Soft drinks: time trends and correlates in twenty-four European countries. A cross-national study using the DAFNE (Data Food Networking) databank

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Abstract

Objective: To evaluate time trends in the availability of soft drinks, to identify food choices associated with their consumption and to assess the relationship between socio-economic status and daily soft drink availability in a wide range of European countries.
Design: Data on food and beverage availability collected through the national household budget surveys and harmonized in the DAFNE (Data Food Networking) project were used. Averages and variability of soft drink availability were estimated and tests for time trends were performed. The daily availability of food groups which appear to be correlated with that of soft drinks was further estimated. Multivariate logistic and linear regression models were applied to evaluate the association between socio-economic status and the acquisition of soft drinks.
Setting: Twenty-four European countries.
Subjects: Nationally representative samples of households.
Results: The availability of soft drinks is steadily and significantly increasing. Households in West and North Europe reported higher daily availability of soft drinks in comparison to other European regions. Soft drinks were also found to be correlated with lower availability of plant foods and milk and higher availability of meat and sugar products. Lower socio-economic status was associated with more frequent and higher availability of soft drinks in the household.
Conclusions: Data collected in national samples of twenty-four European countries showed disparities in soft drink availability among socio-economic strata and European regions. The correlation of soft drinks with unfavourable dietary choices has public health implications, particularly among children and adolescents.

In several studies the consumption of soft drinks, particularly sugar-sweetened ones, has been positively associated with the risk of: weight gain and type 2 diabetes[1–4]; osteoporosis[5]; CHD in women[6]; dental caries and potential enamel erosion[7]; and gout in men[8]. Among these, the association between high consumption of soft drinks and weight gain is more frequently evaluated, since overweight and obesity are recognized as important public health challenges worldwide. In Europe, overweight affects 30–80 % of adults and about 20 % of children and adolescents and the trend is particularly alarming since the current annual rate of increase is much higher than that in the 1970s[9]. Several studies, mostly undertaken in the USA, indicate that the increase in the prevalence of overweight and obesity is concurrent to an increase in the intake of added sugars. An important source of readily absorbable sugars in the daily diet is non-diet soft drinks, encompassing carbonated beverages, lemonades, orangeades, iced tea and similar drinks[2,7].

In Europe, publications on the consumption of soft drinks make use of data collected through studies undertaken in specific countries, using various methodologies and mainly addressing children and adolescents[10–12]. Few attempts have been made to compare the consumption of soft drinks among various European countries[13,14]. The diet-related data regularly collected through national household budget surveys (HBS) offer a unique source of dietary information, allowing comparisons across essentially all European countries and several survey years. The use of the national HBS for nutrition monitoring purposes has been evaluated in the context of

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† See Appendix for full list of DAFNE Participants.

the EU-supported Data Food Networking (DAFNE) initiative[15].

In the present analysis, DAFNE data from twenty-four European countries have been used to: (i) undertake inter-country comparisons and evaluate time trends in the availability of soft drinks; (ii) identify food choices associated with soft drinks consumption; and (iii) assess the relationship between socio-economic status and daily soft drink availability.

Methods

The DAFNE databank comprises data collected through standardized HBS, which are periodically conducted by the National Statistical Offices using country-representative population samples. HBS collect data on all household expenditures in order to calculate the consumer price index and analyse topics of social and economic interest[16]. All HBS are confined to the population residing in private households, excluding collective or institutional ones. The sample is either obtained from registers of households or individuals with characteristics useful for stratification and sample selection, or through lists of households or dwellings in area units selected from the population census. Multistage stratified probability sampling is used in the large majority of surveys, with the household itself forming the ultimate sampling unit. In Germany and the Slovak Republic, a sampling scheme based on quota sampling is used instead. During data collection, the members of the participating households are asked to record, mainly in open questionnaires, all food and beverage purchases, contributions from the household's own production and items offered to members as gifts. Data on food quantities consumed when eating out (at restaurants, canteens and similar establishments) are, however, not collected. At present, within the European Union, the recording period for food and beverage acquisitions is in most countries 14 d and data collection is carried out throughout the year with due attention to capture seasonal variation in intake. In Belgium, Germany and Sweden the recording period is 1 month. Trained interviewers visit the households regularly to ensure complete data recording and to collect further information on demographic, socio-economic and lifestyle characteristics of the household members through standardized interviewer-administered questionnaires[16].

The collected national data sets are centrally analysed according to the methodology developed and validated in the DAFNE project[15]. Briefly, data are read, cleaned and managed to a format suitable for a between-countries analysis. To improve comparability, food, demographic and socio-economic data are subsequently classified under common groupings with the application of criteria and iterative cross-coding allowing the formation of operational classification schemes. The data collected refer to quantities of foods and beverages available for consumption to the household members. The daily individual availability is calculated by dividing the household availability by the product of the referent time period and the mean household size, without making allowances for waste or food offered to domestic pets. The results thus estimated are stored in the DAFNE databank, which currently includes data sets of seventy-one surveys from twenty-four European countries.

