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Eating out is different from eating at home among individuals who occasionally eat out. A cross-sectional study among middle-aged adults from eleven European countries

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Abstract

Eating out has been linked to the current obesity epidemic, but the evaluation of the extent to which out of home (OH) dietary intakes are different from those at home (AH) is limited. Data collected among 8849 men and 14 277 women aged 35–64 years from the general population of eleven European countries through 24-h dietary recalls or food diaries were analysed to: (1) compare food consumption OH to those AH; (2) describe the characteristics of substantial OH eaters, defined as those who consumed 25 % or more of their total daily energy intake at OH locations. Logistic regression models were fit to identify personal characteristics associated with eating out. In both sexes, beverages, sugar, desserts, sweet and savoury bakery products were consumed more OH than AH. In some countries, men reported

Abbreviations: 24-HDR, 24-h dietary recalls; AH, at home; EPIC, European Prospective Investigation into Cancer and Nutrition; OH, out of home.

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higher intakes of fish OH than AH. Overall, substantial OH eating was more common among men, the younger and the more educated participants, but was weakly associated with total energy intake. The substantial OH eaters reported similar dietary intakes OH and AH. Individuals who were not identified as substantial OH eaters reported consuming proportionally higher quantities of sweet and savoury bakery products, soft drinks, juices and other non-alcoholic beverages OH than AH. The OH intakes were different from the AH ones, only among individuals who reported a relatively small contribution of OH eating to their daily intakes and this may partly explain the inconsistent findings relating eating out to the current obesity epidemic.

Key words: Eating out: Eating at home: HECTOR

Over the past decades, lifestyle and societal changes have led to an increase in the popularity of eating out of home (OH), which is reflected in the growing number of studies undertaken worldwide[1–8]. In light of the rising obesity epidemic[9], the majority of studies on OH eating aim to either evaluate the composition of the diet[1,2,10–12] or to assess the associations between the OH dietary intakes and body fatness, weight gain, overweight or obesity[4,5,13–17]. The evaluation, however, of the extent to which OH dietary intakes are different from those at home (AH) has generally been limited[4,11,14,18–21]. A majority of studies have focused on energy and nutrient intakes when eating out[4,14,18,19,21] and they all agree that eating out is related to alcohol intake and that in Europe there is a north/south diversity in relation to the composition of the OH diet[20].

A limitation, however, in comparing the results of different studies is the use of various definitions to identify the eating-out component of the daily diet. In some studies, eating out was defined to include food items prepared at locations OH, irrespective of whether the items were consumed OH or AH[1,19,22,23]; in other studies, eating out included food items consumed at locations OH, irrespective of where the items had been prepared (AH or OH)[3,4,11,14,17,20]; whereas in certain studies, researchers focused on particular eating-out locations (e.g. fast food restaurants)[5,24,25].

The present manuscript aims to compare food group intakes OH to those AH overall, as well as among individuals who reported a substantial or a not substantial contribution of eating out to their daily energy intakes, using one common definition of OH eating in all the datasets. In addition, it aims to describe personal characteristics of substantial OH eaters. Data collected among thirteen populations of eleven European countries were analysed in the context of the EU-supported project on Eating Out: Habits, Determinants, and Recommendations for Consumers and the European Catering Sector (the HECTOR project; http://www.nut.uoa.gr/hector).

Experimental methods

The study sample

The HECTOR study population consists of individuals from the general population aged up to 98 years who participated in regional studies in Bavaria (Germany) and Porto (Portugal); national studies in Austria, Belgium, Italy and Poland; or belonged to cohorts in seven European countries participating in the European Prospective Investigation into Cancer and Nutrition (EPIC) study (namely, Germany, Greece, Italy, the Netherlands, Norway, Sweden and the UK). Ethical issues were considered in all studies and procedures were in accordance with the Helsinki declaration[26–30].

A description of each study included in the present analysis is given in Table 1. Since studies differed in relation to the range of participants' age, individuals younger than 35 and older than 64 years were excluded in order to maintain the same age range throughout the study sample. In addition, participants with missing information in weight or height (578 subjects), educational level (438 subjects) or smoking status (226 subjects) were not considered in the analysis. Based on information missing in any of the variables listed earlier, 653 participants were excluded. Thus, the study sample consisted of 23 126 eligible individuals aged 35–64 years (8849 men and 14 277 women) from eleven European countries. The Norwegian sub-sample of the EPIC study included only women aged 42–57 years.

Dietary data

Data on dietary intake were mainly collected through 24-hour dietary recalls (24-HDR) and energy and nutrient intakes were estimated based on different food composition databases in each survey (Table 1). Single or multiple recalls were either self-reported (Austria) or administered by trained interviewers either through face-to-face (Belgium, Poland and most centres of the EPIC study) or through telephone interviews (Bavaria and EPIC-Norway)[27,28,30–32]. In the EPIC study, the Belgian and Bavarian surveys, 24-HDR were collected through a standardised computerised software[33]. In the nationwide Italian survey and the regional study in Porto (the EpiPorto Study), participants were asked to provide multiple-day food diaries[29,34]. In every case, composite dishes and recipes had been disaggregated to their ingredients by the corresponding data providers based on recipe information. Edible proportion factors and yield coefficients had also been applied so that food quantities as well as energy intakes were expressed at the cooked, edible ingredient level.

The reported foods and beverages were first classified into groups and sub-groups, which were further aggregated into nineteen food categories selected to highlight items particularly relevant to eating out (e.g. soft drinks, juices and ice cream). A detailed description of the food items/groups included in the food categories is given in online Supplementary Table S1.

