

Sociodemographic Factors and Attitudes toward Food Affordability and Health Are Associated with Fruit and Vegetable Consumption in a Low-Income French Population^{1,2}

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Abstract

Determinants of fruit and vegetable consumption, including affordability and attitudes, have been poorly investigated, especially in European deprived populations. Our objective was to analyze various determinants of low consumption of fruits and vegetables in disadvantaged participants. Our participants were randomized into 2 groups, 1 which received nutritional advice alone and 1 that also received vouchers that were exchangeable for fruits and vegetables during a 12-month period. Socioeconomic characteristics, food insufficiency, affordability, and motivation for eating fruits and vegetables were assessed. A short FFQ was administered. Determinants of consumption of <1 fruit or vegetable/d were analyzed using multivariate logistic regression. A total of 295 participants were included (mean age 44.8 y; 133 men, 162 women). At baseline, mean daily consumption of fruits and vegetables was 2.13 ± 1.57 times/d. Nearly 30% of the sample did not eat fruits and vegetables every day. Determinants of low fruit and vegetable consumption were: age younger than 55 y, education level lower than tertiary, and absence of financial means for buying fruits and vegetables daily. Other determinants were affordability (whether fruits and vegetables are affordable, lack of money in preventing healthy diet) and attitudes (whether one's own diet is healthy, whether or not fruits and vegetables improve health, whether eating fruits and vegetables is a pleasure). Thus, determinants of inadequate consumption of fruits and vegetables in this deprived French population are numerous. The impact of financial difficulties is crucial, as is the perception of affordability of fruits and vegetables. J. Nutr. 140: 823–830, 2010.

Introduction

Reviews of epidemiological studies have reported a protective effect of fruits and vegetables against various types of cancers (1) and cardiovascular disease (2). Health authorities recommend a daily intake of at least 400 g of fruits and vegetables or the equivalent of 5 servings of these foods (3). However, only 20–30% of Americans (4) and 43% of the French (5) meet this recommendation. In the US, low-income populations in particular have a higher risk of consuming a diet poor in fruits and vegetables compared with higher socioeconomic groups (6–8); this observation has also been confirmed in European countries

(9). Consumption of the recommended ≥ 5 servings of fruits and vegetables was reported for only 18% of low-income women living in social housing in the UK (6) and in 24% of African-American women living in a poor suburb of Detroit (10). In a French group of food aid users, only 5.5% declared that they ate fruits and vegetables ≥ 3.5 times/d (11).

Since the 1990s, increasing the consumption of fruits and vegetables has been a public health goal (12). Programs promoting fruit and vegetable intake in adults via counseling and information have led to a modest but significant increase in intake (13). In the US, interventions have been carried out among low-income populations involving delivery of vouchers or food baskets, including the Women-Infants-Children (WIC)⁶

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⁶ Abbreviations used: EPICES, Evaluation de la Précarité et des Inégalités de Santé pour les Centres d'Examens de Santé – Assessment of deprivation and inequalities for the CES; OR, odds ratio; WIC, Women-Infants-Children.

program (14) and the Farmers' Market Nutrition Program (15). However, the efficiency of such interventions needs to be improved. This raises the question of determining factors in fruit and vegetable consumption. Various determinants of fruit and vegetable consumption have been identified in the general population both at the individual level [women with poor education level (16), women of African-American origin (17), cultural factors, financial status, health considerations, nutritional knowledge] and at the environmental level [accessibility, availability, social support (18)]. Accessibility and availability appear to be the main determinants in countries such as the US (10,19). In a deprived British population, reported barriers were access and affordability as well as motivation for eating a healthy diet (6). However, data on these issues remain scarce in Europe.

In France, we implemented a randomized controlled study in a deprived population to evaluate the impact of providing vouchers and nutritional counseling on fruit and vegetable consumption over a 12-mo period. The objectives of the present paper were to describe baseline characteristics of the cohort and to assess determinants of very low consumption of fruits and vegetables, i.e. <1 time/d, in the population of all included participants. Determinants examined included socioeconomic variables (18), perceptions of affordability, and attitudes (20) toward fruit and vegetable intake.

