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ORIGINAL CONTRIBUTION

Regional dietary habits of French women born between 1925 and 1950

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Summary *Background* Diseases distributions are not the same all over France. As diet is an important determinant of health it is essential to determine whether there was still a diversity in food habits across French regions. *Aim of the study* We examined regional differences in dietary habits and nutrient intakes among French women born between 1925 and 1950 participants in the "Etude Epidémiologique auprès des femmes de l'Education Nationale" (E3N) cohort. *Methods* Data were extracted from self-administered dietary history questionnaires completed by 73024 highly educated, middle-aged women between 1993 and 1995. Canonical and cluster analyses were used to identify contiguous areas of homogeneous dietary habits spanning two or more of the 20 French regions. Dietary clusters were described relatively to the entire cohort mean. *Results* Eight dietary clusters were identified. The following food items were over-consumed: cooked vegetables in the Mediterranean, fish in the West, fruit in the South-East, and potatoes in the North. The following food items were under-consumed: fish in the East, fruit in the North, and potatoes in the South-East and Mediterranean cluster. Consumption of soup and fruit increased with age, while consumption of pork, horse meat and coffee fell with age. Ethanol intake was highest in the North and lowest in the South-East; the types of alcoholic beverages consumed also varied across clusters. Total energy intake, nutrient intakes, and the contribution of carbohydrates, fat and protein to total energy intake were similar across clusters. Intake of cholesterol and polyunsaturated fatty acids varied across clusters. *Conclusion* Dietary habits and alcohol consumption show marked regional differences in this population of middle-aged, highly educated French women. Changes in dietary behaviour with age involved few food items and were similar across clusters, suggesting that regional differences in food and beverage consumption persist.

Key words regional – cluster – changes – nutrients – dietary habits

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Introduction

Studies of dietary trends is mainly based on dietary balance sheets published by international organizations such as FAO and OCDE, which take into account the production, importation, exportation, stock variation, waste, and non-food use. Although such data overestimate food consumption, they do reflect overall dietary trends. Striking dietary changes were observed in most Western countries between 1950 and 1990 [1]. In France, these changes included less bread, potato, sugar, butter and wine consumption, and increased consumption of fruit, vegetables, meat, fish, sweets, dairy products and sweet drinks. New food items, such as transformed products and exotic foods, were introduced. These changes tended to have a levelling out effect on dietary habits, even in countries with marked regional variations [1, 2].

Despite this tendency of levelling out, some diffe-

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rences in chronic disease distributions in France [3, 4] remained. Geographical distribution of socio-economical, environmental and socio-cultural factors can contribute to explain these variations. As diet quality is an important health determinant, we hypothesised that disparities in regional dietary behaviours could be involved.

So, we decided to focus on diversity and similarity of dietary habits across French regions in order to relate thereafter, the identified dietary clusters with chronic disease distributions.

We use data from the large E3N female cohort study (Etude Epidémiologique auprès des femmes de l'Education Nationale), the French component of the European Investigation into Cancer and Nutrition.

Subjects and methods

The E3N study was designed to identify risk factors for the most frequent malignancies in women [5]. The cohort consisted of approximately 100000 women aged from 40 to 65 years at baseline (in 1990), who were affiliated to a French national health insurer mainly providing coverage for teachers (MGEN, Mutuelle Générale de l'Education Nationale). The dietary data have been described elsewhere [6]. Briefly, a dietary history questionnaire was addressed between June 1993 and July 1995 to women who had answered two previous questionnaires. It was accompanied by a booklet of photographs to assist with the estimation of portion sizes. Overall, the questionnaires allowed us to estimate daily consumption of 208 food items, which were categorized into 65 groups for analysis.

Both the questionnaire and the photograph booklet have been validated [7, 8].

The questionnaires were mailed to 95644 women. Non-respondents received two reminders. A total of 77613 completed questionnaires were collected, of which 4581 were excluded for the following reasons: miscoded answers (2050 questionnaires), double answers (n = 38), lack of consent to external health follow-up by the teacher's national health insurer in case of drop out (985 subjects), missing values for all dietary items (n = 8), outlier energy intake/energy requirement ratios (n = 1492), and unknown residence at the time the dietary questionnaire was completed (n = 8). Our analysis focused on the remaining 73024 questionnaires.

