Eating at restaurants, at work or at home. Is there a difference? A study among adults of eleven European countries in the context of the HECTOR* project

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Running title: Eating at restaurants, at work or at home in Europe

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Abstract

Background/objectives: To compare macronutrient intakes out of home -by location- to those at home, and to investigate differences in total daily intakes between individuals consuming more than half of their daily energy out of home and those eating only at home.

Subjects/methods: Data collected through 24-hour recalls or diaries among 23 766 European adults. Participants were grouped as "non-substantial", "intermediate" and "very substantial out-of-home" eaters based on energy intake out of home. Mean macronutrient intakes were estimated at home and out of home (overall, at restaurants, at work). Study/cohort-specific mean differences in total intakes between the "very substantial out-of-home" and the "at-home" eaters were estimated through linear regression and pooled estimates were derived.

Results: At restaurants, men consumed 29% of their energy as fat, 15% as protein, 45% as carbohydrates and 11% as alcohol. Among women, fat contributed 33% of energy intake at restaurants, protein 16%, carbohydrates 45%, and alcohol 6%. When eating at work, both sexes reported 30% of energy from fat and 55% from carbohydrates. Intakes at home were higher in fat and lower in carbohydrates and alcohol. Total daily intakes of the "very substantial out-of-home" eaters were generally similar to those of individuals eating only at home, apart from lower carbohydrate and higher alcohol intakes among individuals eating at restaurants.

Conclusions: In a large population of adults from eleven European countries, eating at work was generally similar to eating at home. Alcoholic drinks were the primary contributors of higher daily energy intakes among individuals eating substantially at restaurants.

Keywords: eating out, eating at restaurants, eating at work, daily diet, Europe.

Word count: 248 **Text count:** 2 989

Introduction

Changes in the food environment resulting from urbanization and market globalization led to a rise in food consumption away from home, the "eating out" trend distinctly reflected in current dietary habits worldwide.[1-6] Since the 1990s, large food-service operators adopted policies of international expansion[7] and ready-to-eat food has become available not only in places such as the traditional sit-down restaurants, quick-service establishments, cafeterias and bars, but also through take-away and food delivery services. In addition, eating at work is gaining increasing attention in out-of-home eating, since more than half of an adult's waking hours are spent at work.[8]

In response, the number of studies on eating out of home has increased in Europe and across the world.[1-6,9-24] Systematic reviews concluded that eating out of home was associated with higher total energy and fat intake [25] and that frequent eating out, in general, and at fast-food outlets in particular, was positively associated with overweight or obesity.[26] Reviews further agree that there is a necessity to monitor the out-of-home dietary choices in order to understand public health implications.

In this context, the European project entitled "Eating out: habits, determinants and recommendations for consumers and the European catering sector (HECTOR)" aimed to understand eating out through analyzing data collected among adults in 11 European countries. (www.nut.uoa.gr/hector). The present analysis aims to compare energy contributions of macronutrients across categories of energy intakes through out-of-home eating. Furthermore it aims to investigate how daily intakes of energy and macronutrients are associated with eating locations (home, restaurants, work) between individuals who consumed more than 50% of their total energy intake out of home and those who were essentially eating only at home, since they consumed less than 25% of their daily energy out of home and in places other than restaurants or work (i.e. friends/relatives houses).

Materials and methods

Study sample

The study sample consists of participants in four national studies in Austria, Poland, Belgium and Italy; two regional studies in Bavaria (Germany) and Porto (Portugal, the EpiPorto cohort study) and cohorts from seven countries (Germany, Greece, Italy, Norway, the Netherlands, Sweden and the United Kingdom) participating in the international multicentre European Prospective Investigation into Cancer and Nutrition (the EPIC study). Ethical issues have been considered in all studies and all procedures have been in accordance with the Helsinki declaration.[6,27-33]

The initial sample included 33 500 men and women. In order to maintain the same age range in all the sub-populations, individuals below 35 and over 64 years of age and without complete or consistent data on eating location were excluded (9 721 individuals). A total of 23 766 individuals, 9 077 men and 14 689 women composed the final sample. The Norwegian EPIC cohort consisted of women between 42 and 57 years of age.

