patterns in 5427 women aged 60–69 y who were included in the Dutch European Prospective Investigation into Cancer and Nutrition-Elderly cohort (follow-up: ≈8.2 y). Mortality ratios for 3 major principal components were assessed by using Cox proportional hazard analysis.

Results: The most relevant principal components were a Mediterranean-like dietary pattern (high intakes of vegetable oils, pasta and rice, sauces, fish, and wine), a Traditional Dutch dinner dietary pattern (high intakes of meat, potatoes, vegetables, and alcoholic beverages), and a Healthy Traditional Dutch dietary pattern (healthy variant of the Traditional Dutch dinner dietary pattern; high intakes of vegetables, fruit, nonalcoholic drinks, dairy products, and potatoes). Differences in mean intakes between the highest and lowest tertiles of the 3 patterns were greatest for fruit, dairy products, potatoes, and alcoholic

beverages. Consumption of Mediterranean foods, such as fish and oils, was relatively low overall. Two hundred seventy-seven deaths occurred in 44 667 person-years. Independent of age, education, and other lifestyle factors, only the Healthy Traditional dietary pattern score was associated with a lower mortality rate. Women in the highest tertile of this pattern experienced a 30% reduction in mortality risk.

Conclusion: A Healthy Traditional Dutch diet, rather than a Mediterranean diet, appears beneficial for longevity and feasible for health promotion in older Dutch women. This diet is comparable with other reported healthy or prudent diets that have been shown to be protective against morbidity or mortality.

INTRODUCTION

In Europe, chronic diseases, such as cardiovascular diseases and cancer, have become major causes of death (1). Because lifestyle factors, such as smoking, physical activity, and nutrition play important roles in the onset and progress of chronic diseases, they may be especially important in the elderly, who are at an increased risk of developing chronic diseases (2). Additionally, the acceleration in functional decline caused by external factors is generally believed to be reversible at any age (3). Because society is aging, the importance of a healthy diet in the elderly is evident. Reducing the burden of avoidable chronic diseases not only increases longevity and prolongs survival, but also improves quality of life by delaying or preventing chronic diseases. It is, therefore, of interest to identify existing dietary patterns in the elderly that are more or less healthy.

In the past decade, the analysis of dietary patterns, in addition to studying individual dietary components, has emerged as a method of exploring the relation between diet and disease. The individual component approach may uncover several important relations between dietary factors and disease; however, it passes over the complexity of the true relation between diet and disease. The major limitations of this approach were addressed by Hu (4): intake of various dietary factors is highly correlated, many interactions between components of a diet and disease risk may exist, and it may, in practice, not be possible to detect small differences in disease risk from single nutrients. Studying dietary patterns in relation to health accounts for these issues and can additionally enhance our understanding of dietary practice and provide guidance for nutrition intervention and education.

Recently, an extensive review of dietary pattern studies showed that many variations of a "healthy" or "prudent" dietary pattern, which were positively associated with better health outcome, have been identified across different populations (5). One of the main aims of the European Prospective Investigation into Cancer and Nutrition (EPIC)-Elderly project was also to study the relation between a posteriori dietary patterns and mortality. Within this project, a posteriori dietary patterns have been identified in elderly persons from 9 European countries. Two major principal components were detected: a vegetable-based diet and a sweet- and fat-dominated diet (6). Compared with southern European participants, Dutch (and most northern European) EPIC-Elderly participants scored slightly negative on the first component, whereas the Dutch were indifferent to the second principal component. Eating patterns may be culturally determined to a great extent. We therefore intended to identify dietary patterns in older Dutch women who participated in the EPIC-Elderly study to find out the extent to which dietary patterns in this population of older women were similar to other reported patterns and to examine if existing dietary patterns are related to survival.

