

Socio-economic circumstances and food habits in Eastern, Central and Western European populations

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Abstract

Objective: To assess the relationship between several socio-economic indicators and frequency of consumption of seven predefined healthy foods (consumption of fruit, vegetables, wholegrain bread, vegetable-fat spread, vegetable cooking fat, low-fat milk and low-fat cheese) in populations from Eastern, Central and Western Europe.

Design: Analysis of baseline data collected in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS).

Setting: Urban populations in the Czech Republic, Russia, Poland and Finland.

Subjects: In the HAPIEE study, random samples of men and women aged 45–69 years were drawn from population registers and electoral lists of selected cities. In the HHS, men and women aged 40–60 years employed by the City of Helsinki were recruited. Data on 21 326 working subjects from both cohorts were analysed.

Results: Healthy food habits were, in general, positively associated with higher education, occupational position and fewer economic difficulties, but there were differences in the strength of the gradient by food and country. Fruit consumption showed the most consistent gradients, especially in relation to socio-economic status among men (country-specific relative index of inequality (RII) = 2·02–5·17) and women (RII = 2·09–3·57).

Conclusions: The associations between socio-economic indicators and healthy food habits showed heterogeneity between countries. Future studies of dietary behaviours should consider multiple measures of socio-economic position.

Keywords
Nutrition
Diet
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Eastern Europe
International

Socio-economic inequalities in health and health behaviours are evident throughout Europe, particularly so in Eastern European and Baltic countries⁽¹⁾. In Western and Baltic countries, those in higher socio-economic positions have healthier behaviours^(2–4). However, only a few studies have tested the association between socio-economic circumstances and food habits in Eastern European and Baltic countries, with education level being positively associated with both vegetable and cheese consumption^(5,6). In addition, most studies have examined the association with food habits using only one or a few socio-economic indicators^(7,8). Focusing on only a single domain of socio-economic position provides a limited approach to a multidimensional concept covering many educational, occupational, financial and material

circumstances⁽⁹⁾ and may lead to overestimation or underestimation of effects⁽¹⁰⁾.

Studies that have adopted a more multidimensional approach have a tendency to use education, occupation and income as key socio-economic indicators. While these three indicators are correlated, they are not directly interchangeable as each may have a unique effect on health^(11–14). The current study employs similar socio-economic indicators as each has previously been shown to be associated with food habits^(3,6,15). Education, often the most consistent indicator, is acquired early in life and may influence how a person understands health-related information and generates long-term beneficial behaviours^(16,17). Occupation may determine income and therefore access to healthy food; also, because occupation

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creates a social network, it can influence health behaviours⁽¹⁶⁾. Current economic difficulty is a third important indicator as lack of money can exist across all income levels and may lead to a reliance on a low-cost, energy-rich diet^(18–20). The present study investigates the relationship between these indicators and food habits in populations from Eastern, Central and Western Europe – the Czech Republic, Poland, Russia and Finland. These countries represent distinct economic, education and employment structures, and different socio-economic indicators may have different meanings in Central and Eastern Europe compared with the West⁽²¹⁾.

However, these indicators may also have different influences in these socially and culturally distinct countries. In addition, food habits may differ between countries due to varying traditions and food access⁽²²⁾. It is important therefore to assess multiple food habits, as the association between socio-economic circumstances and other foods may be overlooked. Despite this, many studies have simply assessed the association between one socio-economic indicator and consumption of one or two foods, particularly fruit and vegetables^(5,6,15,23).

The aims of the current study were therefore to assess: (i) the uptake of several predefined healthy food habits in four distinct populations; (ii) the proportion of those with a predefined healthy food habit score; and (iii) the relationship between different socio-economic indicators (education, occupation and current economic difficulty) and these food habits.

Materials and methods

Study populations

The present analyses used data from two cross-sectional cohort studies: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study⁽²⁴⁾ and the Finnish Helsinki Health Study (HHS)⁽²⁵⁾. Both cohorts are designed to investigate the relationship between health behaviours and health outcomes. Both studies have published methods elsewhere; therefore only a brief outline is given below^(3,24–26).

