

Variations in compliance with starchy food recommendations and consumption of types of starchy foods according to sociodemographic and socioeconomic characteristics

Mathilde Touvier^{1*}, Caroline Méjean¹, Emmanuelle Kesse-Guyot¹, Anne-Claire Vergnaud¹, Sandrine Péneau¹, Serge Hercberg^{1,2,3} and Katia Castetbon²

¹Unité de Recherche en Epidémiologie Nutritionnelle (UREN), UMR U557 Inserm/U1125 Inra/Cnam/Paris 13, CRNH IdF, SMBH Paris 13, 74 rue Marcel Cachin, F-93017 Bobigny Cedex, France

²Unité de Surveillance et d'Epidémiologie Nutritionnelle (USEN), Institut de Veille Sanitaire, Université Paris 13, 74 rue Marcel Cachin, F-93017 Bobigny Cedex, France

³Département de Santé Publique, Hôpital Avicenne, F-93017 Bobigny Cedex, France

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Nutritional recommendations call for balanced, diversified consumption of starchy foods and increased whole-grain food intake. Their efficiency may depend on sociodemographic and socioeconomic factors, for which little information is available. The aim of the present study was to investigate the relationship between sociodemographic and socioeconomic characteristics and starchy food consumption in a large general population of French adults. Dietary intake was assessed using at least six 24-h dietary records collected, during a 2-year period, from 4574 men and women aged 45–60 years who participated in the Supplémentation en Vitamines Minérales et Antioxydants cohort study in 1995–7. Compliance with the recommendation (≥ 3 and < 6 servings/d), non-consumption of whole-grain products, variety and daily cost were compared across sociodemographic and socioeconomic categories using logistic regression and covariance analyses. About 55 % of subjects complied with the starchy food recommendation, with little variation across sociodemographic characteristics. Consumption of whole-grain products was less likely in men ($P=0.001$), in subjects with a lower education level (P -trend=0.01) and in those belonging to intermediate occupational categories ($P=0.02$). The variety of starchy food intake increased with education level (P -trend=0.0002) and was lowest for manual workers ($P=0.03$). The proportion of daily food cost spent on starchy foods decreased with occupational category ($P<0.0001$), and was higher in rural areas ($P=0.0004$). The starchy food budget spent on potatoes decreased with the educational level (P -trend=0.007), whereas it increased for rice and unsweetened breakfast cereals (P -trend=0.001 for both). Public recommendations concerning starchy food variety and whole-grain intake should specifically target subjects with a lower education level and/or occupational category.

Starchy foods: Whole-grain foods: Sociodemographic factors: Socioeconomic factors

Starchy foods are good sources of complex carbohydrates. Within this food group, whole-grain products are rich in fibres and carry various micronutrients. Epidemiological evidence suggests that higher consumption of whole-grain foods could significantly reduce the risk of chronic diseases such as CVD, type 2 diabetes and certain cancers^(1–3). Therefore, balanced and diversified consumption of starchy foods, especially whole-grain products, is a major objective of current nutritional public health policies⁽⁴⁾. In France, the 2001–10 French Nutrition and Health Programme (Programme National Nutrition Santé) is being backed up by a large-scale national communications campaign and widespread diffusion of guides. It targets nine nutritional recommendations^(5,6). Starchy food is one of these, with the benchmark being 'at each meal, according to appetite' for starchy foods in general, and an additional recommendation

for whole-grain foods, i.e. 'favour their consumption among starchy foods when possible'⁽⁶⁾.

The different categories of starchy foods carry varying concentrations of nutrients (e.g. vitamin C in potatoes, protein in legumes, and Fe and B-vitamins in whole-grain products). Thus, diversity is of crucial importance. Choices in the types of starchy foods eaten may depend on cultural and generational factors. Cost may play a role in the choice of specific starchy food items such as high-quality breakfast cereals that may be more expensive. Nevertheless, the starchy food group is generally less costly than other food groups. This has been illustrated by Darmon *et al.*⁽⁷⁾, who reported that strengthening the cost constraint reduced the proportion of energy contributed by fruits and vegetables, meat and dairy products, and increased the proportion from cereal products, sweets and added fats.

Abbreviation: SU.VI.MAX, Supplémentation en Vitamines Minérales et Antioxydants.

The work was performed in UREN.