Statistical analysis

Data were analysed according to the French administrative region of residence (France has 20 such regions) when the dietary questionnaire was completed. We used the following multivariate analysis methods [9, 10]:

Regional differences in food consumption were tested using stepwise discriminant analysis (SAS© STEPDISC procedure) to identify the most discriminant food groups. Canonical discriminant analysis (SAS© CANDISC procedure), a dimension-reduction method, was then used to produce linear combinations (canonical components) of the initial quantitative variables (food items) with maximal separation between regions, in order to summarise between-group variations.

The number of subjects in each region was taken into account by weighting. Hierarchical cluster analysis (SAS© CLUSTER procedure, WARD option) was used to group regions with homogeneous dietary patterns according to their coordinates on the canonical components.

The dietary clusters were then compared with the mean food consumptions of the whole E3N population. These rates of daily consumption were standardised for age and educational level, as the latter factors differed across dietary clusters and were strongly related to dietary habits. Regression analysis was used to identify regional differences in the age-related trends in consumption, taking into account total energy intake and educational level. National mean consumption is also indicated for each of the 65 food groups created for this analysis.

Rates of over- or under-consumption of alcoholic beverage and of nutrients were also calculated relative to the French mean values.

Results

Stepwise discriminant analysis revealed significant regional differences ($P < 0.001$, Fisher's test) in the consumption of the 65 food groups.

The food groups with highest Fisher probability (Fisher value > 30), were seafood, vegetable oil (except olive oil), olive oil vinaigrette, potatoes, refined bread, beer, cider, duck fat, cream, soup, olives, horse meat, butter, fortified wine, margarine, 'biscotte', tea, raw vegetables, cooked vegetables, wholemeal bread, coffee, honey and marmalade, fruit, pasta, fish and stewed fruit.

Twenty canonical components were built up, and the first two linear combinations accounted for more than 50 % of the initial information; the first five linear combinations accounted for more than 80 % of the initial information.

The clustering step, based on previously calculated canonical coordinates, was used to group the 20 administrative regions into eight geographically contiguous areas with distinct dietary patterns (Fig. 1).

Other characteristics taken into account are shown in Table 1. Disparities were found in terms of age, body mass index (BMI) and educational level. Women living in the Mediterranean area were older (mean age 53.6

Fig. 1 Regional clustering based on canonical components

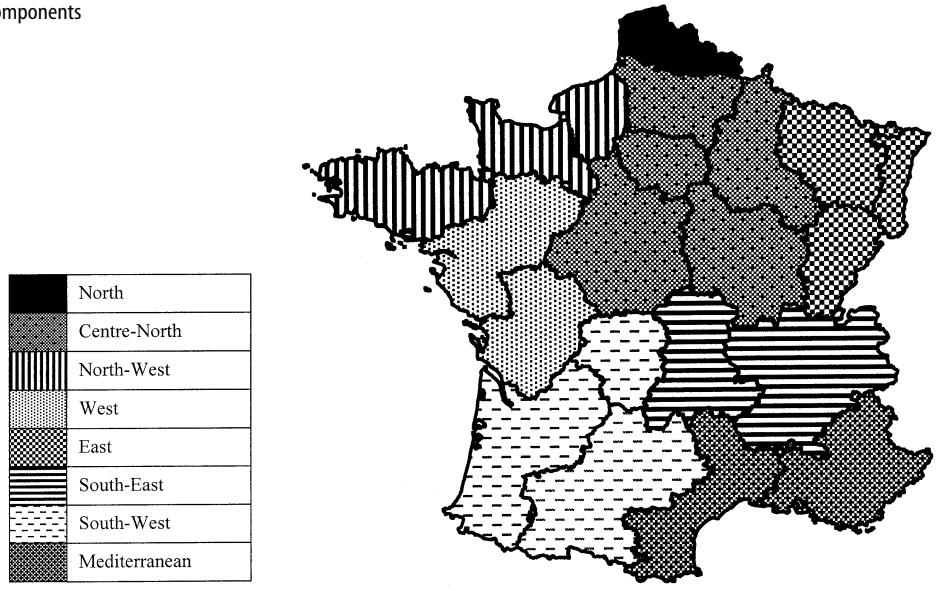

Table 1 Distribution of some characteristics of the E3N-EPIC population (N = 73,024) by dietary cluster

