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An evaluation of energy intakes and the ratio of energy intake to estimated basal metabolic rate (EI/BMR_{est}) in the North/South Ireland Food Consumption Survey

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Abstract

Objective: To examine energy intakes (EI), their ratio to estimated basal metabolic rate (BMR_{est}) and the contribution of food groups to energy intake in the North/South Ireland Food Consumption Survey.

Design and setting: Random sample of adults from the populations of Northern Ireland and the Republic of Ireland. Food intake data were collected using a 7-day food diary. Body weight and height were measured and EI/BMR_{est} was calculated from reported energy intake and estimated basal metabolic rate. Dieting practices were assessed as part of a self-administered questionnaire.

Results: Mean energy intake in men was 11.0 MJ and in women was 7.6 MJ, which is comparable to reported energy intakes in Northern Ireland and the Republic of Ireland over a decade ago. Mean EI/BMR_{est} was 1.38. This increased to 1.42 after the exclusion of dieters and those who were unwell, but still remained less than the established cut-off of 1.53. EI/BMR_{est} was significantly ($P < 0.05$) higher in men than in women and decreased significantly ($P < 0.05$) with increasing BMI in both sexes. The four food groups that contributed 50% of energy in men and women were meat and meat products, breads and rolls, potatoes and potato products, and biscuits, cakes, pastries and puddings.

Conclusions: Energy intakes have not changed remarkably in Northern Ireland or the Republic of Ireland in the last 10 years, but the mean EI/BMR_{est} of 1.38 suggests that energy underreporting occurred. EI/BMR_{est} was lower in women and in the overweight/obese. Additional multivariate analysis of the data is needed to identify more clearly subgroups of the population reporting lower than expected energy intakes and to evaluate the effect of low energy reporting on the consumption of various foods and food groups.

Keywords
Energy intake
EI/BMR_{est}
Ireland
Food consumption survey
7-day food diary

Energy intakes are the fundamental results of food intake surveys. Actual nutrient and recommended nutrient intakes are frequently expressed in terms of energy intake, with macronutrients described as a percentage of total energy or food energy intake and micronutrients described as actual intake per MJ or per 1000 kcal. Furthermore, it is through an evaluation of the validity of energy intakes that the validity of reported food intakes has been examined[1–3]. Accurate food intake data are required to interpret trends in food, energy and nutrient intakes and to interpret the association between diet and disease. The validity of reported food intake data has been frequently queried. There exists no standard method of food intake data collection to which reported food intake data can be compared[4,5], whereas reported energy intake, expressed as a ratio of energy intake to estimated basal metabolic rate (EI/BMR_{est}), can be compared to expected energy expenditure to assess the validity of energy intakes[1,4–6].

With increasing prosperity and a wider selection of food choices than ever before, it is likely that food intakes in both the Republic of Ireland and Northern Ireland are changing. It is, however, over a decade since food consumption data were collected in the Republic of

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Ireland[7] and in Northern Ireland[8]. The North/South Ireland Food Consumption Survey (NSIFCS) provides current information on food and nutrient intakes in both the Republic of Ireland and Northern Ireland. The aim of this paper is to report energy intakes from the NSIFCS, to examine mean EI/BMR_{est} in men and women according to age and body mass index, and to investigate the contribution of food groups to energy intakes.

Methods

Survey sample

A detailed description of the survey design and sampling procedures is given by Kiely *et al.*[9]. In brief, individuals were selected at random from the electoral register and invited by letter to take part. Fieldworkers contacted all individuals selected. Pregnant women, lactating mothers and persons aged 65 years or above were not considered eligible for the survey. In total, 1379 people aged 18–64 years took part. This constituted 63% of the eligible sample. This study collected food intake data, anthropometric measurements and extensive questionnaire information on lifestyles, health, attitudes, physical activity and restrained eating.

Food intake

Food intake data were collected using a food diary over a 7-day period. The protocol for the completion of the food diary has been described in detail elsewhere in this supplement[10] and involved up to four visits by a fieldworker, to each respondent, over the period of the food diary record. Respondents recorded the date, day, time, location and definition of eating occasion for each meal/snack/beverage taken. For each item of food or drink, the respondent recorded the name of the item, including brand name if applicable, the amount of the item eaten/drunk and the cooking method used, if applicable. For composite dishes, the respondent recorded the ingredients of the dish and the number of servings that it provided. A combination of methods was used to quantify foods and drinks recorded. A food photographic atlas was specifically designed for the survey. Respondents compared portions of foods eaten to photographs of known weights of these foods. Replicates of some foods were weighed directly by the fieldworker during visits to the respondent's home. Manufacturer's data were used to quantify manufactured products. Household measures were also used by both fieldworkers and respondents to describe the quantity of a food or drink. Standard portion sizes were only used when necessary[10,11]. Respondents were encouraged not to alter their food or drink choices during the course of the food diary recording week.

