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A systematic review of socio-economic differences in food habits in Europe: consumption of fruit and vegetables

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Objective: To evaluate the differences in the consumption of fruit and vegetables between groups with different socio-economic status (SES) in the adult population of European countries.
Design: A systematic review of published and unpublished surveys of food habits conducted between 1985 and 1999 in 15 European countries. Educational level and occupational status were used as indicators of SES. A pooled estimate of the mean difference between the highest and the lowest level of education and occupation was calculated separately for men and women, using DerSimonian and Laird's random effects model.
Setting: The inclusion criteria of studies were: use of a validated method for assessing intake at the individual level; selection of a nationwide sample or a representative sample of a region; and providing the mean and standard deviation of overall fruit and vegetable consumption for each level of education or occupation, and separately for men and women.
Subjects: Participants in the individual surveys had to be adults (18–85 y).
Results: Eleven studies from seven countries met the criteria for being included in the meta-analysis. A higher SES was associated with a greater consumption of both fruit and vegetables. The pooled estimate of the difference in the intake of fruit was 24.3 g/person/day (95% confidence interval (CI) 14.0–34.7) between men in the highest level of education and those in the lowest level of education. Similarly, this difference was 33.6 g/person/day for women (95% CI 22.5–44.8). The differences regarding vegetables were 17.0 g/person/day (95% CI 8.6–25.5) for men and 13.4 g/person/day (95% CI 7.1–19.7) for women. The results were in the same direction when occupation instead of education was used as an indicator of SES.
Conclusions: Although we cannot exclude over-reporting of intake by those with highest SES, it is unlikely that this potential bias could fully explain the differences we have found. Our results suggest that an unhealthier nutrition pattern may exist among adults belonging to lower socio-economic levels in Europe.
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Descriptors: nutrition; inequalities; socio-economic status; food habits; fruit; vegetables
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Introduction

Inequalities in nutrition have been associated with inequalities in health (Smith & Brunner, 1997). Many studies show that there are large variations between individuals in the quality and quantity of food consumed (Smith *et al*, 1992; James *et al*, 1997; Arija *et al*, 1996; Roos *et al*, 1996; EPIC Group of Spain, 1999). It is generally agreed that food-related behaviours are complex and determined by the interplay of many factors, including physiological factors; socio-demographic characteristics such as education, income, ethnicity and availability of food; behavioural and lifestyle factors; and knowledge and attitudes related to diet and health (López-Azpiazu *et al*, 1997; Terry *et al*, 1991; Slack, 1996). Among nutritional factors, the strongest inverse correlates with death-rates in several European countries are found with the consumption of fresh vegetables and fruit (Wynn, 1987).

A systematic review was performed to establish whether there were substantial differences between individuals having the highest socio-economic status (SES) and those having the lowest SES with respect to consumption of fruit and vegetables. Educational and occupational levels were used to assess SES.

Methods

Identification of studies

To accomplish the systematic review of differences in the consumption of fruit and vegetables across educational/occupational levels we used a formal meta-analysis (Greenland, 1998). Procedures of formal meta-analyses most often have been applied to combine the results from previously published studies. However, in the present meta-analysis we included data from several European countries, which have not yet been published. Most published studies about food habits in European Countries include non-representative samples. Those which have selected a nationwide representative sample almost never provide

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separate estimates of variability for men and women within each SES level, because most of these surveys are based on the household budget surveys (HBS) which do not collect information about food habits at the individual level, but only from households (Trichopoulou, 1998). Separate estimates of variability are required for a study to be included in a formal meta-analysis.

To prepare this report an international network of European investigators was instituted (Compatibility of the household and individual nutrition surveys in Europe and Disparities in food habits, FAIR-97-3096, funded by the DG-XII of the European Union) with the aim of performing a comprehensive search of available data about disparities in food habits in Europe (the Disparities group). The two main methods of identifying relevant studies were bibliography searches, and a questionnaire mailed to researchers working in this field in each country, in order to identify unpublished studies, or those published in grey literature.

The aim of the search was to identify relevant studies and to explore whether there were large-scale comparative studies of the nature and magnitude of educational and/or occupational differences in food habits in the participating European countries (Belgium, Denmark, Estonia, Finland, Germany, Greece, Lithuania, Norway, Spain, Sweden and UK). Additional data were sought in Ireland, The Netherlands and Poland. The bibliography search on disparities in food habits was developed based on literature searches and information from researchers on references and relevant studies. Key words to be used in the literature searches were developed based on the objectives of the study and discussions among the participants. Several key words were used for disparities (socio-economic status, education, occupation, social class, income, employment, poverty, gender and region) and for food habits (fruit, vegetables, food, meal, nutrients, nutrition, diet and eating). References were located by searching electronic databases, such as Medline. The searches were supplemented by contacting European researchers and by consulting documentation centers, books and journals. Researchers were asked in a questionnaire to provide information on key references, relevant studies and names of other researchers in the field. For a more detailed description of the searches see Roos *et al* (1999).