SUBJECTS AND METHODS

Study population and follow-up

The subjects were Dutch participants of the EPIC-Elderly study, a substudy of the EPIC study. EPIC is a multicenter cohort study under the coordination of the International Agency for Research on Cancer that examined the role of diet on the etiology of cancer and other chronic diseases. Details on the design and methods of the EPIC study have been described previously (7, 8). In brief, over half a million apparently healthy volunteers were recruited for the EPIC study from 10 European countries. Two Dutch cohorts, enrolled between 1993 and 1997, contribute to the EPIC study. The Dutch Prospect-EPIC cohort is composed of volunteers recruited from among women who were participating in a regional breast cancer screening program. The cohort is composed of 17 357 women aged 50–69 y at enrollment who reside in Utrecht and its vicinity. The study population was described in detail elsewhere (9). The Monitoring Project on Risk Factors for Chronic Diseases in the Netherlands (MORGEN)-EPIC cohort is composed of 22 769 men and women aged 20–64 y from a random sample of the Dutch population from 3 towns in the Netherlands: Amsterdam, Doetinchem, and Maastricht. The study population was described in detail elsewhere (10). The Medical Ethics Committee of TNO (Netherlands Organization for Applied Scientific Research) approved the study, and the study was conducted according to the guidelines of the Helsinki declaration. Data on vital status, including dates of emigration or death up to 7 November 2002, were obtained through the National Population Database. The objectives of the EPIC-Elderly project were to investigate the prevailing dietary patterns in European elders (persons aged ≥60 y at enrollment) and to study the role of these patterns on their health and longevity.

Of the initial 6729 Dutch men and women aged ≥60 y at recruitment, all 314 men were excluded because their number was too small to consider separately. Vital status was ascertained for 6312 of the 6415 women. Of the women, 732 were excluded because they had self-reported myocardial infarction, stroke, cancer, or a combination of these at enrollment. Another 145 women were excluded due to missing information on one or more of the dietary, anthropometric, or lifestyle variables. Also, 8 participants who died within the first year after enrollment were excluded. The remaining 5427 participants (5194 from Prospect-EPIC and 233 from MORGEN-EPIC) were included in the study. The mean follow-up period was 8.2 y

Dietary intakes

Information on foods and beverages consumed during the year preceding enrollment was collected with the use of a validated semiquantitative food-frequency questionnaire (11, 12). The questionnaire contained questions on habitual consumption frequency during the past year. The questionnaire enables estimation of the average daily consumption of 178 food items. The quantity consumed was estimated in commonly used units, household measures, or by colored photographs of foods shown in different portion sizes. Intake of each of the foods was calculated in grams per day, taking into account standard recipes. Total energy (in kJ/d) and ethanol (in g/d) intakes were estimated by using an extended version of the 1996 computerized Dutch food composition table (13).

Foods were classified into 17 main groups [according to a common classification (**Table 1**)] and into 124 subgroups, which were constructed for the EPIC study. This classification groups foods that could be described and quantified according to common rules across countries for the purpose of the EPIC calibration study, which used a 24-h diet recall (7). All main groups of this classification were

considered in the present analysis, except for the miscellaneous category. In addition, a soy (soy and soy products) category was considered. However, some main groups were broken down: "cereals and cereal products" was divided into "pasta, rice, and other grain", "bread", and "other cereals and cereal products" categories; "added fats" was divided into "vegetable oils", "butter", and "margarine" categories; and "alcoholic beverages" was divided into "wine" and "other alcoholic beverages" categories—this resulted in 22 food groups that were used in the EPIC-Elderly study.

TABLE 1 Factor loadings and consumption of each food group by tertile (T) of the 3 major principal components in women of the Dutch European Prospective Investigation into Cancer and Nutrition–Elderly cohort[1]