* **Corresponding author:** Dr Mathilde Touvier, fax +33 1 48 38 89 31, email m.touvier@uren.smbh.univ-paris13.fr

Results are available concerning consumption of starchy foods and its association with sociodemographic and socioeconomic characteristics^(8–20). However, there is a dearth of information on the variety and types of starchy foods consumed. Nonetheless, such information would be useful for improving public health messages.

The aim of the present study was to investigate the links between sociodemographic and socioeconomic factors and compliance with recommendations, overall variety and distribution of cost across types of starchy foods. We used the definition of 'starchy food' which corresponds to that used in the French dietary guidelines⁽⁶⁾, i.e. potatoes, bread, pasta/semolina, rice, pulses, non-sugared breakfast cereals and other less frequently consumed starchy foods (tapioca, chestnuts, manioc, sweet potatoes, taros, ignam, starch and plantain). According to these official guidelines, sugared foods (such as sugary breakfast cereals, biscuits and cakes) are not considered starchy foods, but rather are classified into the 'sugary food' group, for which specific recommendations exist (i.e. 'limit consumption'). Our hypothesis was that all parameters of starchy food consumption were correlated with several sociodemographic and socioeconomic factors, and that these correlations vary across specific starchy food types.

Methods

Study population

We used data obtained from the 'Supplémentation en Vitamines Minérales et Antioxydants' (SU.VI.MAX) cohort, which is a large sample of middle-aged adults throughout France. The design, methods and rationale of the present study have been described elsewhere⁽²¹⁾. The SU.VI.MAX study was initially designed as a randomised, double-blind, placebo-controlled primary prevention trial to test the efficacy of daily supplementation with antioxidant vitamins and minerals at nutritional doses in reducing the incidence of IHD, cancers and overall mortality⁽²²⁾. A total of 13 017 subjects were included in 1994–5 for a planned follow-up of 8 years. They were volunteers recruited via a mass media campaign in 1994 and were not selected for specific risk factors. The present study was conducted according to the guidelines laid down in the Declaration of Helsinki, and all procedures involving human subjects were approved by the Ethical Committee for Studies with Human Subjects at the Paris-Cochin Hospital (CCPPRB no. 706) and the Commission Nationale Informatique et Liberté (CNIL no. 334641). Written informed consent was obtained from all subjects.

Dietary assessment

Dietary data were collected using the Minitel Telematic Network, which is a small terminal that was widely used as an adjunct to the telephone in France at the beginning of the study. Participants were invited to provide a 24-h dietary record every 2 months. These records were randomly distributed for two weekend days and four weekdays per year, so that each day of the week and all seasons were covered to account for individual variability in intake. At enrolment, participants received a tiny central processing

unit specifically developed for the study and containing specialised software that allowed subjects to fill out the computerised dietary record off-line and to transmit data during brief telephone connections. Portion sizes were estimated using a validated picture booklet distributed to the participants at enrolment⁽²³⁾. This manual included photographs of more than 250 foods (corresponding to 1000 generic foods) represented in three different portion sizes. Along with the two intermediate and two extreme quantities, there were seven choices of amounts. Edible amounts corresponding to each food had been validated previously in a pilot study⁽²³⁾.

The nutritional values of the diet were estimated using a published French food composition table⁽²⁴⁾. This database was completed by the unit cost of each food and beverage based on mean retail prices in France in 1997, which were obtained from marketing research and from the French National Institute of Statistics and Economic Studies. All values reported here are based on the mean daily dietary intake of each subject.

The whole-grain food group included whole-grain bread, pasta and rice. The 'whole-grain'-specific information was left to the subject's discretion. 'Whole-grain consumers' were defined as subjects who consumed at least the minimal amount of one serving of 50 g of total whole-grain foods during the course of the survey (i.e. summed up overall the dietary records). French recipes validated by food and nutrition professionals were used to assess the amounts consumed from composite foods.

Sociodemographic and socioeconomic characteristics

At enrolment, subjects were asked to fill in a self-administered questionnaire to provide sociodemographic and socioeconomic information. Level of education was recoded into three categories (from eight initial categories): elementary school, secondary school (junior and high school), and university or equivalent. The official French classification⁽²⁵⁾ was used to classify subjects into occupational categories according to their self-reported occupation or most recent job if they were retired or unemployed. Occupational category was recoded into four categories (from nine initial categories) and a fifth corresponded to persons who had never worked. Marital status was recoded into two categories (from seven initial categories): living alone and cohabiting. The household location was classified into two categories (urban and rural) according to the definition of the French National Institute of Statistics and Economics Studies, which is based on both population density and economic activity of the area corresponding to each subject's zip code⁽²⁶⁾.