Criteria for choosing studies to be included in the meta-analysis were defined by the Disparities group and are as follows: a validated method for assessing dietary intake at the individual level; a nationwide sample or a representative sample of a region; the subjects were adults (18–85 y); the period of a study was between 1985 and 1999; and information was provided about the mean and standard deviation (or standard error) of overall fruit and overall vegetable consumption across levels of education and/or occupation (ie the mean and standard deviation for each educational or occupational level), and separately for men and women.

Regarding the number of participants, there was a wide variability between studies, but no limit was established for inclusion in the meta-analysis.

Altogether 32 studies from 15 countries were identified.

Data abstraction

From each selected study we identified the highest level of education (university or college) and the lowest level (primary education) and directly obtained the mean and standard deviations of the consumption of fruit and vegetables for men and women for each of both levels. Similarly we abstracted the mean and standard deviations of fruit and vegetable consumption from the highest and the lowest SES level according to the classification of occupations. The validity of each procedure used in individual studies for the classification of education levels and SES levels was subjected to a panel revision by the Disparities group (Roos *et al*, 1999). A document was compiled by this group after reviewing the relevant literature on classification of SES in the participating countries (Roos *et al*, 1999).

The methods for dietary assessment were classified as non-weighed dietary record methods, food frequency questionnaires, 24- or 48-h dietary recalls, and diet history.

Multiple investigators have converged, apparently independently, toward the use of food frequency questionnaires as the method of dietary assessment best suited for most epidemiologic applications (Willet, 1998), therefore there are reasons for not rejecting the surveys that used this approach. Nevertheless, food records present important advantages regarding validity, because food intake is recorded by the subject at the time the foods are eaten to minimize reliance on memory. The 24- and 48-h dietary recall method is based on an in-depth interview conducted by a trained dietary interviewer. Diet history includes a 24-h dietary recall, a detailed listing of all foods consumed by an individual over 3 days and a list where each subject must indicate the frequency of consumption (Buzzard, 1998).

We also took into account the year in which the survey was performed, the participation rate in each survey, and whether the estimates were adjusted or not for total energy intake.

Statistical analysis

The next step was to critically evaluate the nature, extent and comparability of the data sources. The 11 studies were analysed by meta-analysis. The meta-analysis provides a logical structure for systematically quantifying evidence and for exploring bias and diversity in research (Greenland, 1998). The elements needed for meta-analysis of these non-experimental data are exposure, outcome, effect, confounders and effect modifiers. The 'exposure' was considered to be socio-economic status (education or occupation), the outcome was the consumption of fruit and vegetables, the effect was the average difference in food consumption (g/person/day) between individuals with the highest and the lowest SES levels (education and occupation), and a possible confounder was total energy intake. Country, gender, year of the study and method of dietary assessment were considered as potential effect modifiers. On the other hand it was not possible to include age in the evaluation of differences.

The weighted effect size was estimated as (Hedges, 1982):

$$ds = \sum_{di\ wi} / \sum_{wi}$$

where *ds* is the summary estimate of the difference in the intake of the food item (overall consumption of fruit or vegetables); *wi* is the weight, the inverse of the variance estimated for each study, and *di* is the effect size in each individual study. Also, a 95% CI for the summary estimate of effect size was estimated as:

$$95\%\ \mathrm{CI} = \mathrm{ds} \pm (1.96 \times \mathrm{s.e.})$$

where s.e. is the standard error of the pooled estimate. A test of heterogeneity was calculated, estimating a Q statistic, which follows a chi-square distribution.

Because of the wide variations in methodology across studies, a random-effects model was considered to be more appropriate. We used DerSimonian and Laird's (1986) model, which allows for heterogeneity in estimates of mean differences across studies. Under this model, a pooled mean difference estimate was calculated as a weighted average of the mean differences reported in each study. Potential sources of heterogeneity were evaluated by subset analyses and linear meta-regressions (Greenland, 1998).

We also conducted sensitivity analyses recalculating the pooled estimate after excluding the studies with higher weights or those which were outliers. Microsoft Excel Version (7.0), SPSS 9.0 for Windows and Arcus Quick Stat were used to conduct the statistical analyses.

Results

Only 11 studies from seven countries met all the criteria to be included in this meta-analysis, that is, they provided separate information for men and women on means and standard deviations of individual food and nutrient intake across levels of education or occupation.

Most of the information on disparities in food habits across SES levels that we abstracted from these studies was not previously published in widely accessible journals, with some exceptions (Arija *et al*, 1996; Roos *et al*, 1996). The information on descriptive characteristics from the different studies was grouped according to the country of origin (Table 1). The number of subjects included in each individual study ranged from 704 to 41,178 and the range of the response rate was between 55% and 95%. Although age was not available individually in these studies, the age range was 18–85 y.