The mean individual daily availability (in ml) of soft drinks was estimated for all countries and most recent survey years, under the assumption that these are more relevant for contemporary patterns. Soft drinks were defined to include non-alcoholic carbonated, non-carbonated, sugar-sweetened and of low or no energy content beverages, energy drinks, squashes and syrups for the preparation of beverages, but excluding mineral water, fruit and vegetables juices. To assess the variation in dietary choices among households of different levels of soft drink acquisition, the participating households were classified in tertiles according to their daily per person soft drink availability. The mean availability of food groups which appeared to be correlated with household availability of soft drinks was estimated for households belonging to the first tertile. These mean values were used to calculate the proportional deviation (%) of the corresponding mean availability in households of the second and third tertiles (higher soft drink consumers) from that of households in the first tertile (low soft drink consumers).

The households' socio-economic status was assessed through their food purchasing capacity, also referred to as food expenditure ratio[17,18]. It is expressed as the household's expenditure on food (including household acquisitions and expenses for eating out) divided by the total household expenses. The food expenditure ratio is a measure of households' financial welfare and has been used as an indicator of a household's socio-economic status or as a proxy for the household's income, with higher values suggesting lower socio-economic status or lower income[18–20].

Statistical analyses

All analyses were conducted separately for each participating country and survey year with the Stata/SE 8·0 for Windows statistical software package (2003; Stata Corporation, College Station, TX, USA). Descriptive analyses included the estimation of averages and variability of soft drink availability (in ml/person per d), by country and survey year. To assess trends over time, tests for trend were performed. To evaluate the association of socio-economic status, as assessed through the households' food purchasing capacity, with the daily per person availability of soft drinks, data were initially modelled through multiple logistic regression contrasting availability to non-availability of soft drinks. Subsequently

multiple linear regression models were applied among households reporting soft drink acquisitions, in order to evaluate the association of socio-economic status (in quintiles of the food expenditure ratio, categorically and as an ordered variable) with the logarithm of the daily availability of soft drinks (the distribution of which was positively skewed). Both logistic and linear regression models were performed separately for each country and survey year when information on the food expenditure ratio was available, also controlling for the trimester of participation (January–March, April–June, July–September and October–December, categorically).

Results

In Table 1, sample sizes, mean, median and the first and third quartiles of the daily individual availability of soft drinks are given for each of the twenty-four European countries and survey years. As expected, the distribution of soft drink availability in virtually all countries was positively skewed. Based on data collected in the late 1990s or early 2000s, higher average availability of soft drinks at household level was generally recorded in Northern and Western European countries, in the Slovak Republic from Central/Eastern Europe, and in Malta from South Europe. In recent years, the Slovak Republic recorded the highest mean values of daily availability of soft drinks (227 ml/person per d, in 2003) and Latvia the lowest (28 ml/person per d, in 2004). With respect to time trends, in twelve out of the twenty-four participating countries the mean daily individual availability of soft drinks had increased and in most instances significantly so ($P < 0.001$ in most instances); in five countries the mean availability decreased somewhat ($P \leq 0.21$) and in three countries the availability seems to have remained stable. In particular, comparisons of data collected at different time points showed that the household availability of soft drinks increased by 5 % per year in Norway, Finland, the Republic of Ireland, Belgium, Italy and Greece, by about 8 % per year in Sweden, Latvia and the Slovak Republic, and by 23 % per year in Portugal, although starting from a very low level.

Table 2 presents how the availability of certain foods varied according to increasing tertile of soft drink availability. The values in the table indicate the percentage deviations of the food group mean among households of the second and third tertile from the mean availability among households of the first, lower tertile. Results are presented for eleven food groups, common among countries. According to results presented in Table 2, as expected there appeared to be a pattern of a positive association of soft drinks with the indicated foods, reflecting a tendency of concomitant acquisition of larger or smaller food quantities. Nevertheless, stronger positive associations were generally evident with respect to processed

meat, sugar and sugar products; that is, foods the excessive consumption of which is not considered desirable. Moreover, in several though not all countries, higher soft drink availability was associated with similar or lower availability of vegetables and fruits. Finally, in some countries there was an inverse association with milk availability. This could possibly indicate a displacement with soft drinks partially substituting milk, a finding with public health implications particularly among children and adolescents.

Table 3 shows the ratios of the odds of being a soft drink consumer *v.* the odds of not being one by quintile of household food expenditure ratio, with higher quintile indicating lower socio-economic status. Results refer to fourteen European countries with data on food expenditure ratio. Odds ratios above the null value of 1 indicate that the proportion of households consuming soft drinks is higher than in the reference category and vice versa. Table 4 shows the results of analysis undertaken in the same countries, but only among households reporting the acquisition of soft drinks during the survey period. Values in Table 4 indicate the percentage difference in the daily per person availability of soft drinks in comparison to the reference one. Both tables concordantly indicate that lower socio-economic status was associated with more frequent (Table 3, contrasting consumers *v.* non-consumers) and higher (Table 4, consumers only) availability of soft drinks in the household. An exception was noted, however, in Central and Eastern European countries during earlier HBS periods.