Statistical analyses

We focused the present analyses on subjects aged 45–60 years who had completed at least six 24-h dietary records (some subjects had more than six records, with the median number of days of 24-h records being eleven, and the maximum being sixteen) during the first 2 years of follow-up (1995–7), and with available data for all sociodemographic and socioeconomic characteristics. As is the general rule in the SU.VI.MAX cohort⁽²⁷⁾, we excluded dietary records that reported < 418.4 kJ/d (100 kcal/d) or > 25 104 kJ/d

(6000 kcal/d) and we further excluded subjects who had $>2/3$ of their records that reported <3347.2 kJ/d (800 kcal/d) in men and <2092 kJ/d (500 kcal/d) in women. We translated the qualitative recommendation for starchy food intake (at each meal, according to appetite) into a quantitative criterion, i.e. ≥ 3 and <6 servings/d, based on the usual number of meals per day (three to four), with some leeway for variation in appetite. One serving was defined as 200 g for cooked pasta/semolina, rice, pulses and 'other' starchy foods; 150 g for potatoes; 50 g for bread and 30 g for breakfast cereals (i.e. commonly used portion sizes for these foods^(6,28)). Logistic regression analysis was used to assess sociodemographic and socioeconomic factors related to falling short of, or exceeding, the general starchy food recommendation (polytomic model⁽²⁹⁾, common reference = meeting the recommendation) and being a non-consumer of whole-grain foods (dichotomic model). Adjusted relative risk ratios for polytomic models, OR for dichotomic models and their 95% CI are reported. Covariance analyses were performed to compare, across sociodemographic and socioeconomic categories, the number of different starchy foods (seven types, see above) reported during the survey (as a marker of variety) on the one hand, and the share of the starchy food budget devoted to each type of starchy food on the other hand. All multivariate models included sex, age, education level, occupational category, marital status, household location and total daily energy intake as covariates. Interactions with sex were tested, but none were statistically significant; thus, pooled analyses are presented in the present paper. Overall (for nominal variables, i.e. sex, occupational category, marital status and household location) and linear trend (for ordinal variables, i.e. age and education level) tests were performed. For all analyses, the significance level was two-sided and set at 0.05, and all associations or differences mentioned throughout the paper were statistically significant at that level. All statistical analyses were performed using SAS software (version 9.1; SAS Institute, Inc., Cary, NC, USA).

Results

Characteristics of the study population

Among the 13 017 participants in the SU.VI.MAX study, 6463 provided at least six valid 24-h dietary records during the first 2 years of follow-up; among them, 4941 were 45–60 years of age at inclusion. After exclusion of subjects with missing values for sociodemographic or socioeconomic variables, 4574 subjects remained for analysis. The amount of starchy foods provided by composite foods was 13.6%. Whole-grain bread accounted for 10.4% of the total bread intake; whole-grain pasta, 2.7% of the total pasta intake; and whole-grain rice, 6.8% of the total rice intake (data not tabulated). For whole-grain consumers, bread represented an average of 80.0% of whole-grain foods, pasta 8.4% and rice 11.6% (data not tabulated). Sociodemographic and socioeconomic characteristics of the 4574 subjects, as well as adherence to the recommendations, are presented in Table 1, and starchy food intake is described in Table 2. About 55% of the population met the general starchy food recommendation,

Table 1. Sociodemographic and socioeconomic characteristics in the studied population and adherence to national French recommendations* (n 4574), Supplémentation en Vitamines Minérales et Antioxydants cohort, 1995–7 (Number of subjects and percentages)

	<i>n</i>	%
Sex		
Men	2503	54.7
Women	2071	45.3
Age (years)		
45–49	1866	40.8
50–54	1439	31.5
55–60	1269	27.7
Education level		
Elementary school	1016	22.2
Secondary school	1805	39.5
University or equivalent	1753	38.3
Occupational category		
Managerial staff	1419	31.0
Self-employed, farmers	226	4.9
Intermediate professions, employees	2479	54.2
Manual workers	214	4.7
Never employed	236	5.2
Marital status		
Living alone	633	13.8
Cohabiting	3941	86.2
Household location		
Urban	3844	84.0
Rural	730	16.0
Mean number of servings of starchy foods per day		
<3	1638	35.8
≥ 3 and <6	2501	54.7
≥ 6	435	9.5
Whole-grain food consumption (bread, pasta and rice)		
No	2596	56.8
Yes	1978	43.2