We found a positive association between a higher level of education or occupation and a greater consumption of both fruit and vegetables (Table 2). The average difference in the intake of fruit was 24.3 g/person/day (95% confidence interval (CI) 14.0–34.7) between men in the highest level of education and those in the lowest level of education. Similarly, this difference was 33.6 g/person/day for women (95% CI 22.5–44.8). With regard to vegetables, the differences were 17.0 g/person/day (95% CI 8.6–25.5) for men and 17.1 (95% CI 9.5–24.8) for women (Table 2).

In spite of meeting the inclusion criteria, we performed the analysis without the EPIC study (Spanish sample, Agudo *et al*, 1999) because it was based on a non-representive sample. In addition, this study was considered to be an outlier in the analysis of differences in the pooled estimation of fruit consumption between educational levels among men, and it exerted an important influence because of the great number of participating subjects. Nevertheless, when it was also considered the estimations did not substantially change (Table 2 and Figures 1 and 2).

Table 1 Characteristics of studies

Study and country, region	*Study year*	*Sample (age range)*	*n Men (m) Women (w) Total (t)*	*Response rate (%)*	*Socio-economic variables (H: total in the highest level) (L: total in the lowest level)*	*Dietary assessment method*
Norway	1993–1994	Random sample (16–79 y)	m 1,517 w 1,627 t 3,144	62 64 63	Education (H: 623/L: 702) Occupation (H: 916/L: 774)	Food frequency questionnaire
Finland (four regions)	1992	Random sample four regions (25–64 y)	m 870 w 991 t 1,861	61 71 66	Education (H: 829/L: 420)	3 day non-weighed dietary record
Sweden	1989	Random sample. (19–74 y)	m 753 w 772 t 1,525	71 69 70	Education (H: 263/L: 532) Occupation (H: 450/L: 442)	7 day non-weighed dietary record
Denmark	1995	Random sample stratified by gender and age (18–65 y)	m 678 w 731 t 1,409	61	Education (H: 76/L: 336) Occupation (H: 136/L: 152)	7 day non-weighed dietary record
Germany—NVS	1985–1989	Multi-stage multi-stratified random sample (18–65 y)	m 10,901 w 12,308 t 23,209	74	Education (H: 3299/L: 8900) Occupation (H: 9089/L: 4068)	Food frequency questionnaire
Netherlands	1987–1988	Random sample (19–85 y)	m 1,930 w 2,204 t 4,134	81 79	Education (H: 317/L: 1,976)	2 day non-weighed dietary record
Spain (Basque Country)	1990	Multi-stage random sample. (25–60 y)	m 1,143 w 1,205 t 2,348	73	Education (H: 339/L: 285) Occupation (H: 235/L: 1102)	Three 24-h recalls
Spain (Navarre)	1989–1990	Two-stage random stratified sample (health zones) (≥15 y)	m 367 w 337 t 704	95	Education (H: 167/L: 367) Occupation (H: 78/L: 533)	Diet history
Spain (Andalusia)	1997–1999	Multistage sample (25–60 y)	m 1,298 w 1,312 t 2,610	93	Education (H: 644/L: 1,966)	48-h dietary recalls
Spain (Catalonia)	1993	Multistage sample (11–66 y)	m 841 w 873 t 1,714	55	Education (H: 233/L: 641) Occupation (H: 268/L: 573)	24-h dietary recalls
Spain (EPIC)	1995–1997	Blood donors, cancer registry (29–69 y)	m 22,485 w 11,937 t 34,422	55–60	Education (H: 4690/L: 29,932)	Diet history

Table 2 Pooled differences in fruit and vegetable consumption (g/person/day) between individuals with the highest and the lowest educational/occupational levels in 11 European dietary surveys 1985–1995 (95% confidence intervals)

	Education				Occupation			
	Men		Women		Men		Women	
	Pooled estimates	*Q statistic (df, P)*	*Pooled estimates*	*Q statistic (df, P)*	*Pooled estimates*	*Q statistic (df, P)*	*Pooled estimates*	*Q statistic (df, P)*
Fruit								
All studies ($n_1=10/n_2=7$)	+24.3 (+14.0 to +34.7)	12.6 (9, 0.18)	+33.6 (+22.5 to +44.8)	16.2 (9, 0.06)	+16.6 (−8.3 to +41.5)	58 (6, <0.001)	+11.4 (+6.1 to +16.6)	1.9 (6, 0.93)
All studies+EPIC study ($n_1=11$)	+20.8 (+7.2 to +34.4)	37.1 (10, <0.001)	+30.7 (+9.3 to +52.1)	133 (10, <0.001)				
Vegetables								
All studies ($n_1=10/n_2=7$)	+17.0 (+8.6 to +25.5)	22.4 (9, 0.008)	+17.1 (+9.5 to +24.8)	24.6 (9, 0.003)	+20.1 (+9.6 to +30.5)	20.8 (6, 0.002)	+9.6 (+1.2 to +18.0)	14.1 (6, 0.03)
All studies+EPIC study ($n_1=11$)	+14.2 (+5.1 to +23.3)	40.2 (10, <0.001)	+16.9 (+10.7 to +23.1)	25.0 (10, 0.005)				

A positive difference means a higher intake by those in the higher socio-economic level.
n_1: number of studies by educational level; n_2: number of studies by occupational level.