The HAPIEE study examined random samples of men and women aged 45–69 years at baseline in Novosibirsk (Russia), Krakow (Poland) and six Czech urban centres in 2002–2005⁽²⁴⁾. The 28 947 participants (53% female, overall response rate 59%) were recruited from population registers in Poland and the Czech Republic, and from electoral lists in Russia. The baseline survey involved completion of structured questionnaires and a medical examination in a clinic. In Russia and Poland, questionnaires were administered by a nutritionist and nurse, respectively; however, in the Czech Republic, the participants self-completed questionnaires at home. The questionnaires covered health, medical history, socio-economic circumstances, psychosocial factors and health behaviours

including food habits. Data on working participants were used for the current analyses (n 13 417).

The Finnish data came from the HHS baseline survey in 2000–2002. A total of 8960 men and women aged 40–60 years employed by the City of Helsinki (80% female, overall response rate 67%) were recruited. Data were collected using self-administered questionnaires which assessed health, medical history, socio-economic circumstances and health behaviours, including food habits. Data on occupational class were derived from the City of Helsinki personnel register for those with written consent for this linkage (80%). For the remaining participants, information on occupational class was completed from the questionnaires.

Food habits

In the HAPIEE study, food habits were assessed using an FFQ based on the Whitehall II Study FFQ⁽²⁷⁾ which in turn was adapted from the original instrument developed by Willett⁽²⁸⁾. The Czech, Russian and Polish FFQ consisted of 136, 147 and 148 food and drink items, respectively; the different numbers of questions are due to country-specific dishes. A country-specific portion size for each food was specified, and participants were asked how often, on average, they had consumed that amount of the item during the last three months, with nine responses ranging from 'never or less than once per month' to 'six or more times per day'. Dietary information was available for 13 417 working participants.

The HHS assessment of food habits consisted of a questionnaire querying twenty-two food and drink items; participants were asked how often they consumed these foods and drinks, on average, in the last month, with seven responses ranging from 'not at all' to 'at least twice per day'⁽³⁾. The HHS did not assess portion sizes. Dietary data were available on 8960 participants in the HHS.

Healthy food habit score

Similar food groups, measured similarly in both cohorts, were identified, and seven healthy food habits were created based on the frequency of consumption, as recommended by WHO dietary guidelines⁽²⁹⁾: fresh fruit at least twice daily; fresh vegetables at least twice daily; wholegrain bread rather than white bread; skimmed or semi-skimmed milk (low fat) rather than whole milk; vegetable-fat spreads rather than animal-fat spreads; vegetable cooking fats rather than lard or butter; and low-fat cheese rather than high-fat cheese. For example, consumption of white bread only, or a combined consumption of white and wholegrain bread, was not considered as a healthy food habit. Also, for participants who did not report consuming any bread, milk, cheese, spreads or cooking fat such habit was classified as unhealthy because consumption of these foods is recommended in current dietary guidelines⁽²⁹⁾. The rationale for

inclusion was that these foods were included in both studies and in the WHO guidelines.

Participants received one point for meeting each recommended food habit and summation of these points resulted in a healthy food habit score (range 0 to 7), i.e. high scores indicated healthier food habits. The score was arbitrarily dichotomised with participants classified as having healthy food habits if they met at least four of the recommendations (score ≥ 4). A similar index has been used in previous studies^(3,30).

Socio-economic circumstances

The methodological differences and differing education systems, occupational structures and economic situations between these communities limit the comparability of results, but construction of hierarchical classes allows us to examine socio-economic patterning of food habits within communities. In both cohorts, education was divided into three hierarchical categories – basic (incomplete, primary, vocational in HAPIEE cohort; primary, secondary, vocational in HHS cohort), intermediate (secondary in HAPIEE; matriculation in HHS cohort) and higher (university). Occupational class was hierarchically categorised as manual worker, other non-manual worker, semi-professional, professional and managerial. Current economic difficulties were measured in the HAPIEE study using three questions related to the participant's problems buying food, buying clothes and paying bills; and in the HHS using two questions: problems buying food or clothes and problems paying bills. For these questions, response alternatives indicating the level of difficulties were scored and an overall score was constructed. This was then divided into four categories of economic difficulty: frequently; occasionally; rarely; and never.

Statistical analysis

Of the 22 377 working participants who completed the questionnaire in both cohorts, 21 326 had no more than two of the seven food habits missing (97% of these participants had no missing food habits) and had valid data (non-missing) on education, occupational class and economic difficulties. The analyses were carried out separately for men and women in each cohort using the STATA statistical software package version 10.1 (StataCorp, College Station, TX, USA).