Food groups	Mediterranean-like dietary pattern				Traditional Dutch dinner dietary pattern				Healthy Traditional dietary pattern			
	Factor loading	T1	T2	T3	Factor loading	T1	T2	T3	Factor loading	T1	T2	T3
		g/d	*g/d*	*g/d*		*g/d*	*g/d*	*g/d*		*g/d*	*g/d*	*g/d*
Potatoes	−0.30[2]	119 ± 63[3]	87 ± 48	66 ± 44	0.23[2]	73 ± 45	89 ± 50	110 ± 67	0.22[2]	74 ± 45	90 ± 52	107 ± 66
Vegetables	0.20[2]	123 ± 44	130 ± 45	156 ± 59	0.22[2]	119 ± 47	135 ± 47	155 ± 55	0.47[2]	107 ± 40	131 ± 40	171 ± 53
Legumes	0.02	9 ± 11	9 ± 9	10 ± 10	0.11	8 ± 8	8 ± 9	11 ± 12	0.21[2]	7 ± 7	8 ± 9	12 ± 12
Fruit	0.19	205 ± 115	246 ± 130	294 ± 165	−0.17	281 ± 163	246 ± 127	217 ± 128	0.35[2]	188 ± 107	240 ± 116	317 ± 167
Dairy products	0.08	417 ± 226	451 ± 234	487 ± 275	−0.20[2]	517 ± 265	454 ± 233	384 ± 224	0.29[2]	371 ± 213	441 ± 214	543 ± 279
Pasta, rice, and other grain	0.26[2]	14 ± 14	21 ± 19	35 ± 39	0.05	21 ± 27	22 ± 24	25 ± 32	−0.16	2 ± 37	22 ± 24	18 ± 19
Bread	−0.28[2]	125 ± 43	105 ± 38	90 ± 39	−0.07	110 ± 44	107 ± 42	103 ± 41	0.13	99 ± 43	108 ± 40	113 ± 43
Other cereals	0.28[2]	7 ± 8	11 ± 10	18 ± 16	−0.16	15 ± 15	12 ± 12	10 ± 10	−0.14	15 ± 15	12 ± 11	10 ± 10
Meat and meat products	−0.15	9 ± 43	85 ± 41	75 ± 44	0.51[2]	53 ± 31	83 ± 34	116 ± 40	−0.01	84 ± 42	84 ± 42	84 ± 46
Fish and shellfish	0.22[2]	7 ± 7	10 ± 8	15 ± 15	0.12	8 ± 8	11 ± 11	12 ± 13	0.01	11 ± 11	10 ± 11	11 ± 12
Eggs	0.00	15 ± 12	16 ± 13	15 ± 12	0.21[2]	12 ± 9	15 ± 11	20 ± 16	−0.04	16 ± 14	15 ± 12	15 ± 12
Vegetable oils	0.35[2]	1 ± 2	2 ± 3	5 ± 4	0.15	2 ± 3	2 ± 3	4 ± 4	0.11	2 ± 3	2 ± 3	3 ± 4
Butter	−0.01	5 ± 5	5 ± 6	5 ± 6	0.05	4 ± 6	4 ± 5	5 ± 6	−0.32[2]	7 ± 8	4 ± 4	3 ± 3
Margarine	−0.39[2]	21 ± 10	13 ± 8	9 ± 7	0.08	13 ± 10	14 ± 10	15 ± 11	0.09	13 ± 10	15 ± 10	15 ± 11
Sugar and confectionary products	−0.18	44 ± 28	35 ± 22	30 ± 20	−0.33[2]	48 ± 27	36 ± 21	26 ± 19	−0.23[2]	44 ± 29	36 ± 22	29 ± 19
Cakes and biscuits	−0.05	37 ± 23	36 ± 22	34 ± 23	−0.36[2]	47 ± 26	35 ± 18	25 ± 17	−0.03	36 ± 24	37 ± 22	34 ± 21
Nonalcoholic beverages	0.13	1316 ± 387	1398 ± 419	1519 ± 512	0.00	1406 ± 448	1410 ± 434	1417 ± 468	0.28[2]	1258 ± 387	1380 ± 387	1594 ± 501
Wine	0.25[2]	11 ± 32	25 ± 48	63 ± 101	0.19	18 ± 39	26 ± 47	54 ± 103	−0.24[2]	55 ± 101	25 ± 51	17 ± 37
Other alcoholic beverages	0.11	16 ± 44	27 ± 60	42 ± 90	0.26[2]	12 ± 27	20 ± 39	52 ± 104	−0.30[2]	53 ± 103	20 ± 38	11 ± 28
Sauces	0.26[2]	6 ± 6	9 ± 8	14 ± 16	0.06	9 ± 13	10 ± 10	11 ± 11	−0.07	11 ± 15	9 ± 10	9 ± 9
Soups	0.03	65 ± 68	70 ± 75	72 ± 78	0.10	60 ± 63	67 ± 69	80 ± 86	0.08	59 ± 60	71 ± 75	77 ± 83
Soy products	0.23[2]	1 ± 2	1 ± 3	4 ± 8	−0.28[2]	4 ± 8	1 ± 2	0 ± 2	0.08	1 ± 5	2 ± 5	2 ± 6
Eigenvalue	2.24				1.82				1.48			
Variance explained (%)	10.2				8.3				6.7			

[1] n = 5427.
[2] Absolute value ≥0.20; contributed significantly to the dietary pattern.
[3] ± SD (all such values).