Subset analyses identified several sources of heterogeneity (Tables 3 and 4). When the data were analysed separately according to the method of dietary assessment, in five of the eight comparisons the highest estimate was found for studies using dietary records.

The fact that only a few studies adjusted for total energy intake represented a potential threat to the validity of the comparison and to the homogeneity assumption. Therefore, we performed separate meta-analyses for adjusted studies and those with non-adjusted estimates. The studies which were adjusted for total energy intake were more likely to show higher pooled estimates of the differences in fruit consumption between levels of education or occupation. The inverse was true for vegetable consumption, but all the point estimates which were adjusted for energy intake showed higher consumption of vegetables among subjects in the highest SES.

The response rate was also related to some degree of heterogeneity in the results. In studies with higher response rate (> 70%), the pooled mean differences were lower than in studies with poorer response rates.

Stratification was performed by the year in which the study was conducted. Although the difference between means was generally higher in the studies carried out before 1990, the meta-regression analysis did not show a significant reduction in pooled estimates of the differences between socio-economic levels as the studies were more recent (data not shown).

Discussion

Very few studies have systematically assessed socio-economic differences in food habits across several European countries (Prättälä *et al*, 1992). Among the few exceptions is the study of Cavelaars *et al* (1997), which analysed infrequent use of vegetables on the basis of the EUROBAROMETER data in EU-countries.

Our review was conducted with the help of a network of researchers to identify relevant available information in 15 European countries. The study focused on adults because lifestyle characteristics and food consumption patterns differ for children, adults and the elderly. As men and women have different food habits and socio-economic status patterns, it was considered appropriate to study disparities in food habits separately for each gender.

The findings supported, with minor exceptions, the hypothesis that people belonging to a higher social class and educational levels have a higher consumption of both fruit and vegetables, and therefore/healthier diets. This finding is in agreement with previous studies (Marmot *et al*, 1991; Holcomb, 1995; Hupkens *et al*, 1997; Osler & Schroll, 1995; Prättälä, 1995; Rogers *et al* 1995; Roos *et al*, 1999; Johansson *et al* 1999).

Two different measures of socio-economic status, education and occupation, were examined in this study. The aim was to compare the direction and magnitude of associations for each measure of socio-economic status with fruit and vegetable intake. Educational level has an important influence on socio-economic status. Higher levels of education may also increase the ability to obtain or to understand health-related information in general or dietary information in particular needed to develop health-promoting behaviours and beliefs in the field of food habits. Analyses which have taken into account both education,