Definitions

Eating out and eating at home. For each eating (and drinking) occasion recalled in the 24-HDR or recorded in the

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Table 1. Characteristics and methods of dietary assessment in national and regional surveys in the HECTOR project: analysing out-of-home to at-home eating in middle-aged participants (35–64 years)

Country (region)	Survey name	Dietary assessment method	Data collection years	Gender			
				Men		Women	
				n	%	*n*	%
Austria*	Nutritional Knowledge and Dietary Behavior of Austrian Adults	Single 24-HDR	2005–6	565	39	880	61
Belgium†	Belgian National Food Consumption Survey (BNFCS)	Two 24-HDR‡	2004	380	50	377	50
Germany (Bavaria)§	Bavarian Nutrition Survey (BNS)	Two or three 24-HDR‡	2002–3	205	39	322	61
Italy/national‖	Nationwide Nutritional Survey of Food Behavior of the Italian Population	4–7 d food diaries	1994–6	399	50	401	50
Poland/national¶	Polish household food consumption and anthropometric survey	Single 24-HDR	2000	691	44	878	56
Portugal/Porto**	The EpiPorto Study	4–7 d food diaries	1999–2003	119	40	176	60
Italy (Florence, Varese, Ragusa, Turin, Naples)	EPIC‡††	Single 24-HDR	1996–8	1311	36	2324	64
Germany (Heidelberg, Potsdam)		Single 24-HDR	1996–8	2179	51	2116	49
Greece		Single 24-HDR	1997–9	681	42	947	58
Norway		Single 24-HDR	1999–2000	–		1704	100
UK (Oxford)		Single 24-HDR	1997–8	149	35	275	65
The Netherlands (Bilthoven and Utrecht)		Single 24-HDR	1995–7	1007	29	2485	71
Sweden (Umea)		Single 24-HDR	1997–8	1163	46	1392	54
Total				8849	38	14 277	62

24-HDR, 24-h dietary recalls; EPIC, European Prospective Investigation into Cancer and Nutrition.
* Nutrient database sources: The German Food Code and Nutrient Data Base (BLS II.3.1), 1996.
† Nutrient database sources: Combination of Belgian, Dutch and British food composition data[30].
‡ Data were collected through the EPIC-SOFT dietary assessment tool.
§ Nutrient database sources: Der Bundeslebensmittelschlussel — Aktuelle Entwicklungen, Potenzial und Perspektiven, versions II.2. Ernahrungs-Umschau, 2006.
‖ Nutrient database sources: Tabelle di Composizione degli Alimenti, Istituto Nazionale della Nutrizione, 1997.
¶ Nutrient database sources: Tabele wartosci odzywczej produktow spozywczych. Prace IZZ 85. Warsaw 1998.
** Nutrient database sources: Tabela de composicao dos alimentos Potugueses. 2a edicao, 1985 and the USDA National Nutrient Database for Standard Reference, Release 17 (http://www.nal.usda.gov/fnic/foodcomp).
†† Nutrient database sources: EPIC Nutrient Database[43].

diaries, the place of consumption was reported in varying degrees of detail. Since, however, analysis had to conform to the lowest level of common information available, eating out was commonly defined to include meals, beverages and snacks consumed OH, irrespective of where the items had been prepared (AH or OH). Consequently, eating AH included meals, beverages and snacks reported of being consumed at the participants' households, irrespective of the place of food preparation. Eating occasions AH on a daily basis were reported by essentially all the participants (99·2 %).

Substantial and not substantial out-of-home eaters. To identify OH eaters of substantial quantities, we have used a criterion based on each participant's energy intake OH. In particular, the fraction of energy intake during eating out occasions out of the corresponding total energy intake was calculated and among the OH eaters, substantial OH eaters were operationally defined as those who consumed on average one quarter or more of their daily energy OH on the reporting days. Consequently, individuals who did not report any OH dietary intake or reported consuming on average less than 25 % of their daily energy intake at eating out places were regarded as not substantial OH eaters. These definitions have been used in previous publications[11,20,21].

Assessment of participants' personal characteristics

The non-dietary data used in the present analysis include self-reported information on participants' sex, age, educational attainment (grouped as none/primary education completed; technical/vocational/secondary education completed; and university degree) and smoking habits (grouped as never; former; and current smokers). Data on smoking status were not collected in the Polish study. Self-reported anthropometric data were available in all surveys. Weight and height were measured only in the national study in Poland and the regional study in Portugal. The participants' BMI was calculated in kg/m^2.

Statistical analysis

Daily per-person food and energy intakes were estimated by study or country (in the case of the EPIC study), separately for males and females. In the case of studies with multiple recalls or diaries per person, average intakes were estimated by dividing the sum of reported intakes by the number of days recalled or recorded. The relative contribution of each food category to the overall daily energy intake OH and AH was estimated, and the corresponding ratio, by dividing the OH and AH fractions, was further calculated per food category. We have additionally estimated the energy density (expressed as kJ/100 g of consumption) of overall intakes AH and OH by survey and separately for foods (solid items) and beverages (liquid items). In the estimation of the energy density of beverage intakes, only energy-yielding items were considered.

OR (95 % CI) comparing the odds of being a substantial OH eater: (1) at specified referent and non-referent categories for categorical variables; (2) per specific increments for continuous variables were estimated, separately for men and women, by fitting multivariable logistic regression models. The following mutually adjusted personal characteristics were included in the models: age (per 5 years); education and smoking habits (categorical, as previously indicated); energy intake (per 2·09 MJ or 500 kcal); and BMI (continuously, per 5 kg/m^2; or categorically in three categories <25, 25–29·9 and ≥ 30 kg/m^2). In order to assess the effect of missing information, an extra category including participants with missing data in the corresponding variable was added in each of the model covariates. We have additionally conducted a meta-analysis to estimate the summary association between personal characteristics and the probability of being a substantial OH eater, and we further conducted sub-group analyses based on national, regional and cohort studies. We used a random-effects model for our meta-analysis to account for within-study and between-study variances. We further carried out a sensitivity analysis to assess the impact of the cut-off used to identify substantial OH eaters in understanding their characteristics. In particular, we repeated the analysis after defining as substantial OH eaters participants consuming (1) at least 20 % or (2) at least 33 % of their daily energy OH. All statistical analyses were performed using the Stata/SE 11.0 for Windows statistical package (StataCorp LP 2010).