Methods

Participants and methods. Recruitment was conducted from December 2007 to April 2008 among individuals undergoing a health examination at a center affiliated with the French national insurance system in a deprived area. The Seine-Saint Denis, a suburb of Paris, is an economically disadvantaged department with a high percentage of unemployment (12.4%) and foreigners (18.7%) compared with national averages (9.1 and 7.4% of the population, respectively) (21). For each participant, the deprivation level was assessed using the Evaluation de la Précarité et des Inégalités de Santé pour les Centres d'Examens de Santé—Assessment of deprivation and inequalities for the CES (EPICES) score (22). The EPICES score was developed to easily detect deprivation at such health centers (23). Regression analysis showed that 11 variables on a 42-item questionnaire explained 90% of the variance in the deprivation axis. The 42 questions included traditional socioeconomic indicators (education, income, and occupation) and also questions related to family structure, housing conditions, social benefits, financial difficulties, leisure activities, social support, childhood/adult life events, self-perceived health, and health care utilization. The EPICES score is calculated from responses to the 11 selected questions. The score varies from 0 to 100, from the least deprived to the most deprived situation, with a cutoff of 40.2 defining deprivation (23). The EPICES score was validated in 2002 in 200,000 participants examined at 58 French health examination centers (23). Participants with an EPICES score higher than 40.2 were eligible for entry into the present study. Additional eligibility criteria were age ≥ 18 y and the ability to speak French (unless an interpreter was available). One responder per household was enrolled.

During the 4-mo period of recruitment, 1876 persons of the 3841 who came to the center had an EPICES score higher than 40.2. Approximately 350 persons were invited to participate in the study and 302 of them agreed to do so. The most frequent reasons for refusing to participate in the study were “lack of time” and “not interested.” Among the 302 participants who agreed to participate, 7 were excluded due to missing data, errors in calculating the EPICES score, or pregnancy.

All participants provided informed consent. The study protocol was approved by the French Data Protection Authority (no. 907300, 11/12/2007) and by the Ethical Committee (Hôpital Hôtel Dieu, Paris, no. 0711642, 10/29/2007). At inclusion, participants completed questionnaires and were randomized into 2 groups: those in the first received dietary counseling and those in the second received both dietary advice

and vouchers for buying fruits and vegetables. To analyze determining factors, we used only baseline information from the entire cohort prior to randomization.

Data collection. Fruit and vegetable intake frequency was assessed at baseline using a questionnaire that included 16 items used to evaluate compliance with the National Nutrition and Health Program of the Program National Nutrition Santé recommendations (24). The questions were: 1) Do you eat fruits/vegetables every day? 2) If so, how often do you eat fruits/vegetables? Once a day/twice a day/3 times a day/4 times a day or more? 3) If not, do you eat fruits/vegetables 4–6 times a week/2–3 times a week/once a week or less/never?

Participants also completed a socioeconomic questionnaire containing information on occupation, education, marital status, number of persons living in the household, and car ownership (or temporary access).

Financial security of the household was assessed using a 4-point scale: 1) satisfactory; 2) we have to be careful about spending; 3) we barely manage; 4) it is hard not to go into debt. Food insufficiency was assessed via the following statements: 1) we eat all the food we want; 2) we have enough to eat, but don't always have a choice; 3) sometimes we don't have enough to eat; 4) often we don't have enough to eat (25). Food anxiety was assessed using the question “Are you worried about lacking food?” with the answers, “often,” “sometimes,” “rarely,” or “never.” Other questions were: 1) How much do you spend on food each week? 2) With your budget, can you buy fruits and vegetables every day?

In addition, participants were asked about their food purchasing habits, household equipment, refrigerators, stoves, freezers, etc. Participants were asked to estimate how often they went to different types of stores, specifying the kind of foods, the frequency, and means of transport. They also answered questions, adapted from previous studies, on the availability and affordability of products, as follows (6,10): 1) there are many different food stores in my area; 2) where I shop, there is a wide choice of fresh fruits/vegetables; 3) it is easy for me to go to the supermarket (on foot, by car, or using public transportation); 4) I feel that fruits and vegetables are affordable to me in the shop where I buy; 5) I can't afford to buy more fruits and vegetables; 6) lack of money prevents me from eating healthily. Self-perception of diet was assessed using 3 statements: 1) I eat well; 2) I eat enough fruits and vegetables to stay healthy; 3) I enjoy eating fruits and vegetables. For these questions concerning availability, affordability, and perception of diet, a 5-point scale was used as follows: 1) I strongly agree; 2) I more or less agree; 3) I neither agree nor disagree; 4) I disagree somewhat; 5) I strongly disagree.

Data treatment and analysis. Data treatment and statistical analyses were performed using SAS (version 9.1; SAS Institute). Declared fruit and vegetable intake was expressed as daily intake frequency. We created the variable daily fruit and vegetable intake frequency by summing daily intake frequency of fruits and daily intake frequency of vegetables. For the primary outcome in the analysis, participants were categorized into those who did not consume fruits and vegetables each day and those who ate fruits and vegetables once per day or more. Occupational and education categories were divided into 4 and 3 categories, respectively (Table 1). The EPICES score was used as a 2-class variable: 40.2–60.5 (moderate deprivation) and ≥ 60.5 (severe deprivation), with 60.5 being the median in our sample. Questions about financial insecurity, food insufficiency, and food anxiety were treated as 2 modalities (Table 1). For questions using the 5-point scale (availability, affordability, and self-perception), we grouped participants into 3 classes: “strongly or moderately agree,” “neither agree nor disagree,” and “moderately or strongly disagree.” Values in the text and tables are means \pm SD for continuous variables and percentages for categorical variables.