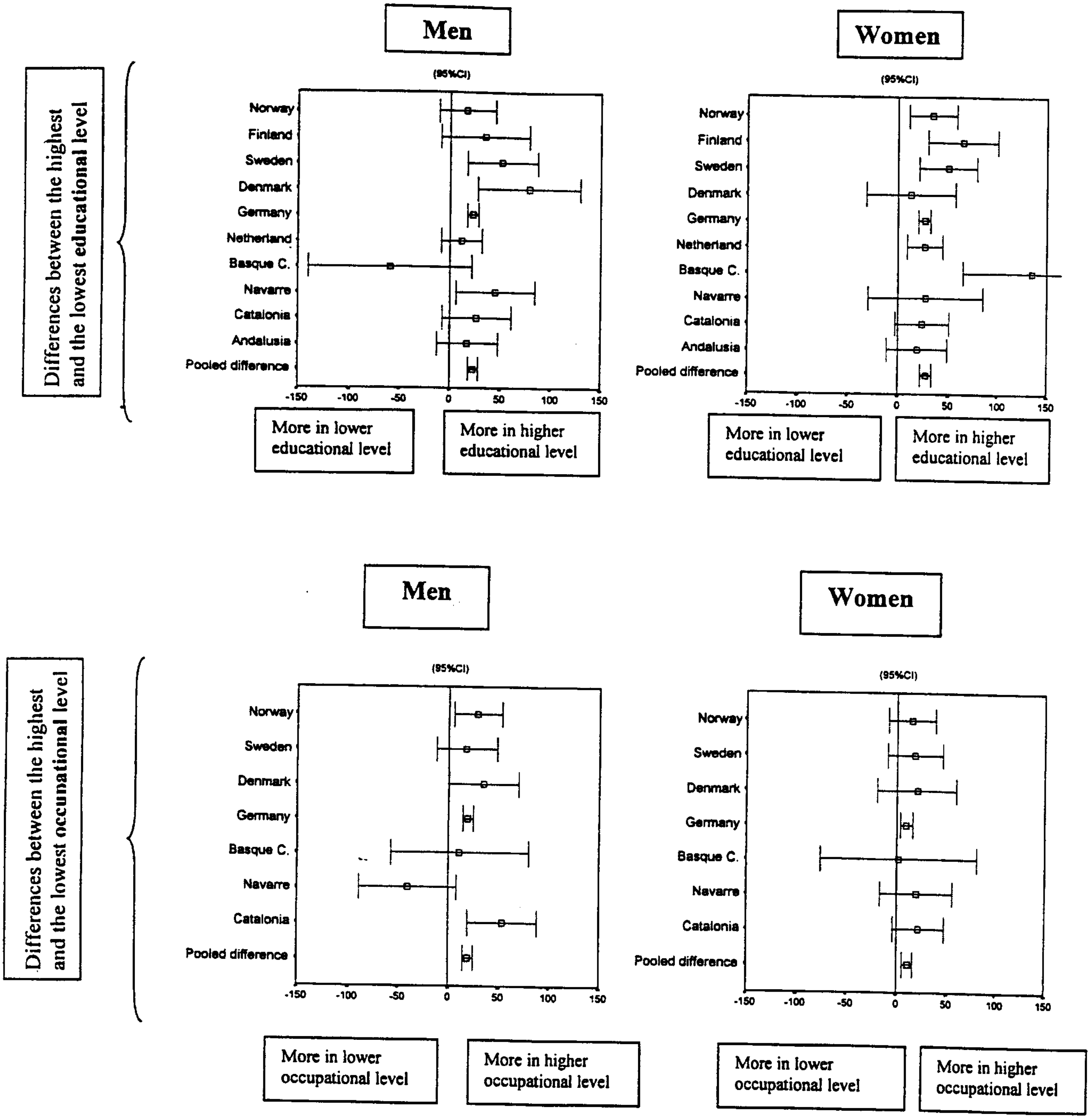

Figure 1 Mean differences between the hightest and the lowest SES level in the intake of fruit (g/pers/day) (95% condifence intervals). The surveys have been ordered from top to bottom according to the respective latitude of the countries.

occupation, income and employment status have shown that usually education is the strongest determinant of socio-economic differences. The other socio-economic variables have a similar but weaker effect than education (Roos *et al*, 1996).

A potential limitation of our study is the bias that can be derived from over-reporting consumption among those with higher levels of education. Better educated people have more knowledge about food items which are healthier (Martínez-González *et al*, 1998; Hjartaker & Lund, 1998; Margetts *et al*, 1997), and it is possible that they would tend to exaggerate their true consumption of these items (Macdiarmid & Blundell, 1998). We acknowledge this fact, but we do not consider that it can fully account for the apparent differences among SES. Moreover, in previous studies (Martínez-González *et al*, 1998; Margetts, *et al*, 1997) we have found that the belief in 'fruit and vegetables' as the main characteristic of healthy eating was more prevalent among those in lower socio-economic and educational levels, whereas more educated individuals were more likely to conceive 'balance and variety' as the main characteristics of a healthy diet. This also was true when we analysed the data from Denmark, where information on beliefs was available.

Another potential limitation is the heterogeneity in methods across pooled studies. Heterogeneity in meta-