Results

Tables 2 and 3 (men) and Tables 4 and 5 (women) present the mean energy intake, the average percentage contribution of food categories to total daily energy intake OH and AH and the ratios of the corresponding contributions to energy intake. Data are not reported for eggs, pulses and ice cream because in all countries their contribution to the daily energy intake either OH or AH was negligible. Ratios greater than 1 indicate that a particular group is proportionally consumed more OH than AH. In terms of their average contribution to the daily energy intake, sugar, desserts, sweet and savoury bakery products and beverages were consumed more OH than AH by both men and women in the majority of the populations under study. Foods of animal origin were consumed more OH than AH only among the EPIC-Oxford study sample, in which health-conscious individuals were over-sampled. In some population groups, male participants reported higher intakes of fish and potatoes OH than AH. Notwithstanding methodological differences between studies, the comparison of findings between the Italian national nutrition survey and the EPIC-Italy cohorts, as well as between the EPIC-Germany cohorts and the regional study in Bavaria led to the same conclusions regarding the food items that contribute most to energy intake when eating out. In almost all instances, the overall OH food choices were more energy dense than the AH ones. Differences were, however, small and they ranged from 24 kJ/100 g of solid foods (approximately 6 kcal/100 g) in the EPIC-Germany cohort to 216 kJ/100 g of solid foods (approximately 52 kcal/100 g) in the national Italian study. On the contrary, the energy density of beverage intakes was not consistently higher OH than AH, but differences were even smaller and did not exceed

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Table 2. Mean contributions (%) of the indicated food categories to daily energy intake out of home (OH) and at home (AH), and the corresponding ratios for males in EPIC cohorts (The HECTOR project)

(Mean values and standard deviations)

	Method of dietary assessment: single 24-HDR																	
	EPIC-Italy			EPIC-Germany			EPIC-Greece			EPIC-UK			EPIC-The Netherlands			EPIC-Sweden		
	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH
Energy intake (MJ)																		
Mean	3·1	8·7		4·2	7·5		2·5	7·7		3·5	7·2		4·2	7·7		3·9	7·6	
SD	3·2	3·9		3·0	3·7		2·9	3·6		2·6	2·8		3·5	3·8		3·1	3·5	
*n**	816	1308		1299	2153		450	675		72	149		745	995		759	1148	
Animal origin	14·9	23·7	0·6	30·1	28·3	1·1	17·3	24·4	0·7	23·4	15·8	1·5	23·6	32·0	0·7	22·0	32·6	0·7
Meat	5·7	10·3	0·6	17·9	14·1	1·3	5·8	8·1	0·7	7·3	4·8	1·5	9·7	15·3	0·6	10·4	11·9	0·9
Fish/seafood	1·8	1·6	1·1	1·4	1·3	1·1	1·3	2·6	0·5	1·9	0·6	3·1	1·3	0·9	1·4	1·8	2·3	0·8
Milk/milk products	7·1	10·9	0·7	10·1	11·9	0·9	9·4	12·8	0·7	13·1	10·0	1·3	12·0	14·9	0·8	9·0	17·3	0·5
Vegetables, fruit and nuts, grains and potatoes	27·0	45·7	0·6	30·0	31·3	1·0	27·9	42·6	0·7	33·6	47·0	0·7	27·5	33·9	0·8	28·7	32·8	0·9
Vegetables	1·9	3·8	0·5	1·7	1·9	0·9	2·1	5·1	0·4	2·5	4·1	0·6	0·6	1·8	0·3	1·8	2·2	0·8
Fruit and nuts	4·7	7·7	0·6	7·7	6·2	1·2	6·6	7·2	0·9	6·8	10·4	0·7	5·7	5·7	1·0	3·8	4·2	0·9
Cereals/bread/pasta	19·1	32·0	0·6	17·3	19·9	0·9	17·6	26·6	0·7	20·7	27·3	0·8	19·6	20·1	1·0	18·3	22·0	0·8
Potatoes	1·1	1·8	0·6	3·2	3·0	1·1	0·8	2·0	0·4	2·9	3·9	0·7	1·6	5·9	0·3	4·6	4·3	1·1
Sugar, desserts, sweet and savoury bakery products	33·2	11·8	2·8	10·9	11·4	1·0	26·3	6·5	4·1	19·8	15·9	1·3	22·2	13·8	1·6	28·1	15·7	1·8
Sugar, similars and sweets	15·9	3·1	5·2	2·7	3·3	0·8	16·8	2·5	6·6	4·1	3·7	1·1	9·8	5·0	2·0	5·4	4·8	1·1
Sweet and savoury bakery products	12·4	7·7	1·6	6·8	6·5	1·1	8·1	3·2	2·6	12·8	10·1	1·3	10·1	6·5	1·6	20·1	9·2	2·2
Chocolate and chocolate sweets	1·3	0·5	2·6	0·8	1·4	0·6	0·7	0·4	1·6	2·7	1·4	1·9	1·4	1·7	0·8	2·0	0·9	2·2
Beverages	24·9	18·8	1·3	29·1	29·0	1·0	28·5	26·5	1·1	23·2	21·4	1·1	26·7	20·3	1·3	21·2	18·9	1·1
Alcoholic	8·3	7·9	1·1	10·1	10·1	1·0	12·7	4·8	2·7	6·4	6·6	1·0	12·0	7·3	1·7	3·2	3·8	0·9
Soft drinks	2·5	0·5	4·8	2·7	1·0	2·7	0·3	0·1	2·9	3·0	0·7	4·4	3·2	1·7	1·9	2·6	1·5	1·8
Juices	0·9	0·3	2·8	3·2	3·6	0·9	0·6	0·4	1·5	1·5	2·0	0·7	1·2	1·4	0·9	0·4	0·8	0·5
Other non-alcoholic	8·8	0·5	17·8	3·3	1·0	3·4	6·7	0·5	14·8	2·3	0·5	5·0	3·1	0·6	5·6	4·5	0·7	6·7
Fats and oils	4·3	9·6	0·5	9·8	13·2	0·7	8·2	20·8	0·4	10·1	11·6	0·9	7·2	9·4	0·8	10·5	12·1	0·9

24-HDR, 24-h dietary recalls; EPIC, European Prospective Investigation into Cancer and Nutrition.

* Number of participants reporting any consumption OH or AH.