Discussion

High intake of sugar-sweetened soft drinks has been associated with weight gain and increased risk of type 2 diabetes[1–4]; increased risk of osteoporosis due to displacement of milk consumption and a subsequent lower calcium intake[5,21–23]; higher risk of CHD in women[6]; increased risk of dental caries[7]; and increased risk of gout in men[8]. Using data collected in nationally representative samples of households in twenty-four European countries and at multiple time points, the availability of soft drinks at household level was found to be generally higher in Western and Northern as compared with Southern and Central/Eastern European regions. In most countries the mean daily availability of soft drinks has tended to increase in recent years. Higher soft drink availability was generally found to be positively associated with the daily availability of processed foods and negatively associated with fruits, vegetables and milk. When socio-economic differences in the availability of soft drinks were examined, households of lower socio-economic status, reflected through the proportion of their expenses covering dietary needs, were associated with more frequent and higher availability of soft drinks in the household. With the exception of Central and Eastern

Table 1 Mean and quartiles (P25, P50, P75) of the availability of soft drinks, by country and survey year (ml/person per d)

Country	Year of HBS	Number of participating households	Soft drinks availability				P for trend*	Country	Year of HBS	Number of participating households	Soft drinks availability				P for trend*
			Mean	P25	P50	P75					Mean	P25	P50	P75	
Austria	1999	7098	116	0	36	151		Malta	1994	2715	244	104	204	340	(−) 0·019
Belgium	1988	3235	129	41	91	170	(+) <0·001		1995	2748	239	101	200	331	
	1997	2041	147	21	94	207			2000	2586	207	66	153	281	
	1999	3745	191	31	129	266		Montenegro	2003	380	29	8	20	37	(0) 0·47
Croatia	1999	2937	125	0	72	198	(−) 0·037		2004	380	30	7	23	42	
	2004	2847	116	0	67	178		Norway	1987	4393	109	2	62	149	(+) <0·001
Cyprus	1997	2645	113	15	88	154	(−) <0·001		1993	4033	152	27	107	214	
	2003	2990	101	0	75	137			1997	3792	177	36	119	243	
Finland	1985	8200	49	0	15	64	(+) <0·001	Poland	1988	29 645	34	1	16	43	
	1990	8258	62	0	28	85		Portugal	1990	12 403	19	0	0	0	(+) <0·001
	1998	4359	81	0	36	107			1995	10 554	47	0	0	47	
France	1985	7288	31	0	0	0	(+) <0·001		2000	10 020	63	0	12	89	
	1991	6353	47	0	0	43		Serbia	2003	3683	68	0	27	91	(−) <0·001
Germany	1988†	17 855	100	0	28	140	(0) 0·73		2004	4302	50	0	0	67	
	1993	15 825	124	0	38	175		Slovak Republic	1997	1671	154	64	128	210	(+) <0·001
	1998	12 680	108	0	22	144			2000	1647	207	96	169	269	
Greece	1981	6034	31	0	0	28	(+) 0·13		2003	1645	227	99	183	309	
	1987	6489	69	0	0	94		Slovenia	1998	3867	91	0	14	98	(0) 0·88
	1998	6258	65	0	36	98			2000	3806	93	0	16	97	
	2004	6555	66	0	36	99			2002	3687	90	0	8	91	
Hungary	1991	11 813	41	7	23	53		Spain	1981	23 972	93	0	24	142	(−) 0·21
Ireland	1987	7705	70	18	50	95	(+) <0·001		1991	21 155	84	0	7	114	
	1994	7877	95	32	71	130			1999	14 644	85	0	1	114	
	1999	7644	122	43	92	168		Sweden	1989	2079	77	13	51	102	(+) <0·001
Italy	1990	33 172	32	0	0	7	(+) <0·001		1996	1104	115	15	80	159	
	1993	34 273	39	0	0	20		United Kingdom	1992	7115	185	0	95	287	(+) 0·040
	1996	22 740	42	0	0	33			1993	6925	189	0	95	286	
Latvia	2002	3949	24	0	0	21	(+) 0·17		1994	7163	194	0	95	286	
	2003	3631	28	0	0	29			1995	7320	212	0	107	321	
	2004	3913	28	0	0	30			1996	7739	208	0	101	302	
Luxembourg	1993	3012	181	0	83	250			1997	7204	211	0	95	317	
									1998	7059	200	0	95	286	
									1999	7556	202	0	90	286	

Source: The DAFNE databank (http://www.nut.uoa.gr/dafnesoft).
HBS, household budget survey.
*Trend analysis refers to the mean value: (+), increasing availability; (−), decreasing availability; (0), no trend (P > 0·30).
†Data collected in 1988 refer to the former West Germany.