Using logistic regression, the association between each recommended food habit and socio-economic indicator was examined. Subsequently, the association between each socio-economic indicator and healthy food habit score (score ≥ 4) was examined. Each logistic regression model included one socio-economic indicator and was adjusted for age only.

The association between socio-economic indicators and food habits was examined using a summary index, the relative index of inequality (RII), for each cohort⁽³¹⁾. RII is a total effect measure, as it considers both the

strength of the differences between the social classes and the distribution of the population across the classes. Before the RII could be calculated, each category of our three socio-economic indicators was represented by a country-specific cumulative midpoint centile. The RII for healthy food habits was then calculated based on a continuous logistic regression coefficient for each socio-economic indicator adjusted for age and compared those at the bottom of the hierarchy with those at the top of the hierarchy (i.e. RII values above 1.00 suggest that those in higher socio-economic positions have healthier food habits)⁽³¹⁾. As interpretation of the RII assumes linearity of the association between socio-economic indicators and healthy food habits, departures from linearity were tested for, but were not found.

Results

Socio-economic circumstances

The proportion of non-manual workers and those with high education differed between cohorts and the sexes (Table 1). Economic difficulty was reported more frequently among females; particularly so among the Russian sample.

Recommended food habits

Compared with the males, a much higher proportion of females met the dietary recommendations for fruit and wholegrain bread consumption, and, in the Finnish sample, vegetable consumption (Table 2). Still, apart from the Finnish sample, few participants reported the consumption of wholegrain bread rather than white, or the use of vegetable-fat spreads. On the contrary, the use of vegetable cooking fats was reported by the majority of participants (overall 78%). Fewer (8%) reported consumption of low-fat rather than high-fat cheese; therefore these results are not presented in Table 2. Low-fat milk was less commonly consumed in Russia than in other countries.

Healthy food habit scores

Figures 1 and 2 present the distribution of the healthy food habit scores by country and sex. Mean healthy food habit scores in ascending order were: 2.5 (SD 0.8) for Russian males; 2.7 (SD 0.8) for Russian females; 2.7 (SD 1.2) for Finnish males; 3.0 (SD 1.1) for Czech males; 3.1 (SD 1.1) for Polish males; 3.3 (SD 1.0) for Polish females; 3.4 (SD 1.4) for Finnish females; and 3.4 (SD 1.0) for Czech females. The highest proportion with healthy food habits (score ≥ 4) existed among the Czech (52%), Polish (46%) and Finnish females (45%). Fewer males (Czech and Polish 36%, Finnish 27%, Russian 10%) and Russian females (19%) were defined as having healthy food habits.

Table 1 Distribution of socio-economic circumstances by sex and country; data from participants in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS)

	Males								Females							
	Czech Republic (n 1947)		Russia (n 2559)		Poland (n 2194)		Finland (n 1729)		Czech Republic (n 1846)		Russia (n 2330)		Poland (n 1856)		Finland (n 6865)	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
Education																
Basic	851	44	739	29	560	26	694	40	674	36	861	37	286	15	2918	42
Intermediate	645	33	890	35	683	31	476	28	898	49	679	29	764	41	2249	33
High	451	23	930	36	951	43	559	32	274	15	790	34	806	44	1698	25
Occupational class																
Manual workers	509	26	977	38	370	17	472	27	325	18	449	19	212	11	810	12
Other non-manual workers	408	21	459	18	412	19	175	10	878	48	867	37	585	32	2896	42
Semi-professionals	329	17	123	5	298	13	336	20	188	10	107	5	177	9	1284	19
Professionals	526	27	744	29	801	37	453	26	394	21	781	34	755	41	1432	21
Managers	175	9	256	10	313	14	293	17	61	3	126	5	127	7	443	6
Economic difficulties																
Frequently	58	3	294	12	129	6	67	4	99	6	485	21	168	9	341	5
Occasionally	215	11	447	17	297	13	275	16	227	12	609	26	329	18	985	14
Rarely	560	29	669	26	494	23	486	28	648	35	653	28	463	25	2031	14
Never	1114	57	1149	45	1274	58	901	52	872	47	583	25	896	48	3508	51

Socio-economic circumstances and recommended food habits

Fruit and vegetables

After adjusting for age, men and women with high educational qualifications, high occupational class and no economic difficulties were significantly more likely to consume fruit at least twice daily than those with basic education, low occupational class and frequent economic difficulties (Tables 3 and 4). Among Finnish participants, similar gradients were seen for vegetable consumption.