Table 3. Mean contributions (%) of the indicated food categories to daily energy intake out of home (OH) and at home (AH), and the corresponding ratios for males in non-EPIC studies (The HECTOR project)

(Mean values and standard deviations)

	Method of dietary assessment																	
	Single 24-HDR						Two 24-HDR			Two or three 24-HDR			4–7 d food diaries					
	Austria			Poland			Belgium			Germany/Bavaria			Italy			Portugal/Porto		
	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH
Energy intake (MJ)																		
Mean	3·1	6·2		4·2	10·9		3·2	6·8		2·5	7·2		2·2	8·0		2·1	7·1	
SD	2·4	2·9		3·0	4·7		2·5	3·3		1·8	2·6		1·8	2·4		1·6	2·1	
*n**	350	553		311	688		285	376		155	205		324	399		101	119	
Animal origin	28·6	31·8	0·9	21·3	27·2	0·8	23·2	27·7	0·8	29·8	29·7	1·0	16·5	25·4	0·7	24·9	32·4	0·8
Meat	18·5	18·9	1·0	15·9	18·4	0·9	10·4	14·3	0·7	21·4	17·5	1·2	8·4	10·8	0·8	14·0	16·2	0·9
Fish/seafood	0·6	0·8	0·7	0·9	1·0	0·9	2·5	1·8	1·4	0·9	1·2	0·8	2·2	2·5	0·9	5·1	6·7	0·8
Milk/milk products	8·8	10·9	0·8	3·7	6·0	0·6	9·6	10·7	0·9	7·1	10·2	0·7	5·6	11·1	0·5	5·3	8·3	0·6
Vegetables, fruit and nuts, grains and potatoes	40·8	36·3	1·1	39·0	41·1	1·0	28·7	35·4	0·8	28·5	31·6	0·9	48·6	46·2	1·1	30·1	42·4	0·7
Vegetables	1·6	1·9	0·8	1·2	2·4	0·5	1·2	2·0	0·6	1·8	2·2	0·8	1·8	3·5	0·5	2·9	4·2	0·7
Fruit and nuts	19·4	6·5	3·0	5·4	3·7	1·5	5·5	4·0	1·4	4·7	4·6	1·0	3·5	4·8	0·7	3·1	6·9	0·5
Cereals/bread/pasta	18·3	25·4	0·7	30·7	26·9	1·1	19·0	23·5	0·8	18·8	22·1	0·9	41·3	35·1	1·2	16·1	22·1	0·7
Potatoes	1·2	2·0	0·6	1·6	7·7	0·2	2·9	5·8	0·5	3·2	2·4	1·3	1·6	2·1	0·8	7·2	8·3	0·9
Sugar, desserts, sweet and savoury bakery products	5·6	8·4	0·7	17·4	12·9	1·4	16·5	13·3	1·2	11·0	13·8	0·8	23·0	8·8	2·6	21·7	7·5	2·9
Sugar, similars and sweets	3·3	4·9	0·7	10·7	7·8	1·4	3·7	3·8	1·0	2·1	3·7	0·6	6·7	2·6	2·6	8·4	2·0	4·3
Sweet and savoury bakery products	1·0	1·7	0·6	5·9	4·4	1·3	9·7	6·3	1·5	7·7	8·1	0·9	10·2	5·3	1·9	12·5	5·0	2·5
Chocolate and chocolate sweets	1·1	1·7	0·7	0·4	0·7	0·6	2·6	2·6	1·0	0·8	1·7	0·5	0·1	0·2	0·8	0·5	0·2	2·3
Beverages	25·0	23·5	1·1	22·4	18·8	1·2	31·6	23·6	1·3	30·7	24·9	1·2	12·0	19·7	0·6	23·4	17·7	1·3
Alcoholic	3·9	4·7	0·8	7·2	2·4	3·0	19·8	9·5	2·1	12·6	9·0	1·4	6·9	6·5	1·1	11·7	8·8	1·3
Soft drinks	3·4	1·2	2·7	1·5	0·2	8·5	3·5	2·1	1·6	4·8	1·9	2·5	1·4	0·3	5·3	0·7	0·8	1·0
Juices	2·9	2·6	1·1	0·4	0·3	1·3	1·1	1·0	1·1	5·3	4·2	1·3	0·7	0·2	3·8	0·3	0·3	1·1
Other non-alcoholic	6·9	0·5	14·4	1·1	0·3	4·2	0·2	0·1	2·5	2·3	1·3	1·8	0·4	0·3	1·6	7·3	3·9	1·9
Fats and oils	7·9	14·5	0·6	12·3	15·7	0·8	7·0	10·9	0·6	5·8	8·5	0·7	2·6	12·4	0·2	3·3	4·0	0·8

24-HDR, 24-h dietary recalls; EPIC, European Prospective Investigation into Cancer and Nutrition.

* Number of participants reporting any consumption OH or AH.

Table 4. Mean contributions (%) of the indicated food categories to daily energy intake out of home (OH), at home (AH) and the corresponding ratios for females in EPIC cohorts (The HECTOR project)

(Mean values and standard deviations)