Lifestyle and anthropometric variables

Data on several lifestyle and health variables were recorded with the use of a core lifestyle questionnaire, which included questions on education, history of previous illnesses, history of smoking, and physical activity (occupational and leisure time). To calculate a score for daily physical activity during leisure time, the time spent on each of several activities (in h/wk) was multiplied by an energy cost coefficient to convert h/wk to kJ, and the kJs were summed.

Physical examinations were conducted by trained paramedics according to a standardized protocol. Weight (measured to the nearest 100 g on calibrated scales), height, and waist and hip circumferences (measured to the nearest 0.5 cm) were measured while the participants were wearing only light indoor clothing and no shoes. Body mass index (BMI) was calculated as weight (in kg)/height^2 (in m).

Statistical analysis

For each of the 22 food groups (Table 1), a regression analysis was performed on the food group to control for energy intake. The residuals of these linear regressions were the variables entered in the factor analysis (14).

Dietary patterns were identified by means of a Principal Component Analysis (15). Principal Components were extracted by using the correlation matrix to adjust for unequal variances of the original variables. To identify the number of principal components to be retained, we used the criterion of eigenvalues exceeding 1, a scree plot, and the interpretability of each component. Food groups (residuals) with absolute scoring coefficients (or factor loadings) >0.2 were considered important contributors to a component. We labeled patterns based on the combinations of food groups that contributed most strongly to the respective component. Each person received a score for each identified pattern by summing the standardized values of the food groups (ie, the residuals) weighted by their factor loadings.

The association between dietary pattern and mortality was analyzed with Cox proportional hazards regression. For the 3 dietary components, Cox models were developed to control for age (continuous), BMI (continuous), the waist-to-hip ratio (continuous), total energy intake (continuous), physical activity at work (categorical: unemployed, sedentary occupation, standing occupation, manual work, or heavy manual work), physical activity during leisure time (in tertiles), smoking status (categorical: never, past use, ≤1 cigarette/d, 2–10 cigarettes/d, 11–20 cigarettes/d, or >20 cigarettes/d), self-reported diabetes mellitus at enrollment, and educational achievement (categorical: none or primary school completed, technical or vocational school completed, secondary school completed, or higher degree). Mean intake of nutrients was calculated for tertiles of the relevant principal components. Tests for trend, Mantel-Haenszel chi-square test, and logistic regression were carried out for demographic and lifestyle characteristics and mean nutrient intakes according to tertiles of the principal components. SAS version 9.1 (SAS Institute, Cary, NC) statistical software package was used to perform the calculations.

RESULTS

The first 3 principal components were judged most relevant considering their interpretability and the scree plot. These 3 components explained 25% of the total variance in the consumption of the 22 food groups. The factor loadings for the first 3 principal components for the total population of older Dutch women are

shown in Table 1, as well as the mean intakes of the 22 food groups for each tertile of a component.

The first principal component, which we labeled a Mediterranean-like dietary pattern, was characterized by higher loadings of pasta and rice, sauces, fish, and vegetables in combination with vegetable oils, wine, and other cereals. Foods often consumed in the Netherlands, such as potatoes, bread, and margarine, contributed negatively to this component. The second principal component, the Traditional Dutch dinner dietary pattern, had positive scorings for meat, potatoes, vegetables, eggs, and alcoholic beverages. It was low in intakes of dairy products, sweets, and pastries. The traditional Dutch dinner consists of a combination of potatoes, meat, and vegetables. The third component, which represented a Healthy (variant of the) Traditional Dutch diet, was high in intakes of vegetables, fruit, dairy products, potatoes, and legumes, and also nonalcoholic beverages. It was low in intakes of butter and alcoholic beverages.

Differences in the mean intakes of food groups between the highest and lowest tertiles of the 3 patterns were largest for intakes of fruit, dairy products, potatoes, wine, and other alcoholic beverages. Consumption of fish, vegetable oils, legumes, and soy products were relatively low in all tertiles of each factor. Mean nutrient intakes for tertiles of each of the 3 principal components are presented in **Table 2**. Across tertiles of the Mediterranean-like dietary pattern, substantial decreases were seen for intakes of fat, particularly for saturated and monounsaturated fatty acids, and cholesterol. Alcohol intake increased from the first to the third tertile.