We analyzed determinants of low frequency of fruit and vegetable consumption (less than once per day) using univariate and multivariate logistic regressions. As complex relationships between various determinants exist (18,20), questions concerning socioeconomic status, affordability, and self-perception of fruit and vegetable intake were analyzed separately.

TABLE 1 Sociodemographic characteristics of all participants¹

	Men		Women		All	
	<i>n</i>		<i>n</i>		<i>n</i>	
Age, y	133	45.0 ± 8.4	162	44.6 ± 8.1	295	44.8 ± 8.2
Age group, %						
30–54 y	110	82.7	136	84.0	246	83.4
55–60 y	23	17.3	26	16.0	49	16.6
Gender, %	133	45.1	162	54.9	295	100
Occupation, %						
Full-time job	52	39.4	45	28.0	97	33.1
Part-time job	14	10.6	26	16.2	40	13.7
Unemployment with insurance	55	41.7	44	27.3	99	33.8
Without activity	11	8.3	46	28.6	57	19.4
Education level, %						
None or primary	49	37.1	71	43.8	120	40.8
Secondary	63	47.7	69	42.6	132	44.9
Tertiary	20	15.2	22	13.6	42	14.3
Marital status, %						
Married or living with a partner	81	60.9	81	50.0	162	54.9
Single or not living with a partner	52	39.1	81	50.0	133	45.1
Had at least 1 child, %						
Yes	70	55.1	116	74.4	186	65.7
No	57	44.9	40	25.6	97	34.3
EPICES score, ² %	133	61.3 ± 13.8	162	61.8 ± 13.6	295	61.6 ± 13.7
Smokers, %	22	33.8	45	13.7	67	22.8
Financial situation of the household, %						
It is satisfactory, or we need to pay attention	68	51.1	71	43.8	139	47.1
We barely manage, or It is hard not to go into debt	65	48.9	91	56.2	156	52.9
Food budget, ³ %						
<30€/wk	30	22.6	26	16.1	56	19.0
30 – <80€/wk	43	32.3	71	43.8	114	38.6
80 – <150€/wk	35	26.3	48	29.6	83	28.1
≥150€/wk	25	18.8	17	10.5	42	14.3
Food insufficiency of the household, %						
We can eat all the food we want/we have enough to eat but not all the types of food we would like	118	88.7	125	77.2	243	82.4
We sometimes/often don't have enough food	15	11.3	37	22.8	52	17.6
Anxiety about lacking food, %						
Often or sometimes	52	39.1	79	49.1	131	44.6
Rarely or never	81	60.9	82	50.9	163	55.4
Financial means for purchasing fruits and vegetables each day, %						
No	53	39.9	64	39.5	117	39.7
Yes	80	60.1	98	60.5	178	60.3
Access to a car, %						
No	56	42.1	81	51.3	137	47.1
Yes	77	57.9	77	48.7	154	52.9

¹ Values are means ± SD or percentages.² EPICES score was higher than 40.2 for all (inclusion criteria used to select this low-income population).³ Food budget is expressed in Euros/wk.

We assessed 3 models. In a first model, we evaluated the association between socioeconomic variables and risk of low fruit and vegetable intake frequency. The second model explored the relationship between affordability and low fruit and vegetable consumption frequency. Finally, in the 3rd model, we investigated the relationship between perception of one's diet, fruit and vegetable intake, and risk of low fruit and vegetable consumption frequency.

Odds ratios (OR) for low fruit and vegetable consumption frequency are presented with their 95% CI. Two-tailed *P*-values < 0.05 were considered significant.

For each model, variables of interest analyzed in univariate and multivariate logistic regressions are listed in the corresponding table.

Gender and age were forced as potential confounders in the first model, which evaluate socioeconomic determinants.

Multivariate logistic regression models were constructed using stepwise backward elimination. Initially included variables were selected from univariate analyses with a *P* < 0.20. Variables were removed from the model 1 by one using a *P* > 0.05 for exclusion. Factors retained in the final model were those significantly (*P* < 0.05) associated with low frequency of fruit and vegetable consumption and those identified as confounding factors (e.g. modifying other OR by >10% when they were taken out or variables whose exclusion gave rise to significant Wald's test (*P* < 0.05)).