	Method of dietary assessment: single 24-HDR																				
	EPIC-Italy			EPIC-Germany			EPIC-Greece			EPIC-Norway			EPIC-UK			EPIC-Netherlands			EPIC-Sweden		
	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH
Energy intake (MJ)																					
Mean	2·2	6·3		3·0	5·8		2·2	5·7		3·1	5·5		2·6	5·8		2·5	6·2		3·1	5·4	
SD	2·5	2·7		2·2	2·8		2·2	2·6		2·3	2·7		2·2	2·9		2·5	2·7		2·4	2·5	
*n**	1032	2316		1128	2093		343	945		1148	1677		153	274		1515	2470		939	1378	
Animal origin	18·5	25·6	0·7	27·8	28·4	1·0	19·6	25·4	0·8	27·9	35·3	0·8	24·2	20·6	1·2	22·3	32·2	0·7	23·5	33·2	0·7
Meat	5·2	9·5	0·5	11·7	10·9	1·1	4·6	6·5	0·7	8·7	12·7	0·7	3·6	5·2	0·7	6·0	12·0	0·5	8·6	10·3	0·8
Fish/seafood	1·2	1·6	0·7	1·6	1·2	1·3	1·8	2·6	0·7	2·1	4·5	0·5	2·0	1·6	1·2	1·0	0·9	1·1	2·3	2·4	1·0
Milk/milk products	11·7	13·4	0·9	13·8	15·1	0·9	12·4	15·2	0·8	16·1	16·7	1·0	17·6	13·1	1·3	14·6	18·1	0·8	11·7	19·2	0·6
Vegetables, fruit and nuts, grains and potatoes	22·5	44·8	0·5	32·5	34·3	1·0	31·1	40·5	0·8	36·6	35·2	1·0	31·0	43·0	0·7	21·4	35·2	0·6	34·5	35·4	1·0
Vegetables	1·9	4·1	0·5	2·5	2·6	0·9	2·1	5·2	0·4	1·8	2·7	0·7	2·6	5·1	0·5	0·8	2·1	0·4	3·2	2·8	1·2
Fruit and nuts	6·2	9·9	0·6	10·4	8·8	1·2	9·5	8·8	1·1	7·4	6·4	1·2	8·5	11·1	0·8	6·3	7·7	0·8	9·4	6·6	1·4
Cereals/bread/pasta	13·7	28·5	0·5	16·6	19·6	0·9	18·1	23·3	0·8	26·3	22·2	1·2	16·5	22·2	0·8	12·9	20·5	0·6	18·5	21·9	0·8
Potatoes	0·6	1·7	0·4	2·9	3·2	0·9	1·1	1·6	0·7	1·1	3·9	0·3	2·8	3·8	0·8	1·4	4·7	0·3	3·3	3·9	0·8
Sugar, desserts, sweet and savoury bakery products	42·1	15·3	2·8	17·9	14·0	1·3	27·9	10·9	2·6	21·2	13·7	1·5	26·8	18·1	1·5	36·3	15·9	2·3	26·9	15·9	1·7
Sugar, similars and sweets	14·9	3·5	4·2	2·7	3·5	0·8	7·8	3·4	2·3	2·6	3·3	0·8	3·3	3·1	1·1	7·6	4·2	1·8	3·9	4·4	0·9
Sweet and savoury bakery products	20·6	9·9	2·1	11·7	8·0	1·5	16·2	6·4	2·6	14·6	6·9	2·1	19·4	11·0	1·8	23·9	8·8	2·7	20·6	9·4	2·2
Chocolate and chocolate sweets	2·7	0·8	3·3	1·7	2·1	0·8	2·3	0·7	3·4	2·6	2·5	1·0	2·3	3·2	0·7	3·2	2·2	1·5	1·3	1·2	1·1
Beverages	17·0	14·3	1·2	21·8	23·3	0·9	21·4	23·3	0·9	14·3	15·8	0·9	18·1	18·3	1·0	20·0	16·7	1·2	15·1	15·4	1·0
Alcoholic	2·9	3·0	1·0	6·2	5·1	1·2	3·6	1·3	2·7	2·2	2·9	0·8	4·5	4·9	0·9	5·2	4·9	1·1	2·2	2·4	0·9
Soft drinks	1·1	0·3	3·7	1·0	0·7	1·5	1·0	0·1	14·5	2·1	2·1	1·0	1·8	1·3	1·4	2·5	0·9	2·9	1·9	1·8	1·1
Juices	1·1	0·4	2·6	4·2	4·7	0·9	3·1	1·0	3·1	1·4	2·9	0·5	1·3	2·5	0·5	2·7	2·3	1·2	0·7	1·2	0·6
Other non-alcoholic	7·7	0·9	8·5	3·3	1·6	2·1	3·5	0·4	8·0	3·2	1·4	2·4	2·5	0·8	3·1	5·0	0·6	8·1	2·8	0·9	3·1
Fats and oils	4·3	9·7	0·4	7·2	11·3	0·6	10·2	20·4	0·5	5·4	6·4	0·8	8·0	8·8	0·9	4·7	8·0	0·6	7·6	9·2	0·8

24-HDR, 24-h dietary recalls; EPIC, European Prospective Investigation into Cancer and Nutrition.
* Number of participants reporting any consumption OH or AH.

Table 5. Mean contributions (%) of the indicated food categories to daily energy intake out of home (OH), at home (AH) and the corresponding ratios for females in non-EPIC studies (The HECTOR project)

(Mean values and standard deviations)

	Method of dietary assessment																	
	Single 24-HDR						Two 24-HDR			Two or three 24-HDR			4–7 d food diaries					
	Austria			Poland			Belgium			Germany/Bavaria			Italy			Portugal/Porto		
	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH	OH	AH	OH/AH
Energy intake (MJ)																		
Mean	2·4	5·8		2·7	7·3		1·7	5·2		1·7	5·7		1·4	7·1		1·5	6·3	
SD	1·9	2·7		2·4	3·2		1·5	2·3		1·4	2·0		1·3	1·8		1·3	1·9	
*n**	460	874		355	875		243	377		230	322		287	401		127	176	
Animal origin	22·7	27·0	0·8	16·9	25·3	0·7	23·9	29·5	0·8	26·8	28·7	0·9	14·1	26·5	0·5	28·9	34·0	0·9
Meat	8·9	12·1	0·7	9·7	14·8	0·7	8·6	12·7	0·7	12·8	12·8	1·0	7·5	10·1	0·8	14·6	16·4	0·9
Fish/seafood	0·5	0·9	0·6	0·3	0·9	0·4	1·9	2·2	0·8	1·0	1·4	0·8	1·6	2·4	0·7	3·8	6·2	0·6
Milk/milk products	12·4	12·6	1·0	6·5	8·1	0·8	13·1	13·5	1·0	12·5	13·5	0·9	4·8	13·0	0·4	9·6	10·1	1·0
Vegetables, fruit and nuts, grains and potatoes	42·3	39·4	1·1	35·5	42·2	0·8	29·0	37·2	0·8	28·8	35·3	0·8	46·9	45·9	1·0	28·0	44·1	0·6
Vegetables	2·0	2·7	0·7	1·3	2·5	0·5	1·6	2·5	0·6	1·7	2·5	0·7	1·9	3·9	0·5	2·8	4·5	0·6
Fruit and nuts	23·0	9·6	2·4	9·2	6·1	1·5	6·1	5·7	1·1	8·1	6·3	1·3	3·9	5·4	0·7	3·0	9·1	0·3
Cereals/bread/pasta	16·3	24·1	0·7	23·1	25·9	0·9	18·4	24·1	0·8	16·3	23·2	0·7	39·7	33·6	1·2	15·8	21·6	0·7
Potatoes	0·7	2·4	0·3	1·7	7·4	0·2	2·8	4·9	0·6	2·7	3·1	0·9	1·3	2·3	0·6	5·8	7·8	0·7
Sugar, desserts, sweet and savoury bakery products	15·2	11·3	1·4	30·9	15·5	2·0	24·8	14·5	1·7	21·7	16·0	1·4	29·7	10·1	2·9	30·3	10·3	2·9
Sugar and similars	5·5	5·8	1·0	10·2	8·9	1·2	2·1	3·2	0·7	2·6	4·1	0·6	9·1	2·8	3·3	6·3	1·8	3·5
Sweet and savoury bakery products	5·8	3·3	1·8	17·6	5·6	3·2	19·2	8·0	2·4	16·3	9·6	1·7	13·1	6·4	2·1	23·1	7·7	3·0
Chocolate/sweets	3·1	2·0	1·5	2·4	1·0	2·6	2·2	2·8	0·8	1·8	1·9	1·0	0·2	0·2	1·0	0·5	0·6	0·8
Beverages	19·8	22·4	0·9	16·8	16·9	1·0	22·4	18·7	1·2	22·7	20·0	1·1	9·3	17·5	0·5	12·9	11·6	1·1
Alcoholic	2·6	1·6	1·7	1·5	0·4	4·1	9·7	4·8	2·0	5·5	4·0	1·4	4·1	2·9	1·4	2·1	2·3	0·9
Soft drinks	0·9	0·9	1·0	0·7	0·4	2·1	5·0	2·0	2·4	1·8	1·1	1·6	1·4	0·3	4·9	1·0	0·6	1·6
Juices	2·3	2·8	0·8	1·3	0·8	1·6	1·8	1·5	1·2	6·8	4·7	1·5	0·9	0·2	4·0	1·0	0·4	2·5
Other non-alcoholic	5·1	1·1	4·9	2·4	0·4	5·9	0·5	0·2	2·1	3·2	1·4	2·3	0·2	0·3	0·8	5·1	3·9	1·3
Fats and oils	8·9	16·1	0·6	10·8	15·0	0·7	5·4	10·1	0·5	5·5	8·9	0·6	2·7	13·8	0·2	3·7	4·4	0·8