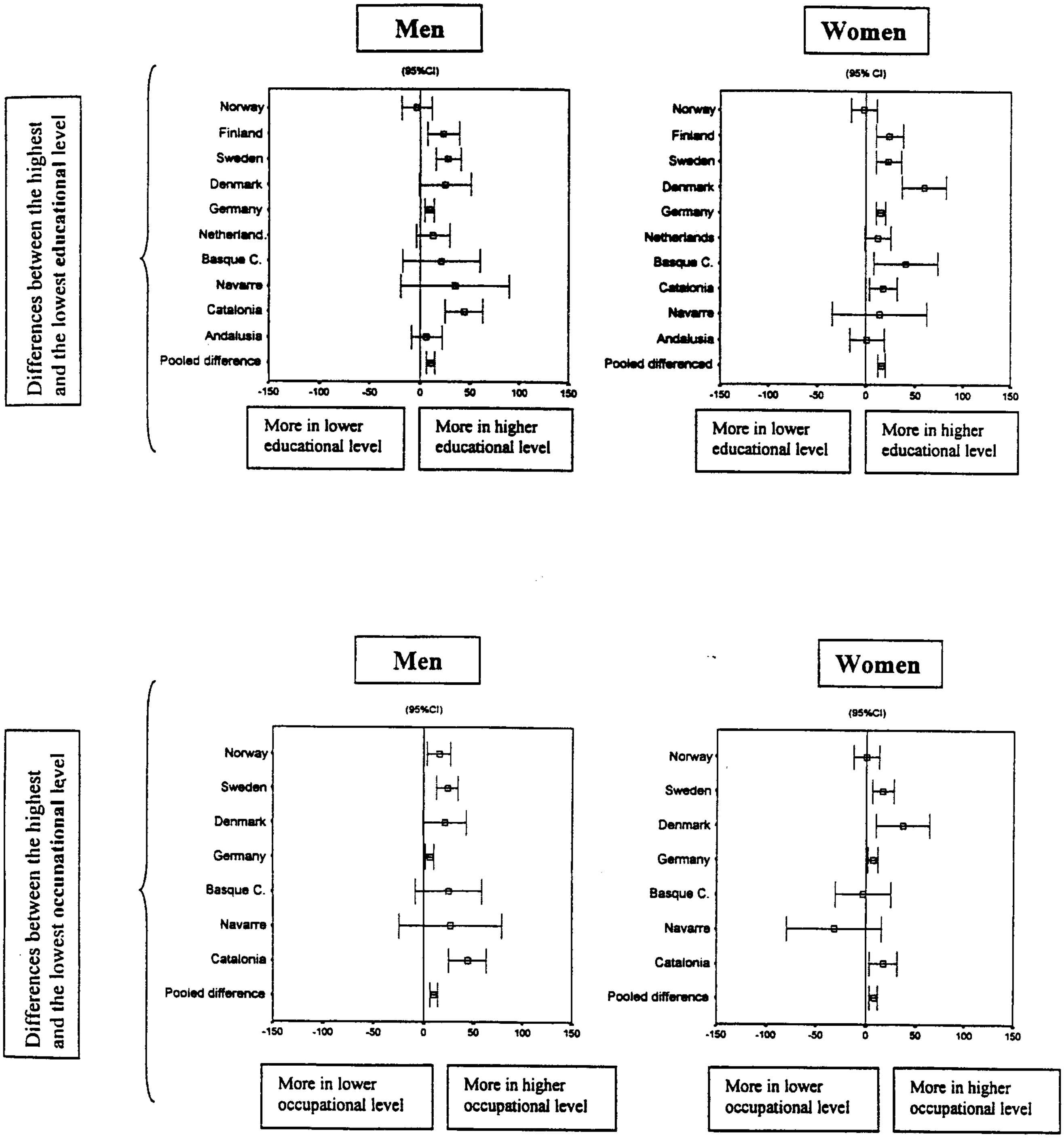

Figure 2 Mean differences between the hightest and the lowest SES level in the intake of vegetables (g/pers/day) (95% condifence intervals). The surveys have been ordered from top to bottom according to the respective latitude of the countries.

analysis is common, but its sources should be explored (Colditz *et al*, 1995). Such analyses might provide insight into the importance of the different outcomes of the study and for planning future studies (Berlin, 1995). Substantial heterogeneity existed in the initial pooled estimates and stratification on several factors reduced this heterogeneity, producing subsets of studies with mean difference estimates that were significant in most cases and persisted through various sensitivity analyses. We acknowledge that another important factor for the variation in food intake within a population is age; it was not included in the evaluation of the differences in food intake and this is a limitation of our study. In spite of the variability of the results after stratifying by dietary assessment method, most of the results exhibited a positive difference. In studies that adjusted by total energy intake, not only the positive association between the consumption of fruit and the socio-economic status was maintained, but the pooled mean difference showed a substantial increase in most estimates, with little evidence of heterogeneity. Even if the size of pooled difference between the high and the low socio-economic group varies according to the dietary assessment method, the direction of the difference is always similar—people belonging to a higher social

Table 3 Pooled differences in fruit consumption (g/person/day) between individuals with the highest and the lowest educational/occupational levels in 11 European dietary surveys 1985–1995 (95% confidence intervals); subgroup analyses