TABLE 2 Nutrient intakes by tertile (T) of the 3 major principal components in women of the Dutch European Prospective Investigation into Cancer and Nutrition–Elderly cohort[1]

	Mediterranean-like dietary pattern			*P* for trend	Traditional Dutch dinner dietary pattern			*P* for trend	Healthy Traditional dietary pattern			*P* for trend
	T1	T2	T3		T1	T2	T3		T1	T2	T3	
Energy (kcal)	1765 ± 385[2]	1690 ± 367	1757 ± 384	0.54	1758 ± 385	1696 ± 372	1757 ± 380	0.96	1750 ± 396	1708 ± 366	1753 ± 377	0.78
Protein (% of energy)	15.9 ± 2.3	16.5 ± 2.4	16.2 ± 2.5	0.0038	15.4 ± 2.2	16.4 ± 2.3	16.9 ± 2.6	< 0.0001	15.1 ± 2.2	16.3 ± 2.2	17.3 ± 2.4	< 0.0001
Carbohydrates (% of energy)	46.0 ± 5.9	45.6 ± 6.1	45.2 ± 6.6	< 0.0001	49.7 ± 5.2	46.0 ± 4.7	41.2 ± 5.5	< 0.0001	43.7 ± 6.6	45.8 ± 5.7	47.4 ± 5.8	< 0.0001
Fat (% of energy)	36.7 ± 5.3	35.1 ± 5.2	33.8 ± 5.4	< 0.0001	33.5 ± 5.0	35.2 ± 5.0	36.9 ± 5.7	< 0.0001	36.2 ± 5.5	35.5 ± 5.1	33.9 ± 5.4	< 0.0001
Saturated fatty acids (% of energy)	16.3 ± 2.8	15.4 ± 2.6	14.2 ± 2.7	< 0.0001	15.1 ± 2.8	15.3 ± 2.7	15.5 ± 3.0	< 0.0001	15.9 ± 3.1	15.4 ± 2.6	14.5 ± 2.6	< 0.0001
Monounsaturated fatty acids (% of energy)	13.2 ± 2.3	12.8 ± 2.3	12.5 ± 2.4	< 0.0001	11.9 ± 2.2	12.9 ± 2.1	13.8 ± 2.4	< 0.0001	13.4 ± 2.4	13.0 ± 2.2	12.2 ± 2.3	< 0.0001
Polyunsaturated fatty acids (% of energy)	6.8 ± 1.9	6.5 ± 1.8	6.8 ± 1.9	0.45	6.2 ± 1.8	6.7 ± 1.8	7.2 ± 2.0	< 0.0001	6.5 ± 1.8	6.8 ± 1.8	6.9 ± 2.0	< 0.0001
Cholesterol (mg)	203 ± 70	198 ± 70	194 ± 69	< 0.0001	174 ± 61	193 ± 59	229 ± 76	< 0.0001	207 ± 74	195 ± 67	194 ± 67	< 0.0001
Alcohol (g)	3 ± 7	7 ± 10	12 ± 15	< 0.0001	4 ± 6	6 ± 8	13 ± 16	< 0.0001	13 ± 15	6 ± 9	4 ± 7	< 0.0001
Fiber (g)	23 ± 5	22 ± 5	23 ± 6	0.82	23 ± 6	22 ± 5	23 ± 6	0.18	20 ± 5	22 ± 4	26 ± 5	< 0.0001

[1] *n* = 5427.
[2] ± SD (all such values).

Protein and fat intakes, especially intake of monounsaturated fatty acids, increased, whereas intake of carbohydrates decreased, with increasing scores for the Traditional Dutch dinner dietary pattern. Cholesterol and alcohol intakes were also significantly higher for persons in the higher tertiles of this dietary pattern. In contrast, for persons that scored higher on the Healthy Traditional pattern, fat, cholesterol, and alcohol intakes were lower, whereas intakes of fiber, carbohydrates, and protein were higher.

The women were aged between 60 and 70 y at baseline; 42% were aged ≥65. One-third had no education or had only completed primary school education. Furthermore, almost one-half of the population had never smoked, 60% had a BMI > 25, and 5% had a waist-to-hip ratio > 0.90.