Wholegrain bread

As for consumption of wholegrain bread, participants with high educational qualifications, high occupational class and without economic difficulty were generally more likely to consume wholegrain bread compared with those at the opposite ends of the scales – these associations were particularly strong for Polish males. On the contrary, Czech and Finnish males with high education or occupational class were less likely to consume wholegrain bread than those with lower education or occupational class.

Low-fat milk

Finnish participants with high education, high occupational class and no economic difficulty were significantly more likely to consume low-fat milk than Finnish participants with basic education, low occupational class and frequent economic difficulties. Regarding education and occupational class in the Polish female sample, these gradients lay in the opposite direction.

Vegetable-fat spreads, cooking fats and low-fat cheese

Finnish participants with high education were significantly less likely to use vegetable-fat spreads than those with basic

education; similar gradients were evident for occupational class and economic difficulty among Finnish females. Similarly, Polish participants with high education and high occupational class were significantly less likely to use vegetable-fat spreads compared with those in lower classes. On the contrary, Czech females without economic difficulty were almost twice as likely to use a vegetable-fat spread as those who reported frequent economic difficulty. A strong association between socio-economic circumstances and use of vegetable cooking fats was evident among Russian males and the Finnish cohort – those with high education, high occupational class and no economic difficulty (except Finnish males) were more likely to use recommended cooking fats than those in lower levels and those with frequent economic difficulties. As very few participants reported consuming low-fat cheese, the results are not presented in Tables 3 and 4.

Healthy food habit score

In terms of the healthy food habit score shown in the last rows of Tables 3 and 4, the associations with socio-economic circumstances were similar among females and males. Healthy food habits were strongly related to economic difficulty among Czech males, while being associated with all three socio-economic indicators among Czech females. Stronger associations were evident among Russian males compared with females, with economic difficulty having the strongest effect. The associations among the Polish cohort were less consistent, with no consistent associations seen among Polish males and inverse associations with education and occupation among Polish females. Stronger gradients were evident among Finnish females compared with males, but once again, economic difficulty had the strongest association with healthy food habits among both sexes.

Table 2 Age-standardised proportion of participants following each dietary recommendation by sex and country; data from participants in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS)

Dietary recommendation*	Males					Females										
	Czech Republic		Russia		Finland		Poland		Czech Republic		Russia		Poland		Finland	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Fruit $\geq 2/d$	47	45, 48	19	18, 21	8	7, 10	64	63, 66	30	28, 32	60	58, 61	25	24, 26		
Vegetables $\geq 2/d$	57	56, 59	79	78, 80	19	17, 21	65	64, 67	79	78, 80	68	66, 69	38	37, 39		
Wholegrain bread	4	3, 5	6	5, 7	36	34, 38	7	6, 8	11	9, 12	10	9, 11	53	52, 54		
Low-fat milk†	52	50, 54	19	18, 21	46	44, 48	52	51, 54	21	20, 23	49	47, 51	49	48, 50		
Vegetable-fat spreads‡	13	12, 14	3	2, 4	57	55, 60	20	18, 21	4	3, 4	11	9, 12	55	54, 56		
Vegetable cooking fat	74	73, 75	80	80, 81	70	68, 72	75	74, 76	82	82, 83	78	77, 79	67	66, 68		

*Results for low-fat cheese are presented in main text.
 †Compared with no wholegrain bread, no bread, white, or a combination of white and wholegrain bread.
 ‡Compared with no low-fat milk, no milk, whole milk, or a combination of low-fat and whole milk.
 §Compared with no vegetable-fat spread, no spread, butter, butter-vegetable spreads, or a combination of spreads.
 ||Compared with no vegetable cooking fat, no cooking fat, butter, lard, or a combination of cooking fats.