	Education				Occupation			
	Men		Women		Men		Women	
	Pooled estimates	*Q statistic (df, P)*	*Pooled estimates*	*Q statistic (df, P)*	*Pooled estimates*	*Q statistic (df, P)*	*Pooled estimates*	*Q statistic (df, P)*
All studies ($n_1=10/n_2=7$)	+24.3 (+14.0 to +34.7)	12.6 (9, 0.18)	+33.6 (+22.5 to 44.8)	16.2 (9, 0.06)	+16.6 (−8.3 to +41.5)	58 (6, <0.001)	+11.4 (+6.1 to +16.6)	1.9 (6, 0.93)
By study design								
24-h recall ($n_1=4/n_2=2$)	+13.8 (−3.9 to +31.6)	3.9 (3, 0.28)	+35.8 (+8.7 to +63.0)	9.1 (3, 0.03)	+43.9 (+8.5 to +79.4)	1.1 (1, 0.29)	+19.1 (−4.4 to +42.5)	0.29 (1, 0.59)
7 day non-weighed dietary record ($n_1=3/n_2=2$)	+52.8 (+26.0 to +80.0)	1.4 (2, 0.50)	+49.0 (+24.0 to +73.9)	2.6 (2, 0.27)	+25.2 (+2.8 to +47.7)	0.5 (1, 0.46)	+18.6 (−4.6 to +41.9)	0.006 (1, 0.59)
Food frequency questionnaire ($n_1=2/n_2=2$)	+23.0 (+17.3 to +28.8)	0.2 (1, 0.67)	+27.1 (+20.8 to +33.3)	0.4 (1, 0.53)	+20.2 (+15.2 to +25.2)	0.6 (1, 0.46)	+10.0 (+4.3 to +15.7)	0.2 (1, 0.69)
Diet history[a]	+45.2 (+6.5 to +83.9)		+22.7 (−29.8 to +84.7)		−40.3 (−89.2 to +8.6)		+19.5 (−16.2 to +55.1)	
By adjustment for total energy intake								
Yes ($n_1=3/n_2=2$)	+37.1 (+3.3 to +70.9)	3.8 (2, 0.15)	+40.9 (+15.4 to +66.4)	3.3 (2, 0.19)	+30.8 (+11.4 to +50.2)	0.08 (1, 0.77)	+16.0 (−4.5 to +36.4)	0.05 (1, 0.83)
No ($n_1=7/n_2=5$)	+22.6 (+11.7 to +33.5)	8.3 (6, 0.22)	+31.3 (+18.6 to +44.0)	6.5 (2, 0.04)	+10.8 (−23.1 to +44.8)	55.5 (4, <0.001)	+11.0 (+5.6 to +16.4)	1.7 (4, 0.79)
By response rate (%)								
≥70% ($n_1=6/n_2=4$)	+22.1 (+8.8 to +35.4)	8.2 (5, 0.14)	+33.5 (+18.2 to +48.8)	11.0 (5, 0.05)	+0.6 (−38.2 to +39.3)	50.9 (3, <0.001)	+10.5 (+5.0 to +10.0)	1.0 (3, 0.81)
<70% ($n_1=4/n_2=3$)	+31.3 (+9.9 to +52.7)	3.9 (3, 0.28)	+35.7 (+16.9 to +54.5)	21.3 (1, <0.001)	+36.0 (+18.9 to +53.1)	1.3 (2, 0.52)	+10.2 (+2.3 to +34.0)	0.2 (2, 0.92)
By year of study								
Before 1990 ($n_1=6/n_2=5$)	+22.1 (+8.8 to +35.4)	8.2 (5, 0.14)	+33.5 (+19.0 to +47.9)	10.8 (5, 0.06)	+10.8 (−23.1 to +44.8)	55.5 (4, <0.001)	+11.0 (+5.6 to +16.4)	1.7 (4, 0.79)
After 1990 ($n_1=4/n_2=2$)	+28.4 (+6.2 to +50.6)	4.3 (3, 0.23)	+35.4 (+14.7 to +56.1)	4.5 (3, 0.21)	+30.8 (+11.4 to +50.2)	0.08 (1, 0.77)	+16.0 (−4.5 to +36.4)	0.05 (1, 0.82)

n_1: number of studies by educational level; n_2: number of studies by occupational level. A positive difference means a higher intake by those in the higher socio-economic level.
[a]Only one study: Navarre.

class and educational levels have a higher consumption of both fruit and vegetables. Therefore the main conclusions were supported by these subset analyses (Hedges, 1992).

Twenty-four-hour recalls are more affected by measurement error due to within-person day-to-day variations than other methods, and this fact could explain why some of the pooled differences between SES levels (Tables 3 and 4) from studies which used 24-h recalls were non-significant (fruit consumption between education levels among men, and between occupation levels among women; and vegetable consumption between occupation levels among women). It is reassuring for our conclusions to have found that differences were greater in studies which used the best dietary assessment method (dietary records) in five out of eight comparisons. Nevertheless, even if the size of pooled difference between the high and the low socio-economic group varies according to the dietary assessment method, the direction of the difference is always similar, people belonging to a higher social class and educational levels have a higher consumption of both fruit and vegetables.

The response rate was another source of heterogeneity. Differences between educational/occupational levels were lower as the response rate rose. The meta-regression analysis was consistent with the existence of this inverse relationship between participation rate and the size of the effect. The apparent trends of lower effect size as the response rate was higher may suggest that some of our main findings could be attributed to flaws in the design of studies with a lower participation rate. Nevertheless, in the subset analyses by response rate (≥70% *vs* <70%) the pooled estimates of differences across levels of education were substantially the same for both fruit and vegetables consumption and for both men and women. Moreover, the few studies that adjusted for energy intake were more likely to exhibit wider differences across educational or occupational levels. Adjustment for energy intake can be considered as an indicator of a better overall quality of the survey, and reduces the likelihood of confounding by level of physical activity. When this was taken into account by adjusting for the total amount of consumed food (energy intake) the differences in the use of fruit and vegetables became more obvious, that is, the share of fruit and vegetables out of the total energy intake was higher. Therefore, we do not believe that our findings could be attributed to the influence of lower-quality studies.

Unfortunately our data do not allow adjustment for other lifestyle factors and potential confounders. We have no reason to assume that the other lifestyle factors could explain the association between fruit and vegetables and SES. The previous analyses on associations between the different health lifestyles have shown that the associations are often rather weak and unsystematic. The most common observation has been the association between smoking and alcohol consumption but the other associations seem not to be universal (Blaxter, 1990; Patterson *et al*, 1994, Prättälä *et al*, 1994).

Level of education/occupation is especially associated with age. However age was not available at the individual level for this analysis. We have assessed this issue indirectly by comparing studies with different age ranges and results were consistent across such comparisons (data not shown).