Results

Characteristics of the 295 participants included (133 men, 162 women, 30–60 y old) are presented in Table 1. More than one-half of the women were unemployed or homemakers. The sample was equally divided into the 3 levels of education. More than two-thirds of participants had children. The weekly cost of household food was 86.1 ± 54.9 Euros (US\$ 125.4 ± 79.9). More than one-half of the sample suffered from a poor financial situation self-described as “we barely manage” or “it is hard not to go into debt.” Women declared that “we sometimes/often don’t have enough food” twice as frequently as men.

Fruit and vegetable intake frequency. Participants estimated their fruit and vegetable intake frequency to be 2.13 ± 1.57 times/d. Fruit intake was 1.19 ± 1.06 times and vegetable intake was 0.94 ± 0.79 times/d.

Frequency of fruit consumption was reported to be less than once per day in 67.7% of the participants, 1–2 times/d in 17.7% of participants, and ≥ 3 times/d in 14.6% of participants. For vegetables, the distribution was 76.2, 20.5, and 3.3%, respectively. For fruit and vegetable consumption, the distribution was 29.4, 39, and 31.6%. Nearly 30% (29.4%) ate no fruits or vegetables daily (31.7% of men and 27.4% of women). This low consumption was reported in 32.5% of participants between 30 and 54 y of age and in 13.6% of those aged 55–60 y. Among 31.6% of participants who ate fruits and vegetables at least 3 times daily, those consuming fruits and vegetables at least 5 times/d represented 7.0%.

Affordability and availability of fruits and vegetables. About one-half of the participants (47.0%) reported purchasing food at least once per week at discount stores and 8.7% went to food aid distribution centers. Food expenses were similar at all food stores. Forty-three percent of persons went to the store on foot; mean walking time was 13.2 ± 10.1 min. In addition, 7.1% declared that they moderately or strongly disagreed with the fact that a wide choice of food shops was available in their area. A few participants complained about the unavailability of fresh fruits and vegetables (1.8%), frozen fruits and vegetables (5.5%), and tinned fruits and vegetables (1.8%). Nearly all households had a refrigerator (98.3%), but 25.2% had no freezer, 19.8% no oven, and 12.4% no microwave oven.

Determinants of fruit and vegetable consumption. Daily frequency of fruit and vegetable consumption was not significantly related to demographic or socioeconomic variables such as gender, occupation, marital status, children, weekly food budget, or access to a car (Table 2). In univariate analysis, low consumption of fruits and vegetables was associated with secondary school level, severe deprivation (estimated through a higher EPICES score), financial situation, food insufficiency, anxiety about lacking food, lack of financial means for buying fruit and vegetables every day, and age younger than 55 y. Variables selected from univariate analysis for introduction into the multivariate model were occupation, education level, EPICES score, financial situation, food insufficiency, anxiousness about lacking food, financial means to buy fruits and vegetables each day, mean expenses, age group, and sex. After stepwise backward elimination proceeding, levels of education lower than the tertiary level, age <55 y, and insufficient financial means for buying fruits and vegetables daily were independently associated with low frequency of fruit and vegetable consumption.

Associations between affordability and low frequency of fruit and vegetable consumption are presented in Table 3. In univariate analysis, participants who declared that they moderately or strongly disagreed with the fact that “fruits and vegetables are affordable” or that “lack of money prevents me from eating healthily” were at higher risk of not eating fruits and vegetables daily compared with participants who declared that they moderately or strongly agreed. The other perception of affordability (“I cannot afford to buy more fruits and vegetables”) was not related to intake. The 2 variables (“I feel that fruits and vegetables are affordable...” and “Lack of money prevents me...”) were included in multivariate analysis. Both factors remained significant in multivariate analysis.

In another model, attitudes and healthy diet perception in relationship to consumption of fruits and vegetables were explored (Table 4). In univariate analysis, participants who declared having an unhealthy diet or who disliked an insufficient intake of fruits and vegetables were more likely to be low consumers of fruits and vegetables. Individuals who neither agreed nor disagreed with the statement “I enjoy eating fruits and vegetables” were at higher risk of low consumption of fruits and vegetables than those who agreed with that statement. In a multivariate model, all 3 previous variables were included and all associations remained independently significant.

Discussion

This study was conducted to identify determinants of low frequency of fruit and vegetable consumption in economically disadvantaged individuals. We showed that about one-third of this deprived French population reported eating fruits and vegetables less than once a day. Participants had a greater risk of being low consumers if they were <55 y of age, had less than a tertiary education level, and lacked the financial means for purchasing fruits and vegetables. For subjective determinants concerning affordability, they were more likely to be low consumers if they disagreed with the notion that fruits and vegetables are affordable or if they agreed with the fact that lack of money prevents one from eating healthily. Concerning attitudes, participants who were more likely to be poor consumers were those who disagreed with the statements that their diet was healthy, that their diet included enough fruits and vegetables for their health, or those who neither agreed nor disagreed that they enjoy eating fruits and vegetables.