Percentages of the categorical sociodemographic and lifestyle variables for each tertile of the principal component scores are shown in **Table 3**. Women who scored high on the Mediterranean-like dietary pattern were younger, higher educated, and more often former smokers than were the women who had a low score on this pattern. Higher scores for the Traditional Dutch dinner dietary pattern were associated with women who had a lower level of education, were more current smokers, and were more overweight. Women that were less educated, more likely nonsmokers, had higher BMIs, and were more physically active scored higher on the Healthy Traditional dietary pattern.

TABLE 3 Demographic and lifestyle characteristics by tertile (T) of the 3 major principal components in women of the Dutch European Prospective Investigation into Cancer and Nutrition–Elderly cohort[1]

	Mediterranean-like dietary pattern					Traditional Dutch dinner dietary pattern					Healthy Traditional dietary pattern				
	T1	T2	T3	Chi-square *P*	*P* for trend[2]	T1	T2	T3	Chi-square *P*	*P* for trend[2]	T1	T2	T3	Chi-square *P*	*P* for trend[2]
Age				< 0.0001					0.014					0.059	
60–64 y	56	57	63			57	58	61			60	58	57		
65–70 y	44	43	37		< 0.0001	43	42	39		0.0139	40	42	43		
Education				< 0.0001					0.0002					< 0.0001	
None or primary school	49	32	19		< 0.0001	31	33	36		0.0031	29	33	39		< 0.0001
Technical school	26	29	22		0.0060	25	28	24		0.37	22	28	27		0.0005
Secondary school	20	30	39		< 0.0001	29	30	31		0.40	36	29	25		< 0.0001
University degree	4	8	19		< 0.0001	14	9	9		< 0.0001	13	10	10		0.0007
Smoking status				0.0002					< 0.0001					< 0.0001	
Never	56	51	42		< 0.0001	56	54	39		< 0.0001	42	51	56		< 0.0001
Former	25	33	42		< 0.0001	32	32	36		0.023	35	34	31		0.0039
Current	19	16	15		0.0010	12	14	25		< 0.0001	23	15	13		< 0.0001
BMI				< 0.0001					< 0.0001					< 0.0001	
≤25 kg/m^2	35	37	42			46	38	30			44	38	32		
>25 kg/m^2	65	63	58		< 0.0001	54	62	70		< 0.0001	56	62	68		< 0.0001
Waist-to-hip ratio				0.0050					< 0.0001					0.89	
≤0.90	92	93	95			95	93	92			94	93	94		
>0.90	8	7	5		0.0054	5	7	8		< 0.0001	6	7	6		
Physical activity at work				0.035					0.060					< 0.0001	
Sedentary	81	80	81		0.77	79	81	83			82	80	79		0.0321
Standing	9	10	11		0.050	11	9	9			11	10	9		0.084
Manual work	6	7	6		0.83	6	7	5			5	6	6		0.15
Heavy manual work	5	4	2		0.0001	4	3	4			2	3	5		< 0.0001
Physical activity during leisure time				0.70					0.62					< 0.0001	
Low	34	36	34			35	34	34			39	32	33		< 0.0001
Moderate	34	35	35			34	36	34			33	37	34		0.65
High	32	30	31			31	30	31			28	31	34		< 0.0001

[1] *n* = 5427.
[2] *P* for trends are only shown if the Mantel Haenszel chi-square test was significant at the 0.05 level.

During the follow-up of this cohort, 277 deaths occurred in 44 667 person-years (mean follow-up length: 8.2 y). The association between the tertiles of the 3 principal components and overall mortality are shown in **Figure 1**. Independent of age, education, and other lifestyle factors, only the Healthy Traditional pattern score was significantly associated with a lower mortality rate. Women in the highest tertile of this pattern had a 30% lower mortality risk than those in lowest tertile (95% CI for the hazard ratio: 0.52, 0.95). The Mediterranean-like dietary pattern showed a tendency to a reduced overall mortality. Mortality risk was higher in women in the highest tertile than those in the lower tertiles of the Traditional Dutch dinner dietary pattern; however, these hazard ratios were not statistically significant.