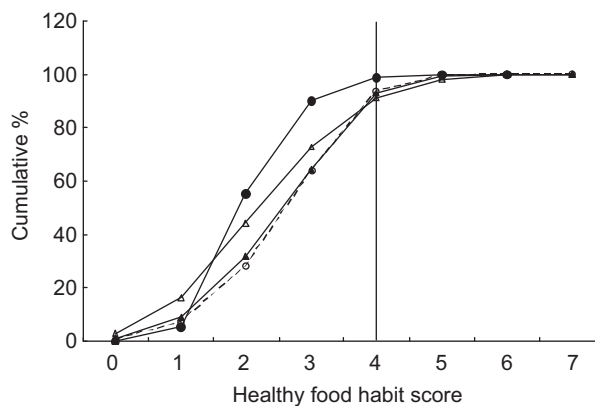


Fig. 1 Distribution of healthy food habit score among males by country (—▲—, Czech Republic; —●—, Russia; --○--, Poland; —△—, Finland); data from participants in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS). Vertical line denotes cut-off for healthy food habits, i.e. score ≥ 4

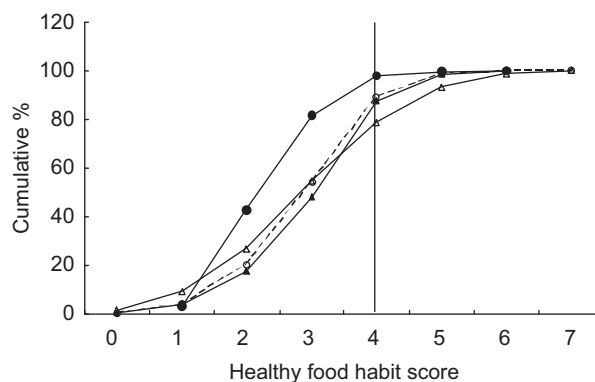


Fig. 2 Distribution of healthy food habit score among females by country (—▲—, Czech Republic; —●—, Russia; --○--, Poland; —△—, Finland); data from participants in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS). Vertical line denotes cut-off for healthy food habits, i.e. score ≥ 4

Discussion

Main findings

The present study examined socio-economic differences in seven healthy food habits in Eastern, Central and Western European populations. We found that most socio-economic gradients were positive, i.e. higher socio-economic groups had healthier food habits, but the strength of the gradients varied between countries, and it was in the opposite direction among the Polish sample. From the three socio-economic indicators, economic difficulties showed the most consistent associations with food habits.

Limitations

When interpreting the results, a number of limitations should be considered. First, it is important to bear in

Table 3 Socio-economic circumstances and food habits among males by country; data from participants in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS)

Model*	Czech Republic		Russia		Poland		Finland	
	RII	95 % CI	RII	95 % CI	RII	95 % CI	RII	95 % CI
Fruit								
Education	1.83	1.19, 2.79	3.16	2.08, 4.81	1.31	0.89, 1.93	1.20	0.73, 1.96
Occupation	1.40	1.07, 1.83	2.94	2.29, 3.78	1.34	1.04, 1.73	1.04	0.66, 1.64
Economics	2.16	1.26, 3.70	5.17	3.31, 8.07	2.09	1.38, 3.17	2.02	0.81, 5.05
Vegetables								
Education	0.75	0.48, 1.19	0.80	0.36, 1.78	0.66	0.41, 1.07	2.20	1.52, 3.18
Occupation	1.10	0.82, 1.47	1.02	0.61, 1.68	0.98	0.71, 1.35	2.19	1.57, 3.05
Economics	1.00	0.56, 1.79	1.67	0.83, 3.35	1.69	1.03, 2.77	2.20	1.15, 4.17
Wholegrain bread								
Education	0.22	0.08, 0.62	2.88	1.45, 5.71	6.50	2.63, 16.07	0.83	0.62, 1.10
Occupation	0.78	0.42, 1.48	1.41	0.95, 2.12	2.77	1.59, 4.84	0.92	0.70, 1.19
Economics	1.45	0.38, 5.65	1.29	0.69, 2.41	5.76	1.87, 17.67	1.68	1.02, 2.77
Low-fat milk								
Education	1.16	0.75, 1.79	1.09	0.74, 1.62	0.71	0.48, 1.05	1.80	1.36, 2.38
Occupation	0.86	0.66, 1.13	1.16	0.90, 1.49	0.85	0.66, 1.09	1.84	1.41, 2.39
Economics	0.86	0.49, 1.50	0.96	0.66, 1.39	0.71	0.47, 1.08	2.27	1.40, 3.69
Vegetable-fat spread								
Education	1.60	0.90, 2.84	0.82	0.36, 1.89	0.27	0.16, 0.46	0.69	0.52, 0.93
Occupation	1.27	0.88, 1.83	0.78	0.45, 1.35	0.52	0.37, 0.75	0.88	0.67, 1.15
Economics	1.71	0.78, 3.72	0.92	0.41, 2.04	0.86	0.49, 1.53	0.76	0.46, 1.25
Vegetable cooking fat								
Education	1.09	0.56, 2.12	3.69	1.66, 8.19	1.52	0.79, 2.93	2.31	1.66, 3.19
Occupation	0.97	0.64, 1.48	3.48	1.83, 6.58	1.20	0.77, 1.88	2.13	1.55, 2.92
Economics	0.66	0.27, 1.62	2.52	1.21, 5.26	1.42	0.70, 2.86	0.97	0.54, 1.74
Healthy food habit†								
Education	1.27	0.82, 1.97	2.81	1.56, 5.07	0.73	0.49, 1.08	1.32	0.96, 1.81
Occupation	1.10	0.84, 1.46	1.77	1.25, 2.51	0.91	0.69, 1.18	1.43	1.06, 1.92
Economics	1.97	1.10, 3.53	3.02	1.65, 5.53	1.50	0.94, 2.28	1.96	1.11, 3.46