Table 2 Differences (%) in the daily individual availability of the indicated food groups, by increasing tertile of soft drink availability. The mean availability of the indicated food groups among households of the first tertile was considered as referent

Country	Year of HBS	Tertiles	Cereal and bakery products	Meat products	Red meat	Cheese	Milk	Dairy products	Lipids of animal origin	Lipids of vegetable origin	Vegetables	Fruit	Sugar and sugar products
Austria	1999	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−0·1	−9·5	−11·0	−12·6	−14·6	−2·6	−25·9	−16·3	−11·1	−18·7	−18·5
		3rd	+26·5	+30·5	+16·9	+0·6	−0·1	+21·3	−14·3	+20·1	+0·6	−9·5	+15·2
Belgium	1999	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−1·7	+0·3	−12·1	−7·3	−1·9	+1·7	−30·3	−10·0	−15·0	−25·1	−6·8
		3rd	+8·1	+24·4	+6·4	−5·2	−6·2	+2·3	−18·6	−7·8	−9·5	−24·8	+8·8
Croatia	2004	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+17·9	−3·2	−14·1	+1·0	−12·1	−1·9	−44·5	−17·2	−14·0	−11·2	−12·6
		3rd	+55·2	+30·3	+29·4	+26·2	+3·4	+25·7	−12·3	+22·4	4·0	+20·7	+17·6
Cyprus	2003	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+25·8	+22·1	+4·7	+8·9	3·0	+29·8	+13·9	−6·0	−7·6	−3·2	+2·9
		3rd	+71·0	+81·9	+54·1	+41·7	+11·5	+71·4	+36·3	+39·5	+24·7	+31·9	+41·4
Finland	1998	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−6·2	−5·8	−1·9	−2·3	+7·4	−3·5	−23·4	−9·1	−13·3	−10·1	+1·8
		3rd	+19·6	+28·4	+28·1	+16·7	+4·1	+5·0	−10·0	−3·7	+1·2	−4·9	+15·2
France	1991	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−19·4	−7·6	−19·5	−6·1	+11·0	+15·6	−16·5	+19·8	−16·0	−28·5	+2·5
		3rd	+2·8	+22·1	+10·9	+12·8	+15·5	+34·2	+4·2	+14·3	+0·6	+6·7	+27·4
Germany	1998	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+3·3	+0·7	−4·7	−10·3	−9·5	+1·4	−18·5	−8·3	−14·4	−25·1	−6·4
		3rd	+11·2	+19·1	+23·1	−15·1	−9·2	+4·2	−14·9	−0·3	−16·7	−25·1	−0·5
Greece	2004	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+11·2	+33·1	−6·1	−1·7	+0·1	−1·5	+15·1	−14·2	−12·4	−11·1	−6·9
		3rd	+43·8	+50·3	+24·0	+28·5	+5·3	+17·8	+11·6	+7·8	+6·2	+5·3	+19·5
Hungary	1991	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+21·9	+9·3	+3·8	+13·2	−4·7	+8·6	−5·5	+2·2	+2·1	+6·6	+2·8
		3rd	+45·0	+24·9	+24·1	+52·2	−1·3	+29·3	+3·3	+11·6	+20·8	+30·8	+15·5
Ireland	1999	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+11·1	+0·2	0·0	−1·4	−3·2	+10·6	−19·4	−0·4	−4·7	−5·5	+6·7
		3rd	+35·4	+22·1	+9·4	+16·6	−1·0	+24·0	−4·5	+22·5	+13·9	+5·4	+24·4
Italy	1996	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+6·3	+10·4	−8·3	+5·8	−4·2	+43·0	−10·1	−22·1	−1·8	−7·0	−14·4
		3rd	+14·4	+27·8	+5·6	+17·6	−0·5	+57·8	+3·4	−3·9	+8·4	+5·6	+3·0
Latvia	2004	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+23·4	−7·1	−16·4	−18·3	−21·7	−10·4	−32·0	−35·8	−27·2	−5·0	−31·9
		3rd	+57·1	+22·8	+1·9	−2·4	−21·4	+8·2	−20·9	−24·7	−13·4	+20·0	−9·9
Luxembourg	1993	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−34·8	+15·8	−7·2	−9·1	+7·6	0·0	+8·2	−5·0	−28·4	−14·9	+15·1
		3rd	−4·2	+56·6	+17·1	+13·1	+0·9	+28·0	−14·1	+16·2	−19·9	+5·0	+19·3
Malta	2000	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+6·4	+19·4	+20·2	+6·2	−19·5	+13·4	+11·9	+20·6	+0·2	+5·3	+11·0
		3rd	+25·6	+66·3	+60·1	+30·8	−8·0	+56·2	+39·4	+56·5	+32·3	+51·4	+44·4
Montenegro	2004	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+187·8	+28·1	+21·2	+28·3	−3·0	−15·6	−42·6	+66·4	+25·1	+43·8	+55·4
		3rd	+164·3	+2·3	+30·8	−17·2	−22·1	+50·1	−29·5	+28·2	−1·4	−7·1	+14·5