24-HDR, 24-h dietary recalls; EPIC, European Prospective Investigation into Cancer and Nutrition.

* Number of participants reporting any consumption OH or AH.

40 kJ/100 ml of energy-yielding beverages (approximately 10 kcal/100 ml) on any occasion (data not shown).

Table 6 presents the summary estimates of the odds ratios of being a substantial OH eater, by specified categories or increments of potential predictor variables, after meta-analysing the results calculated per country, survey within country and by sex (presented in the online Supplementary Table S2). OR above 1 indicates that the odds of being a substantial OH eater are higher either in a certain non-referent category than in the referent category for the categorical variables, or per specified increment of the continuous variables and vice versa for OR below 1. In both sexes, substantial OH eating, as operationally defined, consistently declined with increasing age (pooled OR 0·74, 95 % CI 0·69, 0·80; $I^2 = 78\%$ for males and pooled OR 0·83, 95 % CI 0·79, 0·87; $I^2 = 62\%$ for females). The probability of being a substantial OH eater was also higher among both men and women of higher education (pooled OR 1·34, 95 % CI 1·13, 1·59; $I^2 = 21\%$ for males with a university degree and pooled OR 1·62, 95 % CI 1·40, 1·87; $I^2 = 22\%$ for females with a university degree compared to males or females with no or only primary education completed). Higher total energy intake was only marginally significantly associated with the probability of being a substantial OH eater (pooled OR 1·04, 95 % CI 1·00, 1·09; $I^2 = 42\%$ for males and pooled OR 1·08, 95 % CI 1·02, 1·14; $I^2 = 65\%$ for females). Results remained the same when sub-group analyses were performed among national (Austria, Belgium, Italy and Poland); regional studies (Bavaria, Germany and Porto, Portugal); and cohorts of the prospective EPIC study. In all instances, associations were stronger among women than among men. The pattern of associations between substantial OH eating and total energy intake, BMI or smoking habits was generally not consistent and reached statistical significance only in some sub-populations and among women in particular (online Supplementary Table S2). For instance, women in the EPIC cohorts of Italy, Greece, Norway, the Netherlands and Sweden who reported eating out substantially also reported higher total energy intakes. In addition, female smokers in Austria (former or current) ate out more frequently according to data collected in the country's national study.

Since dietary choices are shaped by cultural factors and personal beliefs, the results of the combined analysis presented in Table 6 should be read in conjunction with the results in each individual cohort presented in Supplementary Table S2 (available online). The percentage of substantial OH eaters among the studies' participants ranged from 18 % (women in EPIC-Greece) to 49 % (men in EPIC-the Netherlands) and was higher among cohorts in Central Europe. Findings remained essentially the same when different energy cut-offs were used to define substantial OH eaters (sensitivity analysis) and when individuals with missing data in each of the variables of interest were considered. In addition, to assess the

Table 6. Pooled OR, contrasting substantial out of home (OH) eaters* to not-substantial ones in middle-aged men and women by the indicated variables†‡ (The HECTOR project)

(Pooled odds ratios and 95 % confidence intervals)

	Random effects		I^2 (variation attributable to heterogeneity; %)	*P*
	Pooled OR	95 % CI		
Men				
Age (per 5 years)	0·74	0·69, 0·80	79	< 0·001
BMI (per 5 kg/m^2)	1·03	0·93, 1·14	48	0·033
Energy intake (per 2·09 MJ or 500 kcal)	1·04	1·00, 1·09	42	0·060
Smoking habits§				
Never smokers	Ref			
Former smokers	0·96	0·86, 1·09	6	0·384
Current smokers	1·01	0·89, 1·14	0	0·879
Education¶				
None/primary education completed	Ref			
Technical/vocational/secondary education completed	1·31	1·09, 1·58	48	0·047
University degree	1·34	1·13, 1·58	19	0·266
Women				
Age (per 5 years)	0·84	0·80, 0·88	60	0·003
BMI (per 5 kg/m^2)	1·02	0·97, 1·07	0	0·599
Energy intake (per 2·09 MJ or 500 kcal)	1·08	1·02, 1·14	65	0·001
Smoking habits§				
Never smokers	Ref			
Former smokers	1·06	0·93, 1·21	34	0·122
Current smokers	1·08	0·90, 1·31	65	0·001
Education¶				
None/primary education completed	Ref			
Technical/vocational/secondary education completed	1·38	1·13, 1·69	71	< 0·001
University degree	1·67	1·39, 2·00	46	0·045

Ref, reference.

* Substantial OH eaters were defined as those reporting consumption of at least 25 % of their daily energy intake through eating out.

† Variables are mutually adjusted.

‡ Results by study can be found in online supplementary Table S2.

§ Information on smoking status was not collected in the national Polish study.

¶ Data collected in the regional study of Bavaria (Germany) and the European Prospective Investigation into Cancer and Nutrition (EPIC)-UK cohort were not included, as there were no participants in the referent category (primary education).