RII, relative index of inequality.

*Models include each socio-economic indicator independently along with age.

†Healthy food habit score ≥ 4 .

mind that the aim of the current study was not to directly compare countries, but rather to test the multidimensional socio-economic framework for food habits in four national contexts from Eastern, Central and Western Europe. The study populations may have differing ideas as to what constitutes a healthy diet or have been exposed to different healthy eating campaigns. For example, while food-based guidelines exist in the Czech Republic, Poland and Finland, only nutrient guidelines are present in Russia, which may explain why only a small number of the Russian sample reported healthy food habits.

Second, the main methodological limitation of the study is the method of dietary assessment. HHS only assessed usual intake of twenty-two food and drink items in the preceding month and did not assess portion size. As the HAPIEE FFQ had more items, the prevalence of consumption may appear to be higher among the HAPIEE cohort compared with the HHS cohort. Although the HAPIEE study used a lengthier FFQ and assessed diet over a longer period of time, the FFQ is not without its faults and can underestimate or overestimate dietary intakes^(27,32). As energy intake could not be calculated for the HHS cohort, the current results could not be adjusted for energy intake. Despite these caveats, proxy measures

using selected indicators of food habits indicate adherence to general dietary guidelines and are therefore useful in large studies of healthy food habits⁽³³⁾. Also, although consumption frequencies do not directly translate into quantities, frequencies can give a reasonable indication of actual intake and food habits in general⁽³³⁾.

Third, differences in reporting may lead to biased estimations of intakes. In Russia and Poland, FFQ were completed under supervision; while in the Czech Republic and Finland, the questionnaires were completed unsupervised. Indeed results from previous HAPIEE analyses indicate that the Russian and Polish samples had higher energy intakes compared with the Czech sample which may reflect differences in FFQ data collection⁽³⁴⁾. However, this should not affect the validity of within-country analyses, unless socio-economic status is associated with over-reporting of healthy foods among persons with high education similarly in all countries⁽³⁵⁾.

Fourth, the cohorts may not be entirely representative since non-response is often associated with health status and health behaviours. It is possible that our results show a more favourable picture than if truly representative samples were examined. However, results from the HHS non-response analyses suggest that health inequalities are unlikely to be biased even though the HHS was

Table 4 Socio-economic circumstances and food habits among females by country; data from participants in two cross-sectional cohort studies between 2000 and 2005: the Health, Alcohol and Psychosocial factors In Eastern Europe (HAPIEE) study and the Finnish Helsinki Health Study (HHS)