Table 2 *Continued*

Country	Year of HBS	Tertiles	Cereal and bakery products	Meat products	Red meat	Cheese	Milk	Dairy products	Lipids of animal origin	Lipids of vegetable origin	Vegetables	Fruit	Sugar and sugar products
Norway	1997	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−1·3	+3·5	−2·1	−4·1	+3·0	−6·3	−18·7	−5·3	−14·0	−6·6	+12·0
		3rd	+20·6	+39·2	+13·0	+4·6	+9·1	+10·8	−1·9	+5·5	−2·6	−2·6	+20·5
Poland	1988	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+11·6	−1·5	−5·4	−12·0	−9·1	−6·2	−9·9	−10·1	−6·9	−1·4	−6·8
		3rd	+49·9	+11·7	+6·7	−0·6	−10·6	+5·8	−4·8	−0·9	+6·5	+16·9	+2·8
Portugal	2000	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+18·6	+15·4	−11·5	−21·9	−13·1	+22·2	+4·1	−11·6	−17·2	−20·7	−14·5
		3rd	+63·6	+65·8	+24·0	+2·9	+3·9	+65·2	+44·0	+19·7	+3·8	−0·8	+12·9
Serbia	2004	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+5·5	−18·5	−20·2	−13·2	−26·6	−6·7	−14·7	−15·5	−14·2	−10·0	+16·6
		3rd	+58·8	+13·2	+50·6	+12·0	−11·1	+2·6	+44·6	−0·4	+18·3	+32·7	+48·4
Slovak Republic	2003	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+12·3	+5·0	+4·7	−2·8	−8·3	+1·7	−0·9	−0·7	−6·1	−4·0	+4·0
		3rd	+27·2	+25·2	+17·4	+7·8	−4·5	+12·9	+1·0	+17·7	−1·3	+2·4	+19·4
Slovenia	2002	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−24·5	−35·9	−39·2	−40·6	−44·7	−29·7	−43·1	−47·5	−36·7	−40·6	−44·2
		3rd	+31·9	+15·8	−29·4	+17·2	−10·3	+15·9	−32·1	+6·2	+1·4	−0·3	−3·5
Spain	1999	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	−14·4	−17·8	−17·8	−22·7	−15·6	−2·2	−55·0	−16·3	−26·0	−23·3	−7·7
		3rd	+39·4	+30·9	+12·5	+24·3	+18·8	+57·3	−25·6	+35·9	+1·7	−0·1	+56·9
Sweden	1996	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+8·1	+6·0	−2·6	−6·9	+18·7	+6·8	−14·0	−3·9	−0·3	+6·4	−5·6
		3rd	+31·0	+34·6	+10·8	+4·3	+12·4	+9·8	−14·9	+18·7	+20·2	+9·5	+20·5
United Kingdom	1999	1st	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent	referent
		2nd	+17·0	+1·3	+4·3	+4·0	−0·7	+20·9	+2·5	+24·8	−4·0	−2·4	+15·4
		3rd	+41·3	+28·2	+26·6	+31·8	+5·0	+51·1	+17·2	+37·8	+14·9	+12·4	+33·9

Source: The DAFNE databank (http://www.nut.uoa.gr/dafnesoft).

Table 3 Odds ratios and 95 % confidence intervals contrasting households reporting *v.* not reporting the acquisition of soft drinks, by quintile of the household food expenditure ratio*, using the first quintile as referent