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impact of influential observations in the associations observed, we repeated the analysis after excluding observations with Cook's distance higher than $4/n$ (with n being the study sample in which the logistic regression models were fit), as well as using the robust variance estimators. In both cases, results remained practically the same.

Comparisons between AH and OH intakes of not substantial or substantial OH eaters, as well as comparisons of intakes between not substantial and substantial OH eaters' AH or OH are summarised in Fig. 1. Fig. 1 indicates food groups whose consumption was at least two times higher or lower half than that in the comparison group. As indicated in Fig. 1, individuals who substantially ate out generally reported similar choices AH and OH, with the exception of, for instance, sugar, similar and sweets whose AH consumption was more than double their consumption OH in Belgium and Germany (both cohorts). Not substantial OH eaters, however, consumed higher quantities of indulging foods (e.g. sweet and savoury bakery products, sugar similars and sweets) and non-alcoholic beverages (including coffee/tea/water, juices and soft drinks) and lower quantities of meat, fish and seafood, vegetables, potatoes, fats and oils OH than AH. The same pattern was again observed when substantial OH eaters were compared to not substantial ones in terms of the food choices they made AH and OH. In particular, individuals who frequently ate out reported consuming substantially higher quantities of essential food groups (meat, fish/seafood, vegetables, potatoes) than individuals who occasionally ate out.

The food intakes of substantial and not substantial OH eaters by country or region, which are briefly presented in Fig. 1, are provided in detail in online Supplementary Table S3. The values in the table present the average contribution (%) of OH and AH consumption of main food groups and categories to the total daily energy intake. Tables 2–5 and online Supplementary Table S3 present OH to AH proportions within each food category and lead to similar conclusions if results are interpreted as per dietary assessment tool or overall.

Discussion

We analysed data collected in eleven European countries with the aim to compare food group intakes AH to those OH. In both sexes, sugar, desserts, sweet and savoury bakery products, drinks and beverages were generally consumed more OH than AH. In the national study in Belgium and the EPIC cohorts in Germany, Italy, the Netherlands and the UK (Oxford), men further reported higher intakes of fish OH than AH. We have further noted that the OH dietary choices were more energy dense than the AH ones, supporting the findings of previous studies on higher intakes of fat, sugar and alcohol OH than AH[11,14,18,19].

We have defined as substantial OH eaters those who consumed more than one-quarter of their respective daily energy OH. Overall, substantial OH eating was more common among men, the younger and more educated participants. Some positive, though not consistent, associations were observed between substantial OH eating and BMI or smoking. A weak and marginally significant positive association between total energy intake and the probability of eating substantially OH was noted and was more frequent among women than among men. In terms of their food intakes, substantial OH eaters reported similar intakes OH and AH.

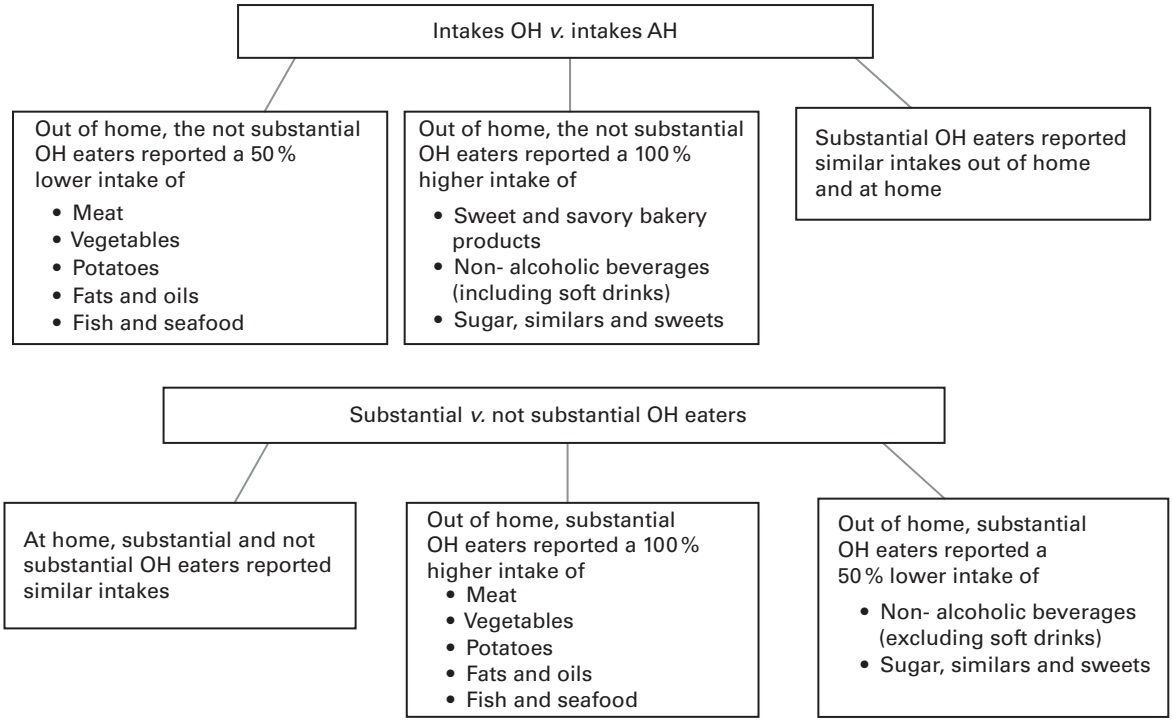

Fig. 1. Comparisons of intakes at home (AH) and out of home (OH) between substantial and not substantial OH eaters. The HECTOR project. Substantial OH eaters: individuals who consumed equal or more than 25 % of their daily energy OH. Not substantial OH eaters: individuals who did not report any OH consumption during the reporting period or consumed less than 25 % of their daily energy OH.

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Different was the case, however, among not substantial OH eaters who reported higher consumption of indulging foods and beverages OH than AH. Based on these findings, one could possibly argue that overall the differences between the AH and OH intakes reported in the literature reflect the choices of individuals who do not eat out regularly. When they do eat out, however, they appear to select indulging items high in fat and/or sugar.