Model*	Czech Republic		Russia		Poland		Finland	
	RII	95% CI	RII	95% CI	RII	95% CI	RII	95% CI
Fruit								
Education	2.05	1.22, 3.45	2.05	1.41, 2.98	0.95	0.58, 1.55	1.72	1.44, 2.05
Occupation	1.81	1.20, 2.71	2.46	1.88, 3.23	1.21	0.86, 1.69	1.74	1.44, 2.11
Economics	2.56	1.50, 4.38	3.57	2.56, 4.99	2.26	1.48, 3.46	2.09	1.57, 2.79
Vegetables								
Education	2.05	1.21, 3.48	1.82	0.76, 4.37	1.14	0.65, 2.02	1.87	1.60, 2.18
Occupation	1.39	0.92, 2.09	1.12	0.60, 2.10	0.97	0.65, 1.43	1.86	1.57, 2.21
Economics	1.41	0.80, 2.49	1.76	0.86, 3.58	1.38	0.83, 2.28	1.88	1.47, 2.39
Wholegrain bread								
Education	1.39	0.61, 3.18	1.48	0.86, 2.52	1.73	0.84, 3.55	1.10	0.95, 1.28
Occupation	1.34	0.73, 2.44	1.59	1.08, 2.33	1.13	0.70, 1.82	1.21	1.02, 1.44
Economics	1.02	0.41, 2.55	1.09	0.69, 1.71	2.97	1.45, 6.10	1.73	1.37, 2.18
Low-fat milk								
Education	1.07	0.68, 1.69	0.94	0.63, 1.41	0.51	0.33, 0.81	1.94	1.67, 2.26
Occupation	1.03	0.74, 1.46	0.77	0.57, 1.03	0.57	0.41, 0.78	2.02	1.70, 2.41
Economics	0.88	0.53, 1.46	0.68	0.48, 0.96	0.79	0.53, 1.19	1.62	1.28, 2.05
Vegetable-fat spread								
Education	1.63	0.96, 2.75	1.09	0.46, 2.56	0.16	0.09, 0.29	0.60	0.52, 0.71
Occupation	1.37	0.93, 2.02	0.72	0.39, 1.35	0.23	0.14, 0.37	0.54	0.45, 0.64
Economics	1.90	1.04, 3.47	0.69	0.34, 1.42	0.83	0.47, 1.48	0.76	0.60, 0.97
Vegetable cooking fat								
Education	2.01	0.95, 4.25	0.87	0.14, 5.50	0.65	0.25, 1.66	2.32	1.95, 2.75
Occupation	1.33	0.74, 2.34	3.99	0.91, 17.43	0.92	0.49, 1.72	2.29	1.86, 2.81
Economics	0.86	0.37, 2.03	1.52	0.33, 6.91	0.93	0.41, 2.11	1.38	1.05, 1.81
Healthy food habits†								
Education	2.56	1.64, 4.01	1.12	0.71, 1.77	0.51	0.32, 0.79	1.76	1.5, 2.0
Occupation	1.68	1.20, 2.35	1.43	1.02, 1.98	0.59	0.43, 0.80	1.81	1.52, 2.14
Economics	1.70	1.04, 2.76	1.52	1.02, 2.26	1.43	0.96, 2.13	2.07	1.63, 2.63

RII, relative index of inequality.

*Models include each socio-economic indicator independently along with age.

†Healthy food habit score ≥ 4 .

conducted only among middle-aged employees of the City of Helsinki⁽³⁶⁾. Also, since only working subjects were included from the HAPIEE cohort, results may not apply to younger or non-working people in this cohort and may not be representative of each country's respective populations. Similarly, since all centres in the present study were urban, we were not able to examine nationally representative samples. In Finland, clear regional differences in food habits have been found⁽³⁷⁾. Although the levels of and trends in mortality and health behaviours in HAPIEE study centres are similar to national figures, generalisations to the whole population are not warranted.

Consistencies with previous literature

It is well recognised that the consumption of a diet rich in fruit, vegetables and whole grains is beneficial to health^(38–40) while a low intake of dairy products is associated with diseases such as osteoporosis⁽⁴¹⁾ and hypertension⁽⁴²⁾. Low-fat dairy products are recommended based on evidence that high intakes of fat increase the risk of CVD⁽⁴³⁾. Many of the results were expected: the strong association between fruit consumption and better socio-economic circumstances, females with healthier food habits than males, and the sex differences in the

associations between socio-economic circumstances and food habits^(15,44,45).

Of all the food habits, fruit consumption had the most consistent association with socio-economic circumstances. A review of socio-economic differences in food habits in seven European countries, including Finland, found that those with higher education and occupational class had a higher intake of fruit than those in lower classes⁽¹⁵⁾. In the current study, the strongest positive association between fruit consumption and socio-economic position was found in the Russian sample. This observation may arise from the fact that in Novosibirsk, due to its location, fresh fruit is less accessible and hence less affordable, making cost a significant determinant in fruit consumption.