Context of our study. The identification and description of deprived persons has become an important goal in public health policies, because socioeconomic differences in mortality and morbidity rates have increased over the last few years (26). About one-third of our sample reported eating fruits and vegetables less than once a day. This result was consistent with previous studies in the US (6,15,27). Indeed, in a low-income population in the US receiving social security benefits (6), 49% of participants claimed they ate between 0 and 2 portions of fruits and vegetables daily (compared with 58% for 0–2 fruits and vegetables in our study). In the WIC Program, daily consumption reached the equivalent of 5.4 servings prior to any intervention (27), which was higher than that reported by our participants (2.1 fruits and vegetables/d) but using different methods [4 24-h recalls in the WIC study (27)].

Moreover, only 7.0% of our participants declared that they ate ≥ 5 fruits and vegetables/d. This result is close to, albeit slightly higher, than that found in a sample of individuals

TABLE 2 Socioeconomic determinants of low fruit and vegetable consumption by low-income French men and women^{1,2}

	Daily consumption of fruits and vegetables			
	Univariate analysis		Multivariate analysis	
	OR [95% CI] ¹	P	OR [95% CI] ²	P
Occupation				
Part-time job	0.71 [0.27; 1.84]	0.48	—	—
Unemployment with insurance	1.85 [0.97; 3.52]	0.06	—	—
Without activity	1.33 [0.63; 2.80]	0.46	—	—
Full-time job	1.00			
Education level ³				
None or primary	2.36 [0.90; 6.16]	0.08	2.76 [1.02; 7.48]	0.048
Secondary	2.75 [1.07; 7.09]	0.04	3.28 [1.18; 9.12]	0.03
University	1.00		1.00	
Marital status				
Married or living with a partner	1.05 [0.62; 1.78]	0.85	—	—
Single	1.00			
Have at least 1 child				
Yes	0.95 [0.55; 1.65]	0.86	—	—
No	1.00			
EPICES score ³				
Severe	1.81 [1.07; 3.08]	0.03	1.64 [0.92; 2.90]	0.09
Moderate	1.00		1.00	
Financial situation ³				
We barely manage/it's hard not to go into debt	2.02 [1.18; 3.46]	0.01	—	—
It is satisfactory/we have to be careful	1.00			
Food insufficiency of the household ³				
We sometimes/often lack food	2.58 [1.36; 4.87]	0.004	1.77 [0.88; 3.57]	0.11
We can eat all the food we want/we have enough to eat but not all the types of foods we would like	1.00		1.00	
Anxiety about lacking food ³				
Often or sometimes	1.71 [1.01; 2.89]	0.045	—	—
Rarely or never	1.00			
Financial means for buying fruits and vegetables every day ³				
No	3.55 [2.02; 6.23]	<0.0001	3.30 [1.80; 6.04]	<0.0001
Yes	1.00		1.00	
Mean expenses, €/wk				
<30	1.63 [0.68; 3.94]	0.28	—	—
30 – <80	1.00 [0.45; 2.22]	0.99	—	—
80 – <150	0.51 [0.21; 1.24]	0.14	—	—
≥150	1.00			
Access to a car				
No	1.69 [1.00; 2.86]	0.051	—	—
Yes	1.00			
Age category ⁴				
30–54 y	3.04 [1.23; 7.52]	0.02	2.76 [1.07; 7.14]	0.04
55–60 y	1.00		1.00	
Sex ⁴				
Women	0.81 [0.48; 1.37]	0.43	0.69 [0.39; 1.23]	0.21
Men	1.00		1.00	

¹ Univariate OR for fruit and vegetable consumption (less than once per day).² Multivariate OR for fruit and vegetable consumption (less than once per day).³ Variables included in the multivariate analysis are those selected from univariate analysis with a $P < 0.20$. Variables presented in the final model are those retained after stepwise backward elimination.⁴ Age category and sex were systematically included in multivariate analysis.

benefiting from food aid, where only 1.2% declared eating at least 5 fruits and vegetables/d (using the same questionnaire) (11). Our results underlined the strong association of deprivation with poor diet quality (28) and much lower consumption of fruits and vegetables than in the general population (5).