Data collection

In five studies, dietary data were collected through single (the EPIC study and the studies in Austria and Poland) or multiple (studies in Belgium and in Bavaria-Germany) 24-hour dietary recalls (24-HDRs).[6,27,30-35] In the Italian survey and the EpiPorto study, 4-7 day diaries were.[28,36] Details on data collection and nutrient estimations are presented in Table 1. Of note that data on alcohol intakes were not collected in the nationwide Polish study. For the present analysis, body mass index (BMI, kg/m^2) was calculated based on self-reported weight and height.

Definition of eating out

The place of consumption was reported for each eating occasion. Locations other than the household included: restaurants, relatives/friends' houses, work, cafeterias, bars, quick-service (fast food) establishments and other (e.g. in the car, at street). The HECTOR Consortium decided to operationally define "eating out" to include all meals, beverages and snacks consumed at places other than the participant's household, irrespective of the place of food preparation. In addition, two sub-categories were defined: "eating at restaurants" including all eating and drinking occasions at restaurants and similar establishments (cafeterias, bars etc) and "eating at work" including all foods and beverages consumed at work (offices, work canteens etc). From the remaining locations, the vast majority of eating occasions was reported at relatives/friends' houses. In the EpiPorto study, participants did not report the place of food consumption when eating out and this dataset was not included in the analyses of "eating at restaurants" or "eating at work".

Three categories of individuals were further identified according to the proportion of total energy intake consumed at out-of-home locations: (a) individuals who reported eating only at home or receiving less than 25% of their total daily energy intake out of home (operationally defined as "not substantial out-of-home" eaters) (b) individuals who reported 25-49% of their total daily energy intake out of home, hereafter referred to as "intermediate out-of-home" eaters and (c) individuals who reported 50% or more of their total daily energy intake out of home, described as "very substantial out-of-home" eaters. The categorization was based on a previous definition.[6,14,22,23]

In a sub-group analysis between the "not substantial" eaters and the "very substantial" out-of-home eaters, comparisons were undertaken among the following sub-groups of participants: a) individuals who reported eating only at home or receiving less than 25% of their total energy intake at relatives/friends' houses only, and not at restaurants or at work (n=11 299), b) the "very substantial out-of-home" eaters who reported eating out only at work (n=1 095), c) the "very substantial out-of-home" eaters who reported eating out only at restaurants (n=936) and d) the "very substantial out-

of-home" eaters who reported eating out both at restaurants and at work during the day of recall (n=646).

Statistical analysis

Statistical analyses were performed overall, separately for men and women and independently in each of the studies. For the EPIC study, analyses were carried out by country. To ensure comparability between studies and correct for skewed distributions across baseline variables, mean energy intakes (and standard errors) corresponding to eating at home, out of home (overall), at restaurants or at work were adjusted for age (continuously), day and season of recall/record and centre or region in the case of the EPIC cohorts (categorically). Information on day and season of recall/record was considered as follows: (a) for studies based on 24-HDRs, means were adjusted for day (Monday to Thursday versus Friday to Sunday) and season of recall (categorically) and (b) for studies using multiple-day diaries means were adjusted for the number of days (four categories, from four to seven days) and for the season of the first day of each individual's diary (categorically). Adjustment for season of recall was not possible in the Polish (data from September to November) and Austrian studies (season of recall not recorded). The adjusted means correspond to the average intakes of populations with mean age of 52.5 years for men and 51.4 years for women, which reflect the sex-specific means of the overall sample. The macronutrient density of intakes at restaurants or at work was further compared with that at home across the groups of "non-substantial", "intermediate" and "substantial out-of-home" eaters.

In the sub-group analysis based on 24-HDR data multiple linear regression models were fitted to compare total intakes of energy and macronutrients across eating out locations reported by the "very substantial out-of-home" eaters in a day to those of individuals eating only at home, after adjusting for sex (p-values for interaction were not statistically significant), age, BMI and total energy intake. For studies with multiple recalls (Belgium and Bavaria) data from the first day were utilized.

Random effects models were applied to derive summary estimates (beta coefficients) and heterogeneity was assessed with the I^2 statistic.[37] All statistical analyses were performed using the Stata statistical package (Stata Corporation: Stata/SE 11.0 for Windows. Lakeway Drive College Station, Texas, USA. 2010).