* Recommendations of the 'Programme National Nutrition Santé' for 2001–10: (1) 'starchy foods: at each meal, according to appetite', translated as ' ≥ 3 and <6 ' for the evaluation; (2) 'whole-grain foods: favour their consumption among starchy foods when possible'. Sugared foods such as sugary breakfast cereals are not considered starchy foods.

while 35.8% fell short of it and 9.5% were above it. The proportion of whole-grain product consumers was 43.2%.

Adherence to recommendations according to sociodemographic and socioeconomic characteristics

Women were less likely to exceed the recommendation for starchy foods than men (Table 3).

Non-consumption of whole-grain products was associated with lower education level and was more frequent in men than in women (Table 3). Compared to managerial staff, self-employed/farmers and intermediate professions/employees were more likely to be non-consumers of whole-grain products.

Variety and types of starchy foods consumed

After adjustment for the number of dietary records provided by the subjects, the number of different starchy foods consumed during the survey (as a marker of variety) increased with education level ($P=0.0002$) and was lowest for manual workers ($P=0.03$) (data not tabulated). The starchy food cost was higher in men, in older subjects and in rural areas,

Table 2. Starchy food intake characteristics in the studied population (*n* 4574)

(Mean values and standard deviations)

	Mean	SD
Total energy intake* (kJ/d)	9153.1	2551.6
Proportion of energy intake provided by starchy foods (%)	24.0	6.6
Variety of food consumed		
Daily starchy food intake (g/d)	286.6	121.2
Number of servings of starchy foods per day†	3.8	1.7
Potatoes		
Percentage of starchy food intake	26.6	13.6
Number of servings per day	0.5	0.4
Bread		
Percentage of starchy food intake	44.6	15.1
Number of servings per day – refined	2.3	1.4
Number of servings per day – whole-grain	0.2	0.5
Pasta and semolina		
Percentage of starchy food intake	12.7	10.2
Number of servings per day – refined	0.2	0.2
Number of servings per day – whole-grain	0.01	0.03
Rice		
Percentage of starchy food intake	7.6	8.2
Number of servings per day – refined	0.1	0.1
Number of servings per day – whole-grain	0.01	0.04
Pulses		
Percentage of starchy food intake	4.3	6.1
Number of servings per day	0.1	0.1
Breakfast cereals (without added sugar)		
Percentage of starchy food intake	2.4	5.9
Number of servings per day	0.2	0.5
Other starchy foods‡		
Percentage of starchy food intake	1.8	2.4
Number of servings per day	0.1	0.1
Number of different starchy foods reported during the survey§	5.3	1.1
Daily costs (€/d)		
Total daily food cost	5.8	1.8
Total daily starchy food cost	0.5	0.2

* Including alcohol.

† One serving was defined as 200 g for cooked pasta/semolina, rice, pulses and other starchy foods; 150 g for potatoes; 50 g for bread and 30 g for breakfast cereals.

‡ Tapioca, chestnuts, manioc, sweet potatoes, taros, ignam, starch and plantain.

§ The seven different categories of starchy foods were potatoes, bread, pasta/semolina, rice, pulses, unsweetened breakfast cereals and other starchy foods. The median number of days of dietary record was eleven.

|| Including alcoholic and non-alcoholic beverages. 1€ = 1.37 US\$ (as of 12 May 2009).

and was inversely associated with occupational category (Table 4). In men, the daily cost for potatoes, pasta/semolina, rice and pulses was higher than in women, and it was lower for bread and other starchy foods. The proportion of the starchy food cost devoted to pasta/semolina decreased with age, while that devoted to other starchy foods increased with age. The portion of the starchy food cost devoted to potatoes decreased with education level, while that devoted to rice and unsweetened breakfast cereals increased with education level.

Discussion

In our population-based study conducted in 1995–7, about 55 % of subjects complied with the starchy food recommendation, 36 % fell short of it and 9.5 % exceeded it.