Socioeconomic characteristics. For our French low consumers of fruit and vegetables, we did not find a significant association with employment, marital status, household composition, or access to a car. This is in contrast to previous studies in various deprived populations, such as that involving women

TABLE 3 Perceptions of affordability and reasons for infrequency of consumption of fruits and vegetables of low-income French men and women¹

		Univariate analysis		Multivariate analysis	
		OR [95% CI]	P	OR [95% CI]	P
I feel that fruits and vegetables are affordable to me in the shop where I buy, %					
Moderately or strongly disagree	40.1	2.42 [1.28; 4.56]	0.01	2.43 [1.27; 4.66]	0.01
Neither agree nor disagree	24.3	1.49 [0.72; 3.09]	0.29	1.65 [0.78; 3.49]	0.19
Moderately or strongly agree	35.6	1.00		1.00	
I cannot afford to buy more fruits and vegetables, %					
Moderately or strongly agree	65.8	1.54 [0.75; 3.18]	0.24	—	—
Neither agree nor disagree	15.8	0.99 [0.38; 2.59]	0.98	—	—
Moderately or strongly disagree	18.4	1.00			
Lack of money prevents me from eating healthily, %					
Moderately or strongly agree	46.4	2.28 [1.16; 4.49]	0.02	2.06 [1.04; 4.11]	0.04
Neither agree nor disagree	26.8	1.11 [0.50; 2.46]	0.79	0.92 [0.41; 2.08]	0.85
Moderately or strongly disagree	26.8	1.00		1.00	

¹ Univariate and multivariate OR for fruit and vegetable consumption (less than once per day). Variables included in the multivariate model are those selected from univariate analysis with a $P < 0.20$. Ref, Reference class used for each variable.

in poor suburbs of Melbourne (16) or adults participating in programs promoting fruit and vegetable consumption in the US (29). As expected (28), the lowest education level carried the highest risk of low consumption of fruits and vegetables. The importance of financial means was evidenced by multivariate analysis. Those results are consistent with previous qualitative (17) and quantitative studies (6).

Availability, affordability, and attitude. In Great Britain (30), Finland (31), and especially in the United States (10,32), it has been shown that persons living in disadvantaged areas are at higher risk of eating an unhealthy diet, even after adjusting for individual socioeconomic characteristics. Our study suggests that, for persons having a low socioeconomic level, affordability remains a greater barrier than availability of fruits and vegetables. In fact, only a small percentage of our participants complained about an insufficient number of food stores. Availability is generally due to a large distribution center located in the area and numerous markets.

In our study, lack of affordability, along with a self-perceived unhealthy diet or one that is poor in fruits and vegetables, were related to low consumption of the latter. Most participants found that price was a major barrier to buying more fruits and vegetables. In the Netherlands, among food shopping environmental factors, the perceived high cost of fruits and vegetables was the major factor in low consumption of fruits and vegetables (33). Likewise, in the WIC program evaluation, major determinants of fruit and vegetable consumption included self-imposed barriers (e.g. cost), purchasing efficiency, and attitude (34).

Among our participants, a similar percentage of persons both complained about the cost of food and wished to eat more fruits and vegetables. Likewise, nearly all volunteers reported enjoying eating fruits and vegetables and disliked an unhealthy diet. This lends more importance to these results, because deprived individuals truly disliked their low fruit and vegetable consumption. In a previous study, three-quarters of low-income women thought that fruits and vegetables were affordable, whereas over one-half thought that purchasing additional fruits and vegetables

TABLE 4 Attitudes toward healthy eating and infrequency of fruit and vegetable consumption of low-income French men and women^{1,2}

		Univariate analysis		Multivariate analysis	
		OR [95% CI]	P	OR [95% CI]	P
I eat a healthy diet	%				
Moderately or strongly disagree	23.5	6.12 [3.10; 12.08]	<0.0001	2.71 [1.22; 6.02]	0.01
Neither agree nor disagree	30.5	1.76 [0.89; 3.46]	0.10	0.85 [0.39; 1.84]	0.68
Moderately or strongly agree	46.0	1.00		1.00	
I eat enough fruits and vegetables to keep healthy					
Moderately or strongly disagree	40.1	12.37 [5.46; 28.00]	<0.0001	10.27 [4.23; 24.90]	<0.0001
Neither agree nor disagree	23.9	3.53 [1.39; 8.95]	0.01	3.23 [1.20; 8.67]	0.02
Moderately or strongly agree	36.0	1.00		1.00	
I enjoy eating fruits and vegetables					
Moderately or strongly disagree	3.3	0.32 [0.04; 2.63]	0.29	0.10 [0.01; 0.86]	0.04
Neither agree nor disagree	5.5	4.95 [1.62; 15.07]	0.005	4.71 [1.33; 16.76]	0.02
Moderately or strongly agree	91.2	1.00		1.00	

¹ Univariate and multivariate OR for fruit and vegetable consumption (less than once per day).

² Variables included in the multivariate model are those selected from univariate analysis with a $P < 0.20$.

was prohibitively expensive (6). Psychosocial determinants of fruit and vegetable consumption could explain such discrepancies (20) and should be taken into account in surveys and nutritional policies.

Limitations. The French population in this study was of interest because it consisted of a high percentage of migrants generally having a low education level and a high EPICES score.