In Europe, the number of studies comparing dietary intakes OH to those AH is small[4,11,14,18–21]. One study each in Norway[11], UK[18] and Ireland[19] pointed out that intakes of energy, protein, fat, sugars and fibre were significantly greater AH than OH, whereas alcohol intake was significantly greater OH than AH. In a Spanish cohort of university graduates (the SUN study), participants who reported never or rarely eating out also reported higher intakes of plant foods and lower intakes of beverages, fish, red and processed meat in comparison to participants who reported eating out frequently[4]. In addition, findings from a large multinational European study show that coffee/tea/waters and sweets were consumed more OH than AH. According to the same study, the composition of home diet was relatively similar to that consumed out in northern, but different in southern countries[20]. Lastly, results of either cross-sectional or longitudinal studies on the association of eating out and obesity have generally been inconsistent[5].

The major advantages of this study are the inclusion of information from several populations of sufficiently large size, the analysis of several datasets with the application of one common definition of OH eating in all the datasets and the investigation of dietary and non-dietary variables in relation to OH eating.

A limitation in the analysis, however, is the use of two data collection methods. Frankenfeld *et al.*[35] compared nutrient intakes based on two 24-HDR to a 4-d food record and concluded that mean nutrient intakes were similar across the two methods and that the 24-HDR provided a good overall ranking of intakes compared to the food record method. In relation to the method of questionnaire administration, Brustad *et al.*[31] compared food and energy intakes estimated through either a face-to-face or a telephone 24-HDR interview and found no statistically significant differences in the intakes recorded through the two methods. In a recent study, Kirkpatrick *et al.*[36] assessed the performance of a self-administered 24-HDR relative to an interviewer-administered one and to true intakes known through a feeding study. In their conclusion, authors report that although the interviewer administered 24-HDR method performed somewhat better relative to true intakes than the self-administered one, little evidence of differences was found between the two recall modes with respect to reported energy, food and nutrient intakes, as well as portion sizes.

The combination of data collected through different dietary protocols is relatively common in Europe, where countries undertake national studies using various data collection methods[37]. The comparability of results has been assessed by the EU-funded EURRECA Network of Excellence, which aimed to develop methodologies to standardise the process of setting micronutrient recommendations in Europe[38]. In this context, EURRECA researchers reviewed thirty-seven European studies in order to identify sources of dietary misreporting. In terms of assessment methods, the authors reported that the mean percentage of energy under-reporters ranged in both sexes from 21 to 31% in studies using the 24-HDR method and from 14 to 38% in studies using weighed food records. Authors further reported that there was no significant difference between the median percentages of misreporters for 24-HDR and food records (weighed or estimated)[39]. In an attempt to address the combined effect of the aforementioned sources of errors, food intake values are expressed in this analysis as percentage contributions to daily energy intake.

Data on sporadic intake (such as those based on single 24-HDR) are affected more from intra-individual variability (and thus random error) compared to the data based on replicate recalls or records[40]. Random error implies that an under-estimation of OH intakes for some participants is counterbalanced by an overestimation for others so that the average intake for a large group of individuals is close to the true mean of the group[41]. In the logistic regression models we used, some apparent associations may be underestimated, but significant results are generally not generated when in reality these do not exist.

To understand the effect of measurement error when using eating out data derived from one or two 24-HDR, Orfanos *et al.*[42] compared the energy, macronutrient and food intake distributions obtained either from a single or the average of two 24-HDR to the usual intake distributions estimated through the application of an established statistical method. Authors concluded that mean intakes were not systematically affected since in large samples random errors tend to cancel out, but standard deviations decreased as the number of repeated measurements increased. In particular, in their exploratory analysis of food and nutrient intakes when eating out, Orfanos *et al.*[42] concluded that mean values for energy and nutrients obtained from one or two recalls were similar to the corresponding mean usual intakes. In addition, at food group level, the relative differences of the mean estimates based on a single 24-HDR from those based on the average of two recalls were generally minimal and in both directions (higher or lower), reflecting random rather than systematic errors. Consequently, we would not expect bias in the estimation of the contribution of each food category to the daily energy intake AH and OH.

An additional limitation is the definition of eating out to include OH eating occasions, irrespective of the place of food preparation. Eating out can include eating at a restaurant/canteen, and it can also include, as it frequently does, eating at work. Eating at work is an ambiguous area, as it can include eating at the work canteen or acquiring an item from a shop or a vending machine, but it can also include eating or drinking something sourced from the household supplies. In addition, take-away restaurants and home delivery will not be considered as eating out if the items were finally consumed at the participants' households. Comparisons of results from different studies on eating out are usually

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hampered by the lack of a comprehensive definition. The two core components of the OH eating (i.e. where the food was prepared and where the food was consumed) should be adequately and separately captured during data collection, in order to avoid introducing an element of uncertainty in the assessment of OH intakes. Furthermore, the collection of detailed and sharply defined information will allow researchers to adjust their choice of variables responding to the analysis needs.

In our analysis, we have operationally defined as substantial OH eaters those individuals who reported 25 % or more of their daily energy intakes at OH locations. The underlying assumption is that those who on the days recalled or recorded did not report any OH consumption or reported a small contribution of OH intakes to their total intake are more likely to not commonly eat out, whereas those who consumed more than 25 % of total energy intake OH are more likely to be common or substantial OH eaters. This criterion was used to measure the magnitude of eating out and does not imply a mediating effect in the associations between personal characteristics and the probability of being a substantial OH eater. The selection of this particular cut-off point could affect the OR estimates, but it would not result in quantitatively contradictory results if the pattern is monotonic, whereas the sensitivity analyses undertaken here suggests is the contrary. Other possible limitations are the self-reported weight and height based on which BMI was estimated and the use of different food composition tables to estimate energy intake. The collective impact of these limitations is likely to be an underestimation of the reported associations.

In conclusion, sugar, desserts, sweet and savoury bakery products and beverages were consumed more OH than AH by both men and women in the majority of the populations under study. In some population groups, male participants also reported higher intakes of fish and potatoes OH than AH. Substantial OH eating was more common among the young and highly educated participants, whereas no association was observed with higher BMI or smoking. When dietary choices made when eating AH were compared to those made when eating out, substantial OH eaters reported similar intakes, while not substantial OH eaters made different choices, possibly because they considered these rare occasions as special eating events. This finding may partly explain the inconsistent findings relating eating out to the current obesity epidemic. It highlights that individuals who systematically eat out do not necessarily consider it as a special occasion different from their eating AH.

Supplementary material

To view supplementary material for this article, please visit http://dx.doi.org/10.1017/S0007114515000963

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