	North[1,2,3]	Centre-North[1,2,3]	East[1,2,3]	North-west[3]	West[3]	South-East[1,3]	South-West[1,2,3]	Mediterranean[1,2]	National E3N-EPIC
N	(3811)	(22938)	(6246)	(6581)	(5102)	(9777)	(8661)	(9908)	(73024)
Age at questionnaire (yrs)									
< 45	8.61	7.96	9.22	7.69	7.84	7.79	6.33	5.55	7.53
45–49	35.58	32.80	34.10	32.09	32.69	31.81	28.09	27.65	31.6
50–54	23.46	23.49	23.73	23.23	22.4	24.66	24.56	23.58	23.84
55–59	16.11	17.46	16.43	17.5	18.13	18.10	19.66	17.95	18.04
60–64	9.89	11.78	10.71	12.93	12.52	11.69	14.39	14.83	12.45
> 64	6.35	6.52	5.81	6.55	6.41	5.94	6.97	7.44	6.55
Mean (sd)	52.1 (6.6)	52.6 (6.7)	52.1 (6.6)	52.8 (6.7)	52.7 (6.7)	52.6 (6.6)	53.4 (6.6)	53.6 (6.7)	52.8 (6.7)
BMI ($kg \cdot m^{-2}$)									
< 19	4.22	5.96	5.24	6.05	6.27	6.97	6.52	6.56	6.12
≥19–25 <	68.83	73.77	70.65	72.98	74.4	74.51	74.54	74.48	73.5
≥25–27 <	12.65	10.45	11.93	10.80	9.84	9.70	9.85	9.85	10.43
≥27–30 <	8.66	6.13	7.49	6.40	5.90	5.83	5.91	6.03	6.31
≥30	5.64	3.69	4.69	3.77	3.59	3	3.18	3.09	3.64
Mean (sd)	23.6 (3.5)	22.9 (3.3)	23.3 (3.5)	23.0 (3.3)	22.8 (3.3)	22.7 (3.1)	22.8 (3.1)	22.7 (3.2)	22.9 (3.3)
Years of education (yrs)									
< 12	15.09	9.58	13.64	11.81	13.27	10.12	11.18	11.13	11.15
12–14	60.19	48.79	55.44	57.29	56.74	52.66	55.96	52.43	53.14
15–16	14.33	19.13	17.66	17.58	17.86	18.90	17.43	17.82	18.12
≥16	10.39	22.49	13.26	13.33	12.13	18.32	15.43	18.61	17.60

[1] $p < 0.05$ for testing the cluster distribution of age compared to the national distribution
[2] $p < 0.05$ for testing the cluster distribution of BMI compared to the national distribution
[3] $p < 0.05$ for testing the cluster distribution of education compared to the national distribution

years), slimmer (mean BMI 22.7 $kg \cdot m^{-2}$) and had a higher educational level (88.9 % had more than 12 years' schooling) than women living in the North (52.1 years, 23.6 $kg \cdot m^{-2}$, and 84.9 %, respectively).

Dietary patterns

Each cluster was then analysed for over-consumption or under-consumption of each food group, relative to French E3N-EPIC mean values (nominally scored 100), standardised on age and educational level.

As all 65 food groups were differently consumed across clusters, here we present only those food items consumed by more than 85 % of the subjects (Table 2, part A), together with those food items with the highest Fisher statistic (F > 30) in discriminant analysis (Table 2, part B), and those falling into both categories (Table 2, part C). Some other food groups of potential interest are shown in Table 2, part D. The linear regression coeffi-

Table 2 Index[a] of over- or under-consumption by dietary clusters of some food items. E3N-EPIC population (N = 73,024)