We used a specific deprivation score that does not permit comparison with other studies. The EPICES deprivation score was selected for our study and was chosen from among other validated deprivation indexes (35), because it is currently used in French health examination centers (23). Second, there was a bias in recruitment due to a poster that informed potential participants that deprivation may be a barrier to a healthy diet rich in fruits and vegetables. Such information may have led to overestimation of declared food insufficiency and unhealthy diet. Third, we used a FFQ that may have underestimated daily fruit and vegetable intake compared with quantitative assessment of the number of servings per day (36).

Finally, we hypothesized that a high percentage of our participants were migrants, as is the case for the general population in this area (18.7% of foreigners). Thus, dietary habits could differ between deprived migrants and other deprived persons and might also include differences according to the country of origin. Unfortunately, this information was not collected.

In conclusion, our study underlines the extremely low consumption of fruits and vegetables in a deprived population of participants, with nearly 30% of participants consuming no fruits or vegetables at all on a daily basis. This is one of the first studies in Europe to focus on determinants of such low consumption, confirming the role of various factors, sociodemographic characteristics, affordability, and attitude toward fruits and vegetables. Concomitantly, with information programs such as the Program National Nutrition Santé, implemented since 2001 to promote fruit and vegetable consumption, improvement in accessibility, e.g. by voucher distribution, could serve as a complement to other strategies.

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Literature Cited

- Hung HC, Joshipura KJ, Jiang R, Hu FB, Hunter D, Smith-Warner SA, Colditz GA, Rosner B, Spiegelman D, et al. Fruit and vegetable intake and risk of major chronic disease. *J Natl Cancer Inst*. 2004;96:1577–84.
- Dauchet L, Amouyel P, Hercberg S, Dallongeville J. Fruit and vegetable consumption and risk of coronary heart disease: a meta-analysis of cohort studies. *J Nutr*. 2006;136:2588–93.
- Expert Panel, World Cancer Research Fund, American Institute for Cancer Research. Food, nutrition, physical activity, and the prevention of cancer: a global perspective. World Cancer Research Foundation 2009. Available from: <http://www.wcrf.org>.
- Casagrande SS, Wang Y, Anderson C, Gary TL. Have Americans increased their fruit and vegetable intake? The trends between 1988 and 2002. *Am J Prev Med*. 2007;32:257–63.
- Castetbon K, Vernay M, Malon A, Salanave B, Deschamps V, Roudier C, Oleko A, Szego E, Hercberg S. Dietary intake, physical activity and nutritional status in adults: the French nutrition and health survey (ENNS, 2006–2007). *Br J Nutr*. 2009;102:733–43.
- Dibsdall LA, Lambert N, Bobbin RF, Frewer LJ. Low-income consumers' attitudes and behaviour towards access, availability and motivation to eat fruit and vegetables. *Public Health Nutr*. 2003;6:159–68.
- Rose D, Richards R. Food store access and household fruit and vegetable use among participants in the US Food Stamp Program. *Public Health Nutr*. 2004;7:1081–8.
- Smith GD, Brunner E. Socio-economic differentials in health: the role of nutrition. *Proc Nutr Soc*. 1997;56:75–90.
- Irala-Estevez JD, Groth M, Johansson L, Oltersdorf U, Prattala R, Martinez-Gonzalez MA. A systematic review of socio-economic differences in food habits in Europe: consumption of fruit and vegetables. *Eur J Clin Nutr*. 2000;54:706–14.
- Zenk SN, Schulz AJ, Hollis-Neely T, Campbell RT, Holmes N, Watkins G, Nwankwo R, Odoms-Young A. Fruit and vegetable intake in African Americans income and store characteristics. *Am J Prev Med*. 2005;29:1–9.
- Bellin-Lestienne C, Deschamps V, Noukpoapé A, Darmon N, Hercberg S, Castetbon K. [Consommations alimentaires et place de l'aide alimentaire chez les personnes incluses dans l'étude Abena, 2004–2005.] *Bulletin Epidémiologique Hebdomadaire*. 2006;11–12:79–81.
- Robinson T. Applying the socio-ecological model to improving fruit and vegetable intake among low-income African Americans. *J Community Health*. 2008;33:395–406.
- Pomerleau J, Lock K, Knai C, McKee M. Interventions designed to increase adult fruit and vegetable intake can be effective: a systematic review of the literature. *J Nutr*. 2005;135:2486–95.
- Havas S, Anliker J, Damron D, Langenberg P, Ballesteros M, Feldman R. Final results of the Maryland WIC 5-A-Day Promotion Program. *Am J Public Health*. 1998;88:1161–7.
- Johnson DB, Beaudoin S, Smith LT, Beresford SA, LoGerfo JP. Increasing fruit and vegetable intake in homebound elders: the Seattle Senior Farmers' Market Nutrition Pilot Program. *Prev Chronic Dis*. 2004;1:A03.
- Ball K, Crawford D, Mishra G. Socio-economic inequalities in women's fruit and vegetable intakes: a multilevel study of individual, social and environmental mediators. *Public Health Nutr*. 2006;9:623–30.
- Yeh MC, Ickes SB, Lowenstein LM, Shuval K, Ammerman AS, Farris R, Katz DL. Understanding barriers and facilitators of fruit and vegetable consumption among a diverse multi-ethnic population in the USA. *Health Promot Int*. 2008;23:42–51.
- Kamphuis CB, Giskes K, de Bruijn GJ, Wendel-Vos W, Brug J, van Lenthe FJ. Environmental determinants of fruit and vegetable consumption among adults: a systematic review. *Br J Nutr*. 2006;96:620–35.
- Algert SJ, Agrawal A, Lewis DS. Disparities in access to fresh produce in low-income neighborhoods in Los Angeles. *Am J Prev Med*. 2006;30:365–70.
- Shaikh AR, Yaroch AL, Nebeling L, Yeh MC, Resnicow K. Psychosocial predictors of fruit and vegetable consumption in adults: a review of the literature. *Am J Prev Med*. 2008;34:535–43.
- Ile de France ORS. [La santé observée en Seine-Saint-Denis] [cited 2009]. Available from: <http://www.seine-saint-denis.fr/IMG/pdf/ORS.pdf>. 2009.
- Bihan H, Laurent S, Sass C, Nguyen G, Huot C, Moulin JJ, Guegen R, Le Toumelin P, Le Clesiau H, et al. Association among individual deprivation, glycemic control, and diabetes complications: the EPICES score. *Diabetes Care*. 2005;28:2680–5.
- Sass C, Gueguen R, Moulin JJ, Abric L, Dauphinot V, Dupre C, Giordanella JP, Girard F, Guenot C, et al. Comparison of the individual deprivation index of the French Health Examination Centres and the administrative definition of deprivation. *Sante Publique*. 2006;18:513–22.
- Hercberg S, Chat-Yung S, Chaulia M. The French National Nutrition and Health Program: 2001–2006–2010. *Int J Public Health*. 2008;53:68–77.
- Radimer KL, Radimer KL. Measurement of household food security in the USA and other industrialised countries. *Public Health Nutr*. 2002;5:859–64.
- Menvielle G, Chastang JF, Luce D, Leclerc A. Changing social disparities and mortality in France (1968–1996): cause of death analysis by educational level. *Rev Epidemiol Sante Publique*. 2007;55:97–105.
- Herman DR, Harrison GG, Afifi AA, Jenks E. Effect of a targeted subsidy on intake of fruits and vegetables among low-income women in