Country	Year of HBS	2nd quintile		3rd quintile		4th quintile		5th quintile		Ordered quintiles	
		OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI	OR	95 % CI
Austria	1999	1·09	0·91, 1·31	1·54	1·30, 1·84	1·65	1·38, 1·97	1·41	1·18, 1·69	1·11	1·07, 1·16
Cyprus	1997	1·59	1·38, 1·85	1·61	1·39, 1·87	1·85	1·58, 2·17	1·50	1·27, 1·77	1·12	1·08, 1·17
	2003	1·59	1·38, 1·82	1·54	1·34, 1·78	2·00	1·73, 2·32	1·64	1·40, 1·91	1·15	1·11, 1·19
Finland	1985	1·50	1·36, 1·66	1·52	1·37, 1·68	1·51	1·36, 1·67	1·29	1·16, 1·43	1·05	1·03, 1·08
	1990	1·64	1·48, 1·82	2·11	1·90, 2·34	2·18	1·97, 2·42	1·92	1·73, 2·14	1·18	1·15, 1·21
	1998	1·79	1·55, 2·07	1·75	1·51, 2·01	2·21	1·91, 2·56	2·19	1·88, 2·54	1·20	1·16, 1·24
Germany	1998	1·22	1·12, 1·34	1·42	1·30, 1·55	1·72	1·58, 1·88	2·07	1·89, 2·27	1·20	1·17, 1·22
Greece	1998	1·10	1·00, 1·21	1·28	1·16, 1·41	1·45	1·31, 1·60	1·32	1·20, 1·46	1·09	1·06, 1·11
	2004	1·19	1·07, 1·32	1·10	1·00, 1·22	1·21	1·09, 1·34	1·25	1·12, 1·38	1·05	1·02, 1·07
Ireland	1994	1·91	1·70, 2·16	2·27	2·01, 2·56	2·13	1·89, 2·40	1·47	1·31, 1·65	1·09	1·06, 1·13
	1999	2·19	1·91, 2·50	2·07	1·81, 2·36	2·28	1·98, 2·62	0·97	0·86, 1·10	1·01	0·97, 1·05
Italy	1990	1·04	0·98, 1·10	1·05	0·99, 1·11	1·03	0·98, 1·09	1·00	0·94, 1·05	1·00	0·99, 1·01
	1993	1·09	1·04, 1·16	1·10	1·04, 1·16	1·19	1·12, 1·25	1·04	0·98, 1·10	1·01	1·00, 1·03
	1996	1·03	0·96, 1·11	1·25	1·17, 1·35	1·21	1·13, 1·30	1·27	1·18, 1·36	1·07	1·05, 1·08
Malta	1994	1·04	0·63, 1·70	1·37	0·86, 2·18	1·47	0·89, 2·42	0·87	0·55, 1·36	1·00	0·89, 1·12
	1995	1·27	0·82, 1·97	1·02	0·66, 1·57	1·97	1·20, 3·24	0·91	0·60, 1·39	1·01	0·91, 1·13
	2000	1·78	1·42, 2·22	2·78	2·19, 2·22	3·32	2·52, 4·38	1·81	1·43, 2·28	1·23	1·16, 1·32
Norway	1997	1·98	1·61, 2·45	1·92	1·53, 2·41	2·58	2·01, 3·29	1·75	1·40, 2·19	1·17	1·10, 1·24
Portugal	1990	1·19	1·08, 1·32	1·28	1·16, 1·41	1·23	1·12, 1·36	1·03	0·93, 1·14	1·01	0·99, 1·03
	1995	1·01	0·91, 1·11	1·01	0·91, 1·11	1·06	0·96, 1·17	0·76	0·68, 0·84	0·95	0·93, 0·97
	2000	1·13	1·01, 1·26	1·28	1·14, 1·42	1·25	1·12, 1·40	1·29	1·15, 1·45	1·06	1·04, 1·09
Slovak Republic	1997	1·38	0·65, 2·91	1·83	0·80, 4·22	4·82	1·59, 14·59	0·74	0·38, 1·45	0·99	0·80, 1·23
	2000	2·22	0·48, 10·21	1·14	0·31, 4·16	5·00	1·68, 14·82	0·41	0·18, 0·92	0·76	0·57, 1·01
	2003	1·09	0·43, 2·74	2·19	0·28, 17·27	0·67	0·27, 1·66	0·54	0·22, 1·31	0·81	0·64, 1·03
Slovenia	1998	1·36	1·20, 1·53	1·42	1·25, 1·60	1·29	1·15, 1·46	1·09	0·96, 1·23	1·01	0·99, 1·04
	2000	1·52	1·35, 1·73	1·54	1·36, 1·74	1·65	1·46, 1·87	1·23	1·08, 1·39	1·05	1·02, 1·08
	2002	1·43	1·26, 1·63	1·58	1·39, 1·80	1·70	1·49, 1·93	1·28	1·12, 1·45	1·07	1·04, 1·10
Spain	1991	1·23	1·15, 1·31	1·56	1·47, 1·66	1·65	1·55, 1·75	1·56	1·46, 1·66	1·13	1·11, 1·14
Sweden	1996	2·36	1·71, 3·26	2·46	1·79, 3·39	4·11	2·87, 5·89	5·13	3·47, 1·63	1·49	1·37, 1·63

Source: The DAFNE databank (http://www.nut.uoa.gr/dafnesoft).
*The food expenditure ratio equals the household's food expenditures (incl. eating out of home) divided by the total household expenditures; increasing ratio reflects lower socio-economic status. Data adjusted for trimester of participation.

European countries during earlier HBS periods, households of higher socio-economic strata were less likely to be consumers of soft drinks and regularly purchased smaller quantities than their lower socio-economic counterparts. The exception in Central and Eastern European regions might indicate that in countries recently undergoing socio-economic transitions, soft drinks may have been considered as novel and trend-setting items.