Food items	North	Centre-North	East	North-West	West	South-East	South-West	Mediterranean	National E3N-EPIC mean (g or mL/day)	λ_{age}[b]
Part A – Food consumed by more than 85 % of the population										
Cheese	98.0	99.4[NS]	106.0	91.9	95.4	108.1	95.6	102.4[NS]	54.6	–0.06*
Eggs	106.4	100.2[NS]	89.0	101.3[NS]	101.9	92.7	106.8	103.1	26.02	–0.50*
Water	108.7	99.1[NS]	93.8	91.4	96.8	97.5	104.6	108.3	845.67	–0.34*
Processed meat	110.1	100.6[NS]	103.5	101.6[NS]	98.2	91.4	102.2	98.6[NS]	30.53	–1.02*
Rice	87.6	99.6[NS]	103.0	97.7[NS]	90.5	102.6	100.7[NS]	107.5	32.51	–1.18*
Legumes	86.4	98.2[NS]	94.0	93.4	114.9[NS]	98.3[NS]	107.6	106.1	21.37	–1.50*
Yoghurt	106.8	101.3[NS]	92.6	105.3	97.9	99.2[NS]	98.8[NS]	98.4[NS]	88.41	–0.20*
Pasta	93.9	96.5	109.0	96.2	95.1	99.0[NS]	103.6	107.7	39.41	–1.28*
Poultry	102.1[NS]	107.3	98.4[NS]	95.7	98.6[NS]	91.6	102.0[NS]	93.7	20.22	–1.47*
Part B – Foods with the highest Fisher statistic (F > 30)										
Seafood	92.1	95.2	63.6	188.5	200.6	60.1	98.0[NS]	79.3	3.86	0.31
Vinaigrette with olive oil	56.1	87.7	75.8	76.7	81.9	106.5	99.5[NS]	180.3	6.37	1.05*
Refined bread	53.3	110.2	100.4[NS]	90.7	101.9[NS]	96.3	96.0[NS]	108.0	81.7	0.45*
Duck fat	64.2	88.8	67.7	68.8	93.0[NS]	71.6	250.6	80.1	0.22	1.50
Cream	99.0[NS]	107.9	114.9	115.9	137.2	77.6	76.5	85.2	3.29	–0.74
Soup	101.8[NS]	90.3	97.8[NS]	112.0	114.4	103.5	112.8	95.8	111.5	2.92*
Olive	62.7	97.1[NS]	69.8	70.4	86.3	93.1[NS]	106.4	165.4	1.19	0.01
Horse meat	193.1	139.9	56.0	64.9	91.0	59.9	75.3	92.3[NS]	1.2	–2.37*
Salted biscuits	147.3	104.6	90.8	120.1	106.3	82.1	81.2	93.7	3.1	–0.28*
Butter	131.4	98.5[NS]	91.7	135.9	117.4	97.6	83.2	80.4	7.2	–0.99*
Tea	58.0	107.1	90.5	128.4	103.4[NS]	107.9	85.3	90.6	183	–0.57*
'biscotte'	42.4	97.5[NS]	73.1	83.1	86.6	116.4	113.5	136.5	5.98	1.70*
Margarine	168.7	112.2	111.4	118.1	110.5	89.3	65.7	66.7	3.0	0.34*
Wholemeal bread	165.2	77.9	98.3[NS]	128.0	121.7	108.5	112.9	76.0	38.5	0.60*
Honey and marmalade	81.8	93.9	120.6	103.8	102.5[NS]	117.6	95.3	91.6	19.4	0.35*
Coffee	129.0	101.2[NS]	109.5	106.8	95.1	90.7	94.0	90.9	282.1	–1.40*
Stewed fruit	74.3	103.3	111.4	86.0	105.7	115.6	99.6[NS]	90.0	20.7	1.26*
Part C – Food consumed by > 85 % and with the highest Fisher statistic										
Cooked vegetables	90.9	98.3	94.0	86.0	99.9	109.0	102.0	110.2	176	0.56*
Vegetable oil**	64.2	92.8	99.2[NS]	70.9	91.2	92.4	139.0	129.4	3.4	0.99*
Raw vegetables	89.3	102.3	95.3	101.1[NS]	105.1	94.3	102.5	102.4	105	–0.13*
Fish	93.4	102.2	88.1	113.3	113.3	88.5	101.3[NS]	99.6[NS]	33.6	0.74*
Fruits	85.9	98.1	93.1	97.0	98.1	111.4	101.8	104.3	200.8	1.66*
Potatoes	149.5	97.5	109.3	119.5	107.7	87.7	93.1[NS]	82.1	63.3	0.34
Part D – Some other food items										
Mutton/lamb	101.7[NS]	106.2	87.2	103.2	96.9	91.3	95.1	105.1	8.92	0.23*
Pork	106.1	105.4	104.1	107.4	104.4	96.1	93.9	85.1	10.3	–1.63*
Sugar	147.1	97.6	81.4	97.9[NS]	97.4[NS]	96.6	106.0	99.5[NS]	5.21	–1.18*
Veal	98.9[NS]	103.0	103.9	100.1[NS]	94.9	106.5	99.6[NS]	87.7	8.0	–0.27*
Beef	108.4	106.3	104.4	97.8[NS]	96.0	95.9	91.3	94.2	15.0	–0.87*
Milk	103.3[NS]	99.7[NS]	92.8	112.0	98.0[NS]	93.6	104.3	99.7[NS]	100.2	0.60

[a] National E3N-EPIC mean was set to 100
[b] parameter of the linear regression between the item considered and age adjusted on educational level and energy intake
[NS] Nonsignificantly different from 100
* $P < 0.001$; ** except olive oil

cient for age, calculated as explained above, is shown in italics.