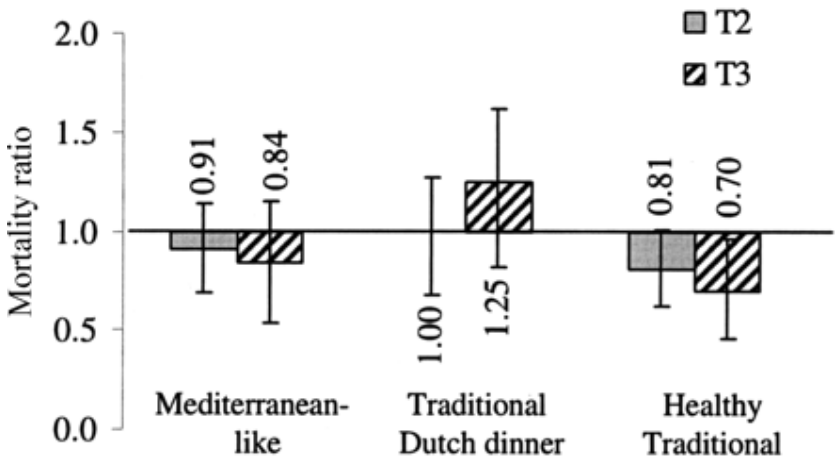

FIGURE 1. Mortality ratios of Cox proportional hazards regression for tertiles of the 3 major principal components for women (*n* = 5427) of the Dutch European Prospective Investigation into Cancer and Nutrition-Elderly cohort adjusted for age, cigarette smoking, education level, diabetes, energy intake, BMI, waist-to-hip ratio, physical activity at work, and physical activity during leisure time. Tertile (T) 1 was the reference category.

DISCUSSION

In this population of older Dutch women, we identified 3 major principal components: a Mediterranean-like dietary pattern, a Traditional Dutch dinner dietary pattern, and a Healthy Traditional dietary pattern. We did not observe a significant association between the Mediterranean-like or the Traditional Dutch dinner dietary patterns and mortality; however, mortality risk was reduced by 30% for women in the highest compared with the lowest tertile of the Healthy Traditional dietary pattern.

A limitation of the present study is that the 22 food groups entered into the analyses may not optimally represent dietary choices of Dutch persons. For example, as can be seen from Table 1, soy products are only marginally consumed and yet represent a distinct food group. In contrast, it would have been appropriate to separate the "bread" category into white bread and brown bread, because Dutch people consume high quantities of several kinds of bread. The construction of and choice for these 22 food groups was made for the European EPIC-Elderly study, of which this cohort was a subcohort. These food groups were created to discern prevailing dietary patterns for a nonspecific European population; eating habits differ considerably between the various countries included in EPIC and these food groups may not be optimal to ascertain the dietary patterns in a specific country, such as the Netherlands. However, we

decided to maintain these food groups to enable comparison. Our study population consisted of women aged between 60 and 70 y at baseline. This group can be described as relatively young elderly women and, therefore, selection bias due to selective survival will not play an important role. However, the number of deaths was limited (n = 277) because the women have only been followed for an average of 8.2 y. For this reason, only associations with total mortality could be studied, and it was only possible to detect strong associations. By excluding prevalent cases of cardiovascular disease or cancer and deaths that occurred during the first year of follow-up, the results are unlikely to be biased by present diseases.

It is of interest whether the discerned patterns are also observed in other populations. When findings from various studies are compared, the methodologic choices of the studies may influence factor solutions (5). Nevertheless, analogous dietary patterns have been identified in several studies and labeled either "prudent" or "healthy", often in combination with a "Western" dietary pattern (16-20). Our Healthy Traditional dietary pattern corresponds appreciably with the prudent and healthy dietary patterns, which are represented by higher intakes of vegetables, fruit, and whole grains and also often by higher intakes of dairy products, fish, or poultry. Adherence to these patterns was shown to lower coronary heart disease risk (19, 21), stroke risk (17), and mortality risk (18).

Red and processed meats are important contributors to the Western dietary patterns identified in the various studies, often in combination with intake of dairy products, refined grains, and sweets. Our Traditional Dutch dinner dietary pattern is also characterized by a higher consumption of meat, but other aspects are less comparable to the Western dietary patterns identified in other studies (16).