Our observations are in line with previous studies indicating an increase in the consumption of soft drinks in recent years, also combined with an increase in the portion sizes offered[24,25]. In addition, a European study comparing the consumption of soft drinks among adults in ten countries using data collected through standardized 24 h dietary recalls also reported that soft drinks are a characteristic of the diet in North European and Scandinavian countries, but not in South Europe and France[13]. According to results of a different cross-national European study on the consumption of fruits and soft drinks among young adolescents, pupils in Scandinavian countries were significantly less likely to consume soft drinks daily than pupils in all other European areas[14]. According to the HBS data used in the present study and including all ages in each country's population, in the late 1990s daily availability was generally low in Finland and Sweden, but not in Norway.

In terms of food choices associated with soft drink consumption, our observation that soft drinks may displace milk in the daily diet has previously been reported through both observational and intervention studies[21,22,26].

Our finding that households of lower social strata purchase more soft drinks agrees with that of a study analysing the influence of socio-economic status on the consumption of fruits and soft drinks among adolescents in a wide range of European countries[14]. Using various models to account for the adolescents' family characteristics, school environment and country of residence, the authors concluded that the daily consumption of soft drinks was significantly lower among pupils of parents of higher occupations for all areas except the Central and Eastern European countries. The authors further reported that in Central/Eastern European countries there was a significant increase in daily soft drink consumption with increasing family affluence, in line with our observation of higher availability of soft drinks among households of higher socio-economic status, and presumably higher prosperity, in Central/Eastern Europe, particularly in earlier years.

The data used in the present analysis were collected through the national HBS and cover all food items available for consumption to the household members for a

Table 4 Percentage difference (% Dif) and 95 % confidence intervals in soft drink availability among consumers only. Results presented by quintile of household food expenditure ratio*, using the first quintile as referent

Country	Year of HBS	2nd quintile		3rd quintile		4th quintile		5th quintile		Ordered quintiles	
		% Dif	95 % CI	% Dif	95 % CI	% Dif	95 % CI	% Dif	95 % CI	% Dif	95 % CI
Austria	1999	+14	−2, +33	+4	−10, +19	+26	+10, +44	+39	+21, +60	+8	+5, +11
Cyprus	1997	+15	+8, +22	+26	+19, +35	+28	+20, +37	+53	+42, +63	+10	+8, +11
	2003	+12	+5, +19	+28	+20, +36	+42	+34, +51	+83	+71, +96	+15	+14, +17
Finland	1985	+3	−3, +9	+14	+7, +21	+22	+15, +30	+36	+27, +45	+8	+7, +10
	1990	+10	+3, +17	+10	+3, +17	+22	+15, +30	+38	+29, +46	+8	+6, +9
	1998	+9	0, +19	+10	+1, +20	+21	+11, +32	+44	+32, 57	+9	+7, +11
Germany	1998	−15	−22, −7	−11	−17, −3	−9	−16, −1	+4	−4, +12	+2	+1, +4
Greece	1998	+4	−2, +9	+2	−3, +7	+5	+0, +11	+10	+4, +16	+2	+1, +3
	2004	+9	+3, +15	+7	+1, +13	+7	+2, +13	+24	+18, +31	+4	+3, +6
Ireland	1994	+5	+1, +9	+15	+11, +20	+24	+19, +28	+33	+28, +39	+8	+7, +9
	1999	+20	+15, +25	+25	+21, +30	+42	+37, +48	+41	+34, +47	+9	+8, +10
Italy	1990	+16	8, +24	+12	+4, +20	+16	8, +24	+27	+19, +36	+5	+3, +6
	1993	+8	+1, +15	+14	+7, +21	+24	+17, +32	+33	+25, +41	+7	+6, +9
	1996	+8	+0, +17	+14	+5, +23	+22	+13, +33	+21	+12, +31	+5	+3, +7
Malta	1994	−2	+1, +5	+4	+1, +12	+9	+1, +16	+17	+9, +26	+4	+3, +6
	1995	+13	+6, +22	+16	+8, +25	+26	+18, +35	+27	+18, +35	+6	+4, +8
	2000	+12	+4, +20	+20	+12, +28	+19	+10, +28	+46	+35, +57	+8	+7, +10
Norway	1997	+14	−2, +33	+4	−10, 19	+26	+10, +44	+39	+21, +60	+8	+5, +11
Portugal	1990	−6	−13, +1	+1	−7, +9	−1	−8, +8	−18	−26, −11	−3	−5, −1
	1995	+1	−6, +10	+12	+4, +22	+13	+4, +22	+15	+6, +25	+4	+2, +6
	2000	−2	−8, +5	+1	−6, +8	+5	−3, +12	+11	+3, +20	+3	+1, +5
Slovak Republic	1997	+7	−5, +21	+7	−7, +26	+39	+23, +58	+36	+20, +53	+9	+6, +12
	2000	+1	−8, +11	−6	−15, +4	+7	−1, +17	+4	−5, +14	+1	−1, +4
	2003	−4	−13, +4	+2	−6, +12	−10	−8, −1	+12	+3, +22	+2	0, +4
Slovenia	1998	+6	−5, +17	+11	+0, +24	−2	−12, +9	+15	+4, +29	+2	0, +4
	2000	+3	−8, +14	+4	−7, +16	+13	+1, +26	+27	+13, +43	+6	+3, +9
	2002	+9	−3, +22	+33	+19, +49	+46	+31, +63	+76	+56, +98	+15	+12, +18
Spain	1991	+13	+5, +21	+8	+1, +16	+14	+7, +23	+21	+13, +29	+4	+2, +5
Sweden	1996	−20	−33, −4	−3	−19, +15	+9	−8, +29	+18	−2, +42	+8	+3, +12