Some food consumptions were typical of the identified food areas. In particular, concerning fat products, butter and margarine were more often consumed in the north-eastern quarter of France, butter and cream in the north-western quarter, vegetal seed fat in the Mediterranean region and duck fat in the Southeast respectively. Consumption of potatoes was typical of the northern half of France while vegetables and fruits were respectively more consumed in the Mediterranean region and South-East. Processed meat and coffee were typical of the North, while milk, fish and seafood were more often consumed in the north-western quarter of France.

Consumption of the following food groups was stable with age (regression with age ≤ 1 %): water, tea, cheese, cream, eggs, mutton/lamb, veal, olives, honey and marmalade, vegetables, potatoes, refined bread and yogurt.

Consumption of some food groups, which were discriminant across clusters, varied with age either positively (the consumption increased with increasing age) or negatively (the consumption decreased with increasing age). Among the most frequently consumed and the most discriminant food groups across clusters (Table 2, part C), consumption of the following increased with increasing age: cooked vegetables, vegetable oil, fish and fruit. In contrast, raw vegetable consumption fell with age. Soup and horse meat consumption were the most strongly age-related food groups in opposite directions (Table 2).

Alcohol

Both total daily ethanol intake and the types of alcoholic beverage consumed differed widely across clusters (Table 3). Total alcohol intake was highest in the North, with an ethanol intake rate equal to 130.6, as compared to the E3N-EPIC mean (set to 100), and lowest in the East and South-East (89.6 % and 87.3 %, respectively) (Table 3). As regards the type of alcoholic beverages, the North strongly over-consumed beer, aperitifs (fortified wine, punch and cocktails, aniseed aperitifs) and spirits, and under-consumed cider and liqueurs. In the Centre-North area, the overall pattern of alcoholic beverages was close to the national mean, but punch, cocktail and spirit consumption was high, and aniseed aperitif consumption was low. Women in the East under-consumed all types of alcoholic beverages except for beer and liqueurs, which they over-consumed. The North-West cluster had the highest cider consumption and also over-consumed punch and cocktails, but under-consumed beer, aniseed aperitifs, aperitifs and liqueurs. With the exception of wine, all alcoholic beverages were under-consumed in the South-West. The Mediterranean cluster had the highest consumption of aniseed aperitifs, and under-consumed fortified wine, beer, cider, punch and cocktails.

Nutrient intakes

Mean total energy intake (Table 4) was similar across the clusters. However, the contribution of ethanol to total energy intake was higher than the national average in the North, and lower in the East and South-East.

The contributions of protein, carbohydrates and fat to total energy intake were similar across the clusters. In contrast, some differences in micronutrient intake were noted (Table 4). Saturated fatty acid (SFA) intake was slightly higher in the North than in other clusters. Polyunsaturated fatty acid (PUFA) intake was above the

Table 3 Index[a] of over- or under-consumption of ethanol and alcoholic beverages by dietary clusters. E3N-EPIC population (N = 73,024)

	North	Centre-North	East	North-West	West	South-East	South-West	Mediterranean	National mean E3N-EPIC (g or mL/day)	λ_{age}[b]
Ethanol	130.6	102.1[NS]	89.6	101.7[NS]	100.5[NS]	87.3	96.4	103.2[NS]	10.9	0.46*
Aniseed beverages	155.4	82.7	72.2	81.6	80.9	106.9[NS]	74.8	172.6	0.75	–1.97*
Beer	344.3	96.1[NS]	154.8	81.3	73.5	68.3	53.4	71.9	17.7	–1.98*
Cider	63.2	105.7[NS]	66.8	377.7	99.9[NS]	45.4	43.3	40.0	5.57	–1.33*
Punch and cocktail	135.8	115.8	69.3	141.6	125.9	91.5	61.8	66.3	4.27	–2.32*
Fortified wines	205.2	101.7[NS]	71.2	108.4	99.7[NS]	82.1	92.2	92.1	6.8	–0.09
Wine	107.5	101.6[NS]	89.9	95.6	102.9[NS]	89.9	104.0	107.6	92.4	0.98*
Spirituous	137.3	113.4	69.1	108.3[NS]	84.9	77.3	85.0	112.5[NS]	1.6	–0.48*
Liquors	72.2	99.2[NS]	144.5	106.3[NS]	71.2	105.9[NS]	74.9	108.1[NS]	0.2	–0.36