We expected to find a greater number of studies meeting the requirements of inclusion in the meta-analysis. Never-

Table 4 Pooled differences in vegetable consumption (g/person/day) between individuals with the highest and the lowest educational/occupational levels in 11 European dietary surveys 1985–1995 (95% confidence intervals) Subgroup analyses

	Education				Occupation			
	Men		Women		Men		Women	
	Pooled estimates	Q statistic (df, P)	Pooled estimates	Q statistic (df, P)	Pooled estimates	Q statistic (df, P)	Pooled estimates	Q statistic (df, P)
All studies ($n_1 = 10/n_2 = 7$)	+17.0 (+8.6 to +25.5)	22.4 (9, 0.008)	+17.1 (+9.5 to +24.8)	24.6 (9, 0.003)	+20.1 (9.6 to +30.5)	20.8 (6, 0.002)	+9.6 (1.2 to +18.0)	14.1 (6, 0.03)
By study design								
24-h recall ($n_1 = 4/n_2 = 2$)	+19.9 (+2.4 to +37.4)	7.2 (3, 0.07)	+12.6 (+1.7 to +23.5)	4.8 (3, 0.19)	+36.1 (+19.0 to +57.1)	0.8 (1, 0.36)	+10.2 (−9.2 to +29.9)	2.0 (1, 0.16)
7 day non-weighed dietary record ($n_1 = 3/n_2 = 2$)	+26.0 (+16.1 to +35.8)	0.2 (2, 0.91)	+30.9 (+14.8 to +47.1)	5.7 (2, 0.06)	+23.4 (+13.9 to +33.0)	0.06 (1, 0.81)	+22.8 (+5.0 to +40.5)	1.7 (1, 0.19)
Food frequency questionnaire ($n_1 = 2/n_2 = 2$)	+5.0 (−6.7 to +16.7)	2.4 (1, 0.12)	+7.8 (−8.5 to +24.1)	5.5 (1, 0.02)	+9.1 (+0.8 to +17.4)	2.1 (1, 0.15)	+6.2 (+1.7 to +10.8)	1.0 (1, 0.32)
Diet history[a]	+35.3 (−19.4 to +90.1)		+14.5 (−33.8 to +62.8)		+26.9 (−25.1 to +78.8)		−31.8 (−79.6 to +16.1)	
By adjustment for total energy intake								
Yes ($n_1 = 3/n_2 = 2$)	+13.6 (−6.1 to +33.2)	6.5 (2, 0.04)	+25.0 (−3.7 to +53.6)	17.6 (2, <0.001)	+16.6 (+6.4 to +26.8)	0.21 (1, 0.65)	+16.4 (−19.5 to +52.3)	5.6 (1, 0.02)
No ($n_1 = 7/n_2 = 5$)	+19.1 (+8.6 to +29.6)	18.9 (6, 0.02)	+15.1 (+10.0 to +22.2)	6.9 (6, 0.33)	+22.6 (+7.2 to 38.0)	19.3 (4, <0.001)	+9.5 (+0.7 to +18.4)	8.4 (4, 0.08)
By response rate (%)								
≥70% ($n_1 = 6/n_2 = 4$)	+14.6 (+6.2 to +23.0)	8.3 (5, 0.14)	+15.3 (+8.7 to +21.8)	6.9 (5, 0.23)	+16.8 (+2.7 to +30.8)	10.8 (3, 0.01)	+7.1 (−3.5 to +17.6)	6.7 (3, 0.08)
<70% ($n_1 = 4/n_2 = 3$)	+21.0 (+0.4 to +41.6)	13.1 (3, 0.004)	+22.1 (+2.8 to +41.4)	17.7 (3, <0.001)	+24.7 (+8.3 to +41.1)	4.8 (2, 0.09)	+15.3 (−3.1 to +33.8)	7.0 (2, 0.03)
By year of study								
Before 1990 ($n_1 = 6/n_2 = 5$)	+22.3 (+9.4 to +35.3)	15.3 (5, 0.009)	+16.0 (+11.8 to +20.3)	4.0 (5, 0.55)	+22.6 (+7.2 to +38.0)	19.3 (4, <0.001)	+9.5 (+0.6 to +18.4)	8.4 (4, 0.08)
After 1990 ($n_1 = 4/n_2 = 2$)	+18.3 (−2.9 to +39.5)	19.9 (3, <0.001)	+6.1 (−8.3 to +20.6)	9.3 (3, 0.03)	+16.6 (+6.4 to +26.8)	0.2 (1, 0.7)	+16.4 (−19.5 to +52.3)	5.6 (1, 0.02)

n_1: number of studies by educational level; n_2: number of studies by occupational level. A positive difference means a higher intake by those in the higher socio-economic level.
[a]Only one study: Navarre.

theless the scarcity of existing studies meeting these criteria underlines the need for developing pan-European comprehensive dietary surveys. In the absence of those global data, the present integration of available studies provides the best base to initiate and design future studies of disparities in food habits in Europe.

In summary, with the available data, we can conclude that overall consumption of fruit and vegetables is likely to be higher among those Europeans with high compared to low SES.

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