Source: The DAFNE databank (http://www.nut.uoa.gr/dafnesoft).
*The food expenditure ratio equals the household's food expenditures (incl. eating out of home) divided by the total household expenditures; increasing ratio reflects lower socio-economic status. Data adjusted for trimester of participation.

specified period of time. Among the strengths of the present study are the nationally representative population samples, the standardized data collection at regular time intervals, the subsequent harmonization of the available information to allow for inter-country comparisons, and the use of an indicator of socio-economic status which has been reported to adequately reflect social strata[18,20]. Socio-economic status can be assessed through various indicators. It is, however, generally acknowledged that no indicator is clearly superior to another and the use of different ones usually provides complementary insights[27].

The study also has some weaknesses imposed by the nature of the data. The lack of information on eating out is an important limitation and is likely to affect estimations of soft drinks consumption[28]. A second limitation of the HBS data relates to different recording periods used in some of the countries. However, this inherent weakness will not affect within-country comparisons and no major bias is expected to be introduced when comparisons between countries are made. The HBS data refer to aggregate household acquisitions and a process of individualization is required. There are different ways to estimate the per person availability of foods and beverages; methods range from a simple division by the number of household members to the application of statistical modelling for calculating age- and gender-specific values[29,30]. In our analysis we have assumed an equal distribution of food among the household members and this is likely to affect the estimates, particularly in households where members of various age groups are present. The years of data collection are not strictly comparable among countries. Our working assumption, however, is that variability among countries is larger than that over time periods, at least for the outlying countries.

In the current paper we observed between- and within-countries disparities in the household consumption of soft drinks across Europe. High availability was generally reported among households of lower socio-economic status in Western and Northern Europe and it appears to be steadily and significantly increasing. Given the nature of our data we were not in a position to document which members of the household consumed these beverages, although children's diet often mirrors that of their parents[10,31]. Soft drinks were also found to be correlated with unfavourable dietary choices such as higher availability of processed meat, sugar and sugar products and lower availability of plant foods and milk. These dietary patterns are likely to be shaped by advertising, the availability of vending machines in many schools and working places, and the relatively inadequate promotion

of healthy food choices. Sources of comparable between-countries information about long-term trends of food choices at home and their sociodemographic determinants can be essential in policy planning.

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Appendix

DAFNE Participants

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Cyprus: E. Markidou, K. Onisiforou and A. Agrotou.

Finland: M.A. Berg, A. Pajunen and T. Hirvonen.

France: J.L. Volatier and J. Maffre.

Germany: G. Karg, K. Gedrich and K. Wagner.

Greece: A. Trichopoulou (project coordinator), A. Naska, V. Bountziouka, Y. Chloptsios, E. Oikonomou and K. Tsiotas.

Hungary: G. Zajkas and P. Szivos.

Italy: A. Turrini, S. Barcherini and S. Martines.

Latvia: N. Petruhina, L. Sparite and D. Šantare.

Luxembourg: J. Langers, A. Schmitt and M. Zanardelli.

Malta: L. Pace, E. Caruana and N. Camilleri.

Montenegro: M. Burzanovic, Z. Savic, N. Terzic and L. Zizic.

Norway: K. Trygg, E. Mork and K. Lund-Iversen.

Poland: W. Sekula, A. Bienkuska, M. Morawska and Z. Niedzialek.

Portugal: M.D. Vaz de Almeida and S. Rodrigues.

Republic of Ireland: C. Kelleher and S. Friel.

Republic of Serbia: Z. Jovanovski and V. Božanić.

Slovak Republic: E. Leskova and H. Sukenikova.

Slovenia: M. Gabrijelcic, M. Adamic, M. Gregoric and M. Remec.

Spain: O. Moreiras, C. Cuadrado, M.L. Boned and P. Seoane Spiegelberg.

Sweden: M. Sjostrom, A. Yngve and E. Poortvliet.

United Kingdom: M. Nelson, D. Rimmer and S. Burr.