Dietary information dating from that period, i.e. the mid/late 90s, is of interest. Indeed, before the start of the French Nutrition and Health Programme in 2001, nutritional messages were not widespread, and recommendations reached only those who sought them out. Moreover, starchy foods were generally negatively perceived as being 'stodgy'. Since 2001, due to intensive media campaigns, several health and nutritional messages have become familiar to the general French population. A new challenge lies in the ability to understand and make use of such messages. Nevertheless, up until now, advice concerning starchy foods was not widespread. Its diffusion (conveyed by television advertisements) began in 2008 and will increase in the near future, justifying the importance of historical data on consumption of these products and identification of sociodemographic and socio-economic factors associated with quality and variety.

In the recent national nutrition and health survey (Étude Nationale Nutrition Santé; ENNS, 2006–7)⁽²⁸⁾ based on a representative sample of the French population, 47 % of subjects in the same age group (45–60 years old) complied with the starchy food recommendation, 44 % fell below it and 9 % were above it. The differences observed between the two studies could be interpreted as a 10-year evolution in compliance with starchy food recommendations. However, caution is needed when interpreting this comparison. Indeed, our subjects were volunteers participating in a nutritional intervention study⁽²²⁾ who generally had a higher education level and occupational status, along with a healthier diet, than the general population. Furthermore, a bias might lie in overreporting of healthy food items (such as whole-grain products) among those with a higher education level, as was observed for fruits and vegetables⁽³⁰⁾. Nevertheless, the selection of at least six 24-h dietary records over a 2-year period represents one strength of the present study, as it enabled reliable diet estimation and limited misclassification by decreasing intra-individual variations⁽³¹⁾. Low intake with respect to recommendations for starchy foods^(8,32,33), bread⁽³⁴⁾ and pulses^(8,35,36) had also been reported previously in other countries.

In the present study, men were more likely than women to exceed the starchy food recommendation (16 v. 2 %), which was in agreement with the literature that reported higher starchy food intake in men⁽²⁰⁾.

This result could be partly explained by the fact that identical serving sizes were used for men and women in order to be consistent with the official French recommendation, which does not mention any difference in serving size between sexes. However, this finding was statistically significant even after adjustment for total energy intake. Excessive intake should therefore be monitored in men. However, on the whole, only about 9 % of subjects exceeded the recommendation in our population, as in the ENNS study. This percentage was far lower than that observed in the same population for animal products (about 30 % for meat/seafood/eggs; data not shown). This suggests that avoiding excessive intake of starchy foods is less crucial than for other food groups. Indeed, in the age range examined here, increasing the daily consumption of these sources of complex carbohydrates with good satiating properties⁽³⁾ remains the main objective.

Nutritional values of the different starchy foods are complementary. Therefore, the national recommendation for

Table 3. Compliance with the starchy food recommendation and whole-grain food (bread, pasta and rice) consumption according to sociodemographic and socioeconomic characteristics (*n* 4574)*

(Relative risk ratios (RRR), odds ratios and 95 % confidence intervals)

	Below v. meeting the starchy food recommendation†		Above v. meeting the starchy food recommendation†			Non-consumer v. consumer of whole-grain foods‡		
	RRR	95 % CI	RRR	95 % CI	P§	OR	95 % CI	P§
Sex					0.001			0.001
Male	1.00		1.00			1.00		
Female	1.15	0.96, 1.38	0.48	0.31, 0.74		0.79	0.68, 0.91	
Age (years)					0.05			0.8
45–49	1.00		1.00			1.00		
50–54	1.00	0.84, 1.20	0.90	0.67, 1.21		1.12	0.97, 1.28	
55–60	0.77	0.64, 0.94	0.99	0.74, 1.33		1.01	0.87, 1.17	
Education level					0.7			0.01
Elementary school	1.00		1.00			1.00		
Secondary school	1.00	0.81, 1.24	0.88	0.64, 1.22		0.96	0.82, 1.14	
University or equivalent	1.08	0.86, 1.37	0.91	0.63, 1.31		0.81	0.68, 0.97	
Occupational category					0.1			0.02
Managerial staff	1.00		1.00			1.00		
Self-employed, farmers	0.91	0.61, 1.36	1.66	0.96, 2.89		1.57	1.15, 2.14	
Intermediate professions, employees	0.82	0.67, 1.01	1.15	0.85, 1.56		1.19	1.02, 1.38	
Manual workers	0.87	0.56, 1.36	1.91	1.13, 3.23		1.24	0.90, 1.72	
Never employed	0.71	0.49, 1.02	1.32	0.45, 3.90		1.01	0.75, 1.37	
Marital status					0.4			0.1
Living alone	1.00		1.00			1.00		
Cohabiting	1.00	0.80, 1.25	1.34	0.88, 2.04		1.14	0.96, 1.35	
Household location					0.1			0.5
Rural	1.00		1.00			1.00		
Urban	1.25	1.01, 1.56	1.01	0.73, 1.39		1.05	0.89, 1.24	

* RRR, OR and 95 % CI are determined by logistic regression analyses. Variables included in the model were sex, age, education level, occupational category, marital status, household location and total daily energy intake. Additional adjustment for the number of dietary records was performed in the whole-grain model.