Because consumption patterns are culturally determined, we compared our findings with results from patterning studies in other Dutch populations. Van Dam et al (22) extracted 3 dietary patterns from 46 energy-adjusted (ie, residual method) food groups in a large sample of Dutch men and women from the MORGEN study. In addition, Balder et al (23) reported 5 different dietary patterns for Dutch women from the Netherlands Cohort Study on Diet and Cancer. Despite some methodologic differences, our Mediterranean-like dietary pattern showed strong similarities with the first patterns extracted by van Dam et al and Balder et al. The second pattern of van Dam et al was similar to our Traditional Dutch dinner dietary pattern—high in meat and alcoholic beverage (ie, beer) intakes and low in intakes of dairy products, cakes, and added sugar. Our Healthy Traditional dietary pattern, which is similar to the reported prudent dietary patterns, was not, surprisingly, found in these 2 Dutch studies. A possible explanation may be that participants in the other cohorts were younger, which would suggest that this Healthy Traditional dietary pattern is disappearing.

The Mediterranean diet has gained considerable attention for its reported positive health effects (24-26). In one study conducted in elderly European persons, a reduced mortality risk of 23% was reported for adherence to the Mediterranean diet (27), whereas no statistically significant association was found in another study (28). Recently, Trichopoulou et al (29) reported that the Mediterranean Diet Score was associated with an increased survival in the EPIC-Elderly study, which combined 9 European countries (of which the present cohort is a subcohort). However, this association was not significant for 6 of these 9 countries, and the association was absent for the Netherlands, Germany, and Italy (29).

Nutritional habits differ substantially between countries and, therefore, dietary patterns that can be found in Mediterranean countries may inadequately assess

the diet in Western European populations. We labeled the first component in our study Mediterranean-like, but it may, in fact, not correspond well with the traditional Mediterranean diet and may not produce the same potential beneficial effects on health and longevity. For example, although vegetable oil consumption increased from the first to the third tertile, it remained low. This is illustrated by the intake of monounsaturated fatty acids, which even decreased along tertiles of the pattern. Wine, fish, and vegetable intakes also remained low.

In the 9 countries of the EPIC-Elderly study, 2 major dietary patterns were identified from the same 22 food groups we used (6). The first was a vegetable-based dietary pattern that was high in intakes of vegetable oils, fruits, pasta, rice and other cereals, vegetables, and legumes. The second pattern was the sweet- and fat-dominated diet and was high in intakes of nonalcoholic beverages, potatoes, and margarine. Neither of these 2 patterns showed substantial similarity with any of the 3 patterns resulting from our analyses. In the international study, the Netherlands was not associated with the sweet- and fat-dominated dietary pattern, whereas Dutch participants scored slightly negative on the vegetable-based dietary pattern, which indicated that a larger part of the Dutch participants showed an eating pattern opposite to this component. In a subsequent study by Bamia et al (Bamia C, Trichopolous D, Ferrari P, et al, unpublished observations, 2006), a strong association of the vegetable-based pattern with overall mortality was observed for the Netherlands. These results suggest a possible health benefit of a vegetable-based diet as identified by Bamia et al. However, although insight into prevailing eating patterns and their occurrence throughout Europe is interesting, the patterns resulting from this international study do not teach us much about Dutch dietary practice. Our results may have stronger implications for elderly Dutch persons.

Despite the small number of deaths in our study, we found a significant association between adherence to a Healthy Traditional Dutch dietary pattern and overall mortality—mortality risk was reduced 30% for the highest compared with the lowest tertile. Similar effects have been found for prudent dietary patterns identified in other populations, patterns that are comparable to our Healthy Traditional pattern. A traditional Dutch meal consists of a combination of meat, potatoes, and cooked vegetables, although the observed mortality reduction cannot be explained by meat consumption. In addition, consumption of milk and dairy products has traditionally been high and fruit consumption has been promoted for many years in the Netherlands. Even though consumption patterns have been changing in recent years (30), this traditional pattern appears to still exist in older women. Additional research conducted in younger women is needed to discern whether this pattern is disappearing. Some adaptations to a more modern variant of the Healthy Traditional dietary pattern (eg, with increased fish consumption and moderate alcohol consumption) may even improve its composition.

In conclusion, our findings showed that a healthy dietary pattern variant can be distinguished within the traditional Dutch diet. In this population of older Dutch women, a healthy traditional Dutch diet, rather than a Mediterranean diet, increases longevity. Because the Healthy Traditional dietary pattern fits in well with Dutch consumption habits, adherence to such a diet seems feasible and may be encouraged.

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