[a] National E3N-EPIC mean was set to 100
[b] parameter of the linear regression between the item considered and age adjusted on educational level and energy intake
[NS] Nonsignificantly different from 100
* $P < 0.001$

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Table 4 Index[a] of over- or under-contribution to energy of the macronutrients and intake of the main nutrients by dietary clusters. E3N-EPIC population (N = 73,024)

	North	Centre-North	East	North-West	West	South-East	South-West	Mediterranean	National E3N-EPIC mean	λ_{age}[b]
Energy (kJ)	102.1	99.7^{NS}	100.0^{NS}	101.9	102.3	98.9	99.4^{NS}	99.0^{NS}	9039.2[1]	–9.62*
Energy (kJ)	101.1^{NS}	99.7^{NS}	100.4^{NS}	101.9	102.4	99.4	99.5	98.8	8720.9[2]	–0.02*
Alcohol free										
% alcohol	128.1	103.0	89.6	99.9	97.8^{NS}	88.2	96.4	103.6^{NS}	3.1	0.43
% carbohydrates	97.47	99.0	101.5	99.9	100.5	102.1	100.2^{NS}	100.0^{NS}	43.8	0.25*
% protein	99.8^{NS}	101.7	97.9	99.6	99.6^{NS}	98.1	100.0^{NS}	99.9^{NS}	17.6	–0.03
% fat	103.0	100.4^{NS}	99.2^{NS}	100.3	99.6^{NS}	98.5	99.8^{NS}	100.1^{NS}	38.6	–0.27*
Carbohydrates	97.7	98.8	101.7	101.1	102.6	101.7	99.9^{NS}	99.2^{NS}	256.1[3]	0.22*
Proteins	100.7^{NS}	101.2	98.4	101.6	101.9	97.6	99.6^{NS}	98.9^{NS}	91.2[3]	–0.04*
Fat	104.3	100.0^{NS}	99.7^{NS}	102.2	102.1	97.9	99.1	98.8^{NS}	89.4[3]	–0.29*
SFA	105.2	100.1^{NS}	102.4	102.6	101.1	100.7	96.1	96.7	33.9[3]	–0.32*
MUFA	101.1^{NS}	99.4^{NS}	97.7	100.4^{NS}	100.4^{NS}	98.5	99.3^{NS}	104.3	29.8[3]	–0.21*
PUFA	102.0	101.4	97.8	103.6	105.9	93.5	105.1	94.0	15.0[3]	–0.25*
Cholesterol	105.6	100.9	98.2	104.0	103.4	95.0	100.0^{NS}	97.3	375.2[4]	–0.43*
Fiber	94.1	98.6	98.6	97.7	103.8	103.8	101.2	101.4	23.5[5]	0.40*
Calcium	100.9^{NS}	99.6^{NS}	99.5^{NS}	99.5^{NS}	98.3	101.1	99.6^{NS}	101.7	1080.0[4]	0.29*
Iron	99.7^{NS}	99.8^{NS}	97.5	101.2	104.3	98.7	100.8	99.9^{NS}	13.5[4]	0.10*
β-carotene	92.9	99.9^{NS}	96.7	93.6	101.1	103.8	101.1	104.4	4130.7[5]	0.58*
Retinol	104.1	100.5^{NS}	99.8^{NS}	95.6	101.9^{NS}	98.7^{NS}	99.8^{NS}	101.2^{NS}	1046.0[5]	–0.04
Vitamin C	95.3	98.9	96.4	98.0	101.4	103.8	100.6^{NS}	103.0	138.1[4]	0.71*
Vitamin E	98.7^{NS}	100.8^{NS}	98.2	101.4	104.6	96.5	104.4	96.2	13.1[4]	0.00

[a] National E3N-EPIC mean was set to 100
[b] parameter of the linear regression between the item considered and age adjusted on and energy intake
[NS] Nonsignificantly different from 100
* $P < 0.001$
[1] 2162.48 Kcal; [2] 2086.33 Kcal; [3] g/day; [4] mg/day; [5] µg/day

national E3N-EPIC average in the West and South-West, and lower in the South-East and Mediterranean. Monounsaturated fatty acid (MUFA) intake was similar across the clusters, as was intake of cholesterol, calcium, iron, and retinol. Fiber intake was lower than the national average in the North, while carotene intake was lower in the North and North-West. Intake of vitamins C and E was similar across the clusters.