† Polytomic regression analysis, with common reference = starchy foods: ≥ 3 and < 6 servings/d v. either < 3 or ≥ 6 servings/d.

‡ Dichotomic regression analysis. The modelled probability is 'whole-grain foods: non-consumer'.

§ Overall *P* for sex, occupational category, marital status and household location and *P*-trend for age and education level.

starchy foods is accompanied by advice on variety⁽⁶⁾. We found very little literature that had examined variety in starchy food consumption^(37,38), and to our knowledge, none provided details on differences in starchy food variety according to sociodemographic and socioeconomic characteristics. In the present study, the diversity of starchy food intake increased with education level and was lowest for manual workers, which is in accordance with previously published results on variety in fruits and vegetables⁽³⁹⁾ and diet as a whole⁽³⁸⁾.

Generally speaking, starchy foods are relatively inexpensive. Indeed, they represented only 8.6 % of the total daily food cost in the present study, while they provided an average of about a quarter of the total energy intake. The fact that starchy foods are an inexpensive source of energy could partly explain the observed inverse gradient between occupational category and the proportion of the food budget devoted to starchy foods. It might be hypothesised that the satiety:cost ratio of the starchy food group is particularly appreciated by disadvantaged subjects. In line with previously published findings, we observed that subjects with a higher education level spent more on 'modern' foods such as high-quality breakfast cereals (without added sugar)^(9,14,17) and rice⁽¹⁴⁾, but less on traditionally recommended foods such as potatoes^(8,15). As starchy foods are usually low-priced, it was not surprising to observe cost differences of only a few cents in the present study. However, a slight difference of only 0.3 €/d represents 3 €/month. In a household of four

persons, for example, this could reach $3 \times 4 = 12$ €/month, which is not to be ignored in the food budget of relatively low-income families, especially considering that this is only part of the overall cost-related food pattern. Further information (unavailable in the present study) on preparation of starchy foods (addition of fats, salt, salsa, etc.) would be of interest, as this could influence the relationship between types of starchy foods consumed and sociodemographic and socioeconomic factors.

Thus far, starchy foods have had a rather negative and fattening image. Women, who are generally more concerned about their weight, spent less on potatoes, pasta/semolina, rice and pulses than men, which is in agreement with the literature⁽²⁰⁾. Other factors (culture, generation and social context) may explain disparities in the types of starchy foods consumed by the different sociodemographic categories, as previously shown for fruits and vegetables⁽⁴⁰⁾. In contrast, availability is probably not a strong determinant of starchy food consumption due to a longer shelf life and ease of storage of such food products.

The present results showing higher whole-grain food consumption in women^(12,18) and in subjects with higher education levels^(14,18) and occupational categories^(10,11,18,19) are in accordance with the literature and with the healthy image of these foods. Low whole-grain food intake has been reported previously in many countries^(19,35,41). Despite a minor restrictive criterion for whole-grain consumers, only

Table 4. Distribution of starchy food cost across types of starchy foods according to sociodemographic and socioeconomic characteristics (*n* 4574)*