Results

Table 2 presents the adjusted mean daily energy intake at home; out of home overall; at restaurants and the workplace in particular; as well as the contribution of out-of-home eating to total energy intake by study/cohort and sex. Overall, the contribution of eating out to daily energy intake was higher in Central and North than in South Europe, and eating out provided more than one fourth of total energy intake among females in Scandinavian countries (Sweden and Norway). Table 2 further presents the ratio of energy intake at restaurants to intake at work ($r_{R/W}$). In general, Europeans consumed more calories through eating out at work than at restaurants. Only in Italy and Austria was the energy intake at restaurants higher than at work among both men and women ($r_{R/W}>1$). Among women in the two Scandinavian countries, eating at work contributed four times more than eating at restaurants to the mean daily energy intake ($r_{R/W}=0.26$). In the absence of data on alcohol, eating at work was the dominant out-of-home location contributing to energy intake in Poland.

The contribution (%) of macronutrients to daily energy intake at home, restaurants and work is presented in Table 3 by study/cohort and sex. Overall, among men the mean contribution of macronutrients to energy intake when eating at restaurants was: 15% for protein, 45% for carbohydrates, 29% for fat and 11% for alcohol. Among women, protein contributed 16% of the energy intake at restaurants, carbohydrates 45%, fat 33% and alcohol 6%. Apparently, alcohol is an important energy provider when eating at restaurants especially among men. When eating at work, men reported receiving on average 14% of their calories from protein intake, 55% from carbohydrates, 30% from fat, while the contribution of alcohol was negligible (1%). The

218 composition was quite similar among women. When compared to the dietary intakes at home (men:
219 protein 15%, carbohydrates 44%, fat 35% and alcohol 6%; women: protein 16%, carbohydrates
220 46% fat 35% and alcohol 3%) the intakes at restaurants were significantly higher in alcohol and
221 lower in fat, while at work the intake of carbohydrates was substantially higher and counterbalanced
222 by a lower intake of alcohol and fat ($p < 0.0001$ in all cases).
223
224 Table 3 further presents comparisons between the three categories of out-of-home eaters described
225 above (i.e. "not substantial out-of-home" eaters, "intermediate" and "very substantial out-of-home"
226 eaters). In the vast majority of cases, "not substantial out-of-home" eaters reported higher intakes of
227 carbohydrates when eating out either at restaurants or at work compared to the other two categories
228 of out-of-home eaters. As we gradually moved from the "not-substantial" to the "very substantial
229 out-of-home" eaters, the increasing energy intake when eating out was associated with an increase
230 of protein and fat intakes at restaurants and fat only at work ($p_{trend}<0.05$ in most cases) and a
231 significant decrease of carbohydrate intakes ($p_{trend}<0.05$ in most cases). In general, higher energy
232 intakes either at restaurants or at work were associated with higher fat intakes in both men and
233 women ($p_{trend}<0.05$ in most cases). Interestingly, the increasing energy intake at restaurants could
234 not be attributed to higher proportion of energy from alcohol, and in some of the cohorts under
235 study the contribution of alcohol to energy intake at restaurants was highest among individuals
236 identified as "not substantial out-of-home" eaters.
237
238 Figures 1 to 5 present linear-regression derived beta coefficients reflecting mean differences in total
239 dietary intake of the "very substantial out-of-home" eaters by eating out location compared to the
240 intake of participants eating only at home, by study/cohort. Thus, the pooled estimates describe how
241 different is the total daily intake of individuals who reported receiving more than half of their daily
242 energy out of home from the total daily intake of individuals who reported eating essentially at
243 home. The daily intake of the "very substantial out-of-home" eaters who ate out only at work was

generally not different from the daily intake of the "at-home" eaters, controlling for participants' sex, age, BMI and total energy intake. Those who reported eating out only at work had slightly higher daily carbohydrate intakes, but the difference was of borderline significance (**Figure 2**: I^2=0%, $p_{heterogeneity}$=0.478). However, the "very substantial out-of-home" eaters who reported eating out at restaurants had lower total carbohydrate intakes (**Figure 2**, I^2>75%, reflecting a varying effect-size across cohorts) and higher total alcohol intakes (**Figure 5**, I^2>91%, reflecting again a consistent association but a varying effect-size across cohorts). In terms of protein and fat intakes, the total daily intakes of the "very substantial out-of-home" eaters were similar to those of the "at-home" eaters controlling for age, sex, BMI and total energy intake (**Figures 3 and 4).** Primarily due to the higher alcohol intakes, those reporting eating out at restaurants had higher total daily energy intakes compared to those eating only at home but of varying effect-size across cohorts (**Figure 1:** for those eating at work only: I^2=29.8%, $p_{heterogeneity}$=0.171; for those eating at restaurants only: I^2=87.2%, $p_{heterogeneity}$<0.001; for those eating at both restaurants and work: I^2=60.5%, $p_{heterogeneity}$<0.001).