Discussion

Eight contiguous geographical clusters of dietary patterns were identified among 73024 French women residing throughout France, by discriminant and canonical analysis. This was observed despite the relative homogeneity of the study population and the availability of most foodstuffs throughout France.

Other statistical methods, particularly cluster analysis, were tested. We identified clusters of subjects whose dietary behaviour were similar and then analysed the distribution of cluster by geographical unit. Findings were quite similar.

In France, official dietary data are based on household purchasing. Surveys are conducted by the Institut National de la Statistique et des Etudes Economiques (INSEE), mainly for marketing purposes. Some surveys provide statistics on consumption taking into account household purchasing, consumption outside the home, garden-grown food, and consumption by people living in institutions. Although such surveys largely over-estimate consumption, they do show trends in eating habits. Since 1950, consumption of bread, potatoes, sugar and wine has fallen, while consumption of dairy products, meat, fats (except butter and drippings), vegetables, fruit, fish, cheese, fruit juices, soft drinks, cereals and ice cream has increased.

INSEE has also conducted yearly surveys since 1965, on a representative sample of the French population. They provide data on individual family diets, but not on consumption according to age and sex. The 1971, 1981 and 1991 surveys, in which the age of the head of the family was recorded, permitted age-cohort-period analyses of variations in dietary habits [11].

The 1991 survey data are in good general agreement with our findings. Our data have the advantage of taking into account individual characteristics and of analysing nutrient intakes precisely.

The range of intakes of nutrients was smaller than the range of intakes of food groups, except for ethanol. Regional differences in nutrient intake reflected dietary choices. Indeed, the North showed lower fiber and β-carotene intake than the other seven dietary clusters, while SFA and ethanol intake was higher. Relative to the national average, PUFA were over-consumed in the West and South-West and under-consumed in the South-West and Mediterranean region.

Our results are not representative of the French population, as the E3N-EPIC study population is composed solely of women born between 1925 and 1950, of whom more than 80 % completed their secondary education.

We found that the consumptions of some food items differed statistically according to age. For instance, the consumption of soup, cooked vegetables, vegetable oil, fish and fruit increased with increasing age, whereas the consumption of horse meat and raw vegetable decreased with age. Such age-related disparities in consumption may be due to an effect of the birth cohort (i. e. variations according to generation), and/or of the life cycle (i. e. changes in behaviour with increasing age). Furthermore, a calendar period effect could also be involved: it corresponds to a similar effect of an event (an economical event for example) on all birth-cohorts [11]. A limitation of our study is that diet was recorded only once, failing to identify whether the variation is attributable to cohort, age or period, since only repeated measures allow this interpretation.

The distribution of several chronic diseases varies across French regions [3]. Indeed, strong geographical disparities, with a North-South dichotomy in health status, exist in France but patterns of mortality are clearer among men than among women. Main concentrations of excess mortality are obvious for a crescent drawn over the North of France. In contrast, some regions have a particularly long life expectancy (West and South-West).

Besides urban setting, alcohol drinking, smoking, physical inactivity and occupational factors, diet has been shown strongly related to longevity [12]. Prospective and case-control studies have focused on the role of specific dietary factors (food items and/or nutrients) on the risk of cancer and cardiovascular diseases [4, 13, 14], which constitute the main causes of mortality in France [1, 3].

The excess of mortality in women from cerebrovascular disease, ischaemic diseases, endocrine disorders and intestine diseases (including digestive cancer), in the North and to a lesser extent in the East, could be partly related to the dietary pattern high in animal fat and alcohol, and low in fruit and vegetable, found in our study.

Our results suggest that there are still important regional variations in dietary habits in France. They could contribute to the observed variations in the incidence of chronic diseases, and especially cancer.

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