Socio-economic inequalities in vegetable consumption were not apparent in the HAPIEE cohort, while strong positive associations between vegetable consumption and socio-economic circumstances were evident among the Finnish sample, as previously reported^(6,26,46–48). A positive association between vegetable consumption and occupation has also been reported in Europe⁽¹⁵⁾, and in previous HHS analyses⁽³⁾. Recently, it has been suggested that the positive association seen between vegetable consumption and education is most evident in countries with low availability and high prices, such as in Nordic and Baltic

countries, compared with countries having higher availability and affordability⁽⁶⁾. However this explanation is inconsistent with the weak gradients in the HAPIEE cohort and may be due to the popularity of home-grown vegetable production in the HAPIEE countries.

Studies on socio-economic circumstances and consumption of bread are few and inconsistent. In Finland, the consumption of rye bread was associated with a low educational level⁽⁴⁹⁾, while in Poland no significant difference in 'dark' bread consumption was found between those of lower and higher education⁽⁵⁰⁾.

Consumption of high-fat milk has been previously linked with low education in Finland and the Baltic countries⁽⁷⁾. This pattern was confirmed in our Finnish sample where those of higher socio-economic position were significantly associated with consumption of low-fat milk compared with those in lower positions. In the Polish sample, however, the associations with low-fat milk consumption were significantly negative. There was also a negative association between high-fat milk and socio-economic circumstances among the Polish sample (results not shown), suggesting that the higher classes in our Polish sample may perceive low-fat milk as an unhealthy rather than healthy food item.

Similar to milk consumption, the only significant associations between the use of vegetable-fat spreads and socio-economic circumstances were found among the Polish and Finnish samples – those with higher socio-economic position were less likely to use vegetable-fat spreads than those with lower socio-economic position. It has been suggested that food costs have a stronger influence on food choice among people with basic education compared with those with a higher education⁽⁵¹⁾. Compared with butter, these vegetable-fat spreads are generally cheaper to purchase in all countries studied, so it is unclear as to why we observed inverse gradients in only the Polish and Finnish samples. Although the results in our Finnish sample differ from previous reports⁽⁷⁾, a previous Polish study found that use of butter increased with educational level and material situation (A Nastaly, M Porebski, K Przewozniak *et al.*, unpublished results) and similar inverse gradients have been reported in other Baltic populations⁽⁷⁾.

The significant positive socio-economic gradient in Finnish participants and Russian males in the use of vegetable cooking fats may be due to campaigns to promote the consumption of vegetable oils in these countries. Similar findings were found in previous HHS analyses⁽³⁾. In Eastern and Central Europe, there are few studies assessing the association between use of cooking fat and socio-economic position; one Polish study found that men with a high school education were more likely to use vegetable cooking fat than lower or higher educated men⁽⁵²⁾.

There were differences in low-fat cheese consumption by education level in Czech males and Russian females. Cost may influence choice of cheese, whereby lower educated persons are more likely to purchase the cheaper low-fat

cheese. An opposite trend was evident among the Polish males (among occupation) and Finnish females (among economic difficulty). It is unclear whether these participants have chosen these lower-fat versions for health reasons or because they perceive them as 'modern' foods. It has been reported that people of higher socio-economic position tend to choose 'modern' foods while people of lower socio-economic position choose more traditional foods^(53,54).

What the present study adds

The present large-scale study offers insights into inequalities in food habits by several indicators of socio-economic position in four distinct populations. The ability to assess several multiple indicators, along with multiple food habits, contributes to a better understanding of the influence which socio-economic inequalities may have on dietary behaviour. The WHO Commission on Social Determinants of Health aims to 'close the gap' in health inequalities between different groups in the course of a generation⁽⁵⁵⁾. However in order to do so, the extent to which the inequalities are modifiable must be clearly evident. The current study, which focused on healthy food habits, implies that this task may not be straightforward. Different populations showed different strength, or even different direction, of gradients measured by different dimensions of socio-economic position. Future studies of inequalities in dietary behaviour should therefore include different indicators and consider the relative importance of each socio-economic indicator.

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