Discussion

We analysed the dietary intake data of 23,766 adults from 11 European countries in order to assess the macronutrient composition of intakes out of home overall and by eating-out location and we further compared the total daily intakes of individuals who reported receiving more than half of their daily calories out of home with those of individuals who eat only at home. Among both sexes, eating at work was associated with higher carbohydrate intakes than eating at restaurants or at home. Women reported similar fat intakes at restaurants and home, but lower at work; while men almost consistently reported lower fat intakes at restaurants than at home. The total daily intakes of the "very substantial out-of-home" eaters are in general similar to the intakes of individuals who eat at home only, with the exception of carbohydrates (lower) and alcohol (higher total intakes) and

only among individuals who ate out at restaurants during the reporting day; the latter probably explaining the higher total energy intakes among individuals eating at restaurants.

Our results agree with previous findings among all the EPIC cohorts that the fraction of energy intake during out-of-home eating is generally higher in Northern European countries than in Southern ones[14] and that in Northern Europe eating at work appeared to contribute more to the mean daily intake than eating at restaurants.[20] Moreover, our results that higher alcohol intakes at restaurants among men explain a large part of the higher energy intakes out of home provide additional evidence to previous findings among all the EPIC cohorts that only among men was eating at restaurants positively associated with BMI cross-sectionally, and with weight gain prospectively.[20]

In accordance to previous publications, higher energy intakes were associated with higher fat intakes at restaurants or at work.[9,10] Our findings that the nutrient intakes of the "very substantial out-of-home" were generally similar to those of individuals eating only at home complements a previous analysis of the HECTOR database,[23] according to which the out-of-home food consumption was different from the at-home ones only among individuals who reported a relatively small contribution of out-of-home eating to their daily intakes.

It has been consistently reported that eating out is associated with increased total energy intake.[25] Our results show that total energy intake was higher among "very substantial out-of-home" eaters who reported eating at restaurants or at both restaurants and work during a day, but not among the "very substantial out-of-home" eaters who reported eating only at work, and the increased alcohol intake at restaurants was largely responsible for this difference.

294 Strengths of the present study are its large sample size, the coverage of several European regions,
295 and the use of the same standardized assessment tool in several data collections. The methods of
296 data collection were suitable for collecting dietary information at specific locations. Means (and
297 standard errors) were adjusted for age, total energy intake (for the case of macronutrients), day and
298 season of recall (or record) to increase the comparability of findings. Furthermore, the focus of this
299 study to specific locations enhanced the clarity of findings and allowed for the potential of
300 complementary behaviors across eating locations throughout the day.[8] In addition, the two places
301 that account for the vast majority of eating out (i.e. restaurants and work) were separately assessed,
302 allowing thus the segregation of work, an ambiguous area of out-of-home eating as it can include
303 eating at the work-canteen or buying something from a vending machine, but it can also include
304 eating foods from the household supplies.
305
306 It should be noted that a single 24-HDR cannot adequately capture the intra-individual variability in
307 dietary intakes and variables carry random measurement error which could lower precision to the
308 point of associations being undetectable.[38] Group means, on the contrary, are not systematically
309 affected by random errors particularly when they are estimated from a sufficiently large number of
310 individuals.[39] The assumption, however, that intra-individual variability is random may not always
311 hold true in the case of self-reported intakes.[40] Our investigation aims to compare relative
312 contributions rather than absolutes values– a situation in which systematic errors, particularly when
313 averaged over several individuals, are likely to be less important. To avoid errors introduced by
314 different data collection methods, we present results by study and country (within multicentre
315 studies). Other possible limitations include: a) the period of data collection, b) the self-reported
316 weight and height and c) the use of different food composition tables to estimate energy intake. The
317 collective impact of the latter limitations is likely to be an underestimation of the reported
318 associations.
319

In conclusion, in a large study of diverse European populations we found that the macronutrient composition of diet varies depending on the eating location. Women and especially those considered as "very substantial out-of-home" eaters, preferred foods rich in fat more at restaurants than at work or at home. Individuals who reported eating at restaurants considerably ($\geq$50% of total energy intake) consistently had the lowest total daily carbohydrate but the highest alcohol and energy intake compared to individuals eating only at home or only at work. Eating at work was essentially associated with high carbohydrate intakes. Dietary interventions at the workplace resulted in moderate improvements of dietary intake.[8] Attempts to increase the awareness of and adherence to healthy dietary choices, for instance a preference for unrefined carbohydrates, could have a beneficial effect on dietary intakes throughout the whole day which includes both "at-home" and "out-of-home" eating.