- the Special Supplemental Nutrition Program for Women, Infants, and Children. *Am J Public Health*. 2008;98:98–105.
28. Darmon N, Drewnowski A. Does social class predict diet quality? *Am J Clin Nutr*. 2008;87:1107–17.
 29. Thompson B, Demark-Wahnefried W, Taylor G, McClelland JW, Stables G, Havas S, Feng Z, Topor M, Heimendinger J, et al. Baseline fruit and vegetable intake among adults in seven 5 a day study centers located in diverse geographic areas. *J Am Diet Assoc*. 1999;99:1241–8.
 30. Cummins S, Stafford M, Macintyre S, Marmot M, Ellaway A. Neighbourhood environment and its association with self rated health: evidence from Scotland and England. *J Epidemiol Community Health*. 2005;59:207–13.
 31. Karvonen S, Rimpela AH. Urban small area variation in adolescents' health behaviour. *Soc Sci Med*. 1997;45:1089–98.
 32. Morland K, Wing S, Diez Roux A. The contextual effect of the local food environment on residents' diets: the atherosclerosis risk in communities study. *Am J Public Health*. 2002;92:1761–7.
 33. Giskes K, van Lenthe FJ, Kamphuis CB, Huisman M, Brug J, Mackenbach JP. Household and food shopping environments: do they play a role in socioeconomic inequalities in fruit and vegetable consumption? A multilevel study among Dutch adults. *J Epidemiol Community Health*. 2009;63:113–20.
 34. Havas S, Treiman K, Langenberg P, Ballesteros M, Anliker J, Damron D, Feldman R. Factors associated with fruit and vegetable consumption among women participating in WIC. *J Am Diet Assoc*. 1998;98:1141–8.
 35. Townsend P. Deprivation. *J Soc Policy*. 1987;16:125–46.
 36. Willett WC. *Nutritional epidemiology*. 2nd ed. New York: Oxford University Press; 1998.