	Daily starchy food cost† (€/d)	Distribution of daily starchy food cost (%)						
		Potatoes	Bread	Pasta/semolina	Rice	Pulses	Breakfast cereals	Other starchy foods‡
Sex								
Male	0.52	14.51	65.99	4.45	2.60	4.83	4.43	3.18
Female	0.51	13.37	68.31	3.24	2.22	4.33	4.47	4.07
<i>P</i>	0.03	0.0005	<0.0001	<0.0001	0.0009	0.03	0.9	<0.0001
Age (years)								
45–49	0.51	13.66	67.21	4.12	2.44	4.58	4.73	3.26
50–54	0.50	14.15	66.75	3.83	2.46	4.73	4.58	3.50
55–60	0.53	14.02	67.48	3.58	2.33	4.43	4.05	4.11
<i>P</i> -trend	<0.0001	0.2	0.7	0.0001	0.3	0.6	0.09	<0.0001
Education level								
Elementary school	0.51	14.53	67.41	3.92	2.22	4.59	3.70	3.64
Secondary school	0.52	13.84	67.30	3.84	2.33	4.63	4.44	3.61
University or equivalent	0.52	13.45	66.73	3.77	2.67	4.52	5.22	3.63
<i>P</i> -trend	0.7	0.007	0.3	0.4	0.001	0.8	0.001	0.98
Occupational category								
Managerial staff	0.49	13.55	67.29	3.91	2.39	4.31	5.28	3.27
Self-employed, farmers	0.51	14.26	66.85	3.80	2.23	5.14	3.69	4.03
Intermediate professions, employees	0.51	13.87	67.12	3.72	2.39	4.53	4.76	3.62
Manual workers	0.53	14.32	66.98	4.02	2.55	4.52	4.26	3.36
Never employed	0.54	13.71	67.50	3.77	2.49	4.40	4.28	3.86
<i>P</i>	0.0004	0.7	0.99	0.7	0.8	0.5	0.3	0.06
Marital status								
Living alone	0.51	13.73	66.73	3.92	2.51	4.84	4.66	3.62
Cohabiting	0.52	14.16	67.56	3.77	2.31	4.32	4.25	3.63
<i>P</i>	0.4	0.2	0.2	0.4	0.1	0.06	0.4	0.96
Household location								
Rural	0.53	14.22	66.89	3.78	2.43	4.60	4.33	3.76
Urban	0.51	13.66	67.41	3.91	2.39	4.56	4.58	3.50
<i>P</i>	0.002	0.1	0.4	0.5	0.8	0.9	0.6	0.1

* Variables included in the ANOVA models were sex, age, education level, occupational category, marital status, household location and total daily energy intake.

† 1 € = 1.37 US\$ (as of 12 May 2009).

‡ Tapioca, chestnuts, manioc, sweet potatoes, taros, ignam, starch and plantain.

43 % of our subjects were consumers of whole-grain bread, pasta or rice. However, we did not include whole-grain breakfast cereals in our analyses of whole-grain foods since the whole-grain-specific information was not available for these products in the present study. In addition, in France, according to official legislation, ‘whole-grain bread’, ‘whole-grain pasta’ and ‘whole-grain rice’ designate foods prepared with 100 % whole-grain ingredients. Therefore, since the whole-grain specification was left to the subject’s discretion in the present study, the consumption of partially whole-grain foods (e.g. bread with 50 % of whole meal starch) may have been underestimated. Moreover, since 1995–7, availability of whole-grain pasta and rice has increased; thus, the corresponding prevalence may currently be higher. A limitation of the present study was that participants with few records had a less chance to meet the ‘whole-grain criterion’. However, subjects who did not even consume at least 50 g whole-grain foods during 6 d were in any case poor consumers. Besides, the prevalence of whole-grain consumption was close in subjects with number of records below and above the median (41 and 45 %, respectively, data not shown). Finally, analysis performed to investigate characteristics associated with whole-grain consumption was adjusted for the number of dietary records.

There is a consistent inverse association between whole-grain products and several chronic diseases in epidemiological studies^(1–3). Therefore, policy makers, scientists and clinicians

should intensify efforts to include clear messages on the beneficial effects of whole-grain foods in public health measures and clinical practice. While awareness of the health benefits of whole-grain foods is on the increase, classification and identification of these foods at the point of purchase may represent major barriers to attaining daily recommended levels of whole-grain intake⁽⁴²⁾.

Specific and strategic stakes for the starchy food group include variety, priority given to whole-grain products and the need to increase overall consumption within the limits of the recommendations. In this context, the present study provides original data on determinants of starchy food consumption in a large general population, simultaneously taking into account occupational category and education level in addition to other sociodemographic factors, as recommended^(43–45). Further information on identification of whole-grain products and related health benefits, as well as development of diversified, tasty, low-cost, easy-to-prepare pulses and whole-grain foods, could significantly improve the quality and variety of starchy food intake. The ongoing French Nutrition and Health Programme, as well as similar public health plans worldwide, would benefit from a better understanding of the influence of budgetary constraints, nutritional awareness, social context and environmental barriers upon food choices. This should help to more efficiently elaborate measures for improving behaviours implicated in chronic disease risk.

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