Acknowledgment / financial support

This study was conducted in the context of the HECTOR project entitled "Eating Out: Habits, Determinants, and Recommendations for Consumers and the European Catering Sector" funded in the FP6 framework of DG-RESEARCH in the European Commission. The collection of EPIC data was performed with the financial support of the European Commission: Public Health and Consumer Protection Directorate 1993-2004; Research Directorate-General 2005-, the Dutch Ministry of Health, Welfare and Sports (VWS), Netherlands Cancer Registry (NKR), LK Research Funds, Dutch Prevention Funds, Dutch ZON (Zorg Onderzoek Nederland), World Cancer Research Fund (WCRF), Dutch Cancer Society (KWF), Statistics Netherlands (The Netherlands); Ragusa local support; Deutsche Krebshilfe, Deutsches Krebsforschungszentrum, German Federal Ministry of Education and Research; Cancer Research UK; Medical Research Council, United Kingdom; Stroke Association, United Kingdom; British Heart Foundation; Department of Health, United Kingdom; Food Standards Agency, United Kingdom; Wellcome Trust, United Kingdom; the Hellenic Health Foundation, Athens, Greece; Italian Association for Research on Cancer (AIRC);

Italian National Research Council, Fondazione-Istituto Banco Napoli, Italy; AIRE ONLUS RAGUSA, Italy; Swedish Cancer Society; Swedish Scientific Council; Regional Government of Skåne, Sweden; Nordforsk the Norwegian Cancer Society. The collection of data for the National Italian study was supported by the Consiglio per la ricerca in agricoltura e l'analisi dell'economia agraria – Centro di Ricerca per gli alimenti e la nutrizione (CRA-NUT) (former INRAN).

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The 'for-profit' members of the HECTOR Consortium did not have any involvement in the collection, analysis and interpretation of dietary data and in drafting or submitting this manuscript.

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Figures legends

Figure 1. Multiple-linear-regression beta coefficients and 95% confidence intervals (CIs) of the mean difference in total energy intake (in kcals) comparing the "very substantial out-of-home" eaters who ate out only "at work", or only "at restaurants" or at both locations with individuals who reported eating only at home, by study/cohort. The HECTOR project.

Note: Controlling for sex, age (in years) and body mass index (in kg/m^2). Groups with 20 individuals or less were not considered

Figure 2. Multiple-linear-regression beta coefficients and 95% confidence intervals (CIs) of the mean difference in total carbohydrate intake (in g) comparing the "very substantial out-of-home" eaters who ate out only "at work", or only "at restaurants" or at both locations with individuals who reported eating only at home, by study/cohort. The HECTOR project.

Note: Controlling for sex, age (in years), body mass index (in kg/m^2) and total energy intake (in kcals). Groups with 20 individuals or less were not considered

Figure 3. Multiple-linear-regression beta coefficients and 95% confidence intervals (CIs) of the mean difference in total fat intake (in g) comparing the "very substantial out-of-home" eaters who ate out only "at work", or only "at restaurants" or at both locations with individuals who reported eating only at home, by study/cohort. The HECTOR project.

Note: Controlling for sex, age (in years), body mass index (in kg/m^2) and total energy intake (in kcals). Groups with 20 individuals or less were not considered

Figure 4. Multiple-linear-regression beta coefficients and 95% confidence intervals (CIs) of the mean difference in total protein intake (in g) comparing the "very substantial out-of-home" eaters who ate out only "at work", or only "at restaurants" or at both locations with individuals who reported eating only at home, by study/cohort. The HECTOR project.

Note: Controlling for sex, age (in years), body mass index (in kg/m^2) and total energy intake (in kcals). Groups with 20 individuals or less were not considered

Figure 5. Multiple-linear-regression beta coefficients and 95% confidence intervals (CIs) of the mean difference in total alcohol intake (in g) comparing the "very substantial out-of-home" eaters who ate out only "at work", or only "at restaurants" or at both locations with individuals who reported eating only at home, by study/cohort. The HECTOR project.

Note: Controlling for sex, age (in years), body mass index (in kg/m^2) and total energy intake (in kcals). Groups with 20 individuals or less were not considered