Coding and nutrient analysis

Data collected were coded for each subject, according to *McCance & Widdowson's The Composition of Foods*[12] and published supplements[13–21], and analysed for nutrients using WISP© (Weighed Intake Software Program) (Tinuviel Software, Warrington, UK). The nutrient database was expanded by the addition of the nutritional information of 860 extra foods/dishes eaten by respondents. These foods/dishes were either not present in the original database or were nutritionally different from similar foods in the database. The nutritional information was obtained from either recipes or manufacturer's information. Foods were also aggregated into 18 food groups to ascertain the contribution that each food group made to mean daily energy intakes.

Weight, height and body mass index (BMI)

Body weight was measured, by the fieldworker, using a Seca 770 digital personal weighing scale (CMS Weighing Equipment Ltd, London, UK) to the nearest 0.1 kg ($n = 1379$). Respondents were weighed while wearing light clothing, without shoes and after voiding. Height was measured ($n = 1312$) using the Leicester portable height measure (CMS Weighing Equipment Ltd, London, UK) to the nearest 0.01 cm. BMI (kg m^{-2})[22] was used to classify respondents as normal weight, overweight or obese[23].

Estimated basal metabolic rate (BMR_{est})

Estimated basal metabolic rate was calculated using body weight by standard equations devised by Schofield *et al.*[24] for those aged 18–59 years, and by the equations used in the 1991 UK Dietary Reference Values[25] for those aged 60 years or more. Energy intake was expressed as a ratio of estimated BMR (EI/BMR_{est}) for each respondent and examined according to sex, age and BMI.

Dieting practices

As energy intakes may be influenced by dieting practices, questionnaire data collected information on dieting. Respondents were asked if they were 'meant to be following a particular diet at the moment'. Those who answered that they were meant to be following a 'low fat', 'weight reducing' or 'cholesterol lowering' diet and who said that they followed the diet either 'always' or 'most of the time' were considered to be dieters. As energy intakes may also be influenced by illness/poor health, respondents were asked if their eating habits, during the week of the survey, had been affected by being unwell. EI/BMR_{est} was examined according to sex, age and BMI, excluding those considered to be dieters and those who reported that their food intake was reduced due to being unwell during the week of the survey.

Statistical analysis

Mean ± standard deviation (SD) energy intakes were calculated for men and women in each age group. Mean ± SD EI/BMR_{est} values were calculated for men and women in each of the age groups and BMI categories, for

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Table 1 Mean daily energy intakes (kcal, MJ) and standard deviations (SD) in Irish adults according to sex and age

Sex	Age group	*n*	Energy (kcal) Mean	(SD)	Energy (MJ) Mean	(SD)
Men	18–64 years	662	2632	(730)*	11.0	(3.1)*
	18–35 years	253	2776	(750)*a	11.6	(3.1)*a
	36–50 years	236	2632	(728)*a	11.0	(3.0)*a
	51–64 years	173	2421	(653)*b	10.1	(2.7)*b
Women	18–64 years	717	1826	(484)	7.6	(2.0)
	18–35 years	269	1848	(473)a	7.7	(2.0)a
	36–50 years	286	1858	(492)ab	7.8	(2.1)ab
	51–64 years	162	1735	(479)b	7.3	(2.0)b

* Significantly higher energy intakes in men than women, $P < 0.001$ (*t*-test), within each age group.
[ab] Different superscripts denote significant differences between age groups within each sex, $P < 0.05$ (ANOVA).

the full sample and after excluding dieters/the unwell. As energy intakes and mean EI/BMR_{est} values were normally distributed in men and women in each of the age groups, an independent *t*-test was used to test for differences in energy intake and EI/BMR_{est} between men and women. A one-way analysis of variance (ANOVA) was used to test for differences in energy intakes and EI/BMR_{est} between age groups and/or BMI categories, followed by the Scheffe *post hoc* test when groups had equal variances or the Tamhane *post hoc* test when groups had unequal variances[26].

The contribution of food groups to energy intake was calculated for the total population and for men and women in each of the age categories. As the sample size was large, small differences in the percentage of energy from food groups (>1%) between men and women and between age groups showed statistical significance ($P < 0.05$). Consequently, this paper focuses on a more descriptive approach to these results and highlights considerable differences in the percentage contribution of foods to energy. All statistical analysis was carried out using SPSS version 8.0 (SPSS Inc., Chicago, IL).

Results

Mean energy intakes are presented in Table 1 for men and women in three age groups (18–35 years, 36–50 years and 51–64 years). Men had a significantly ($P < 0.001$) higher energy intake than women (11 MJ vs. 7.6 MJ). This was consistent across all three age groups. Energy intakes decreased significantly ($P < 0.05$) with age in men and women, with men and women aged 51–64 years reporting significantly ($P < 0.05$) lower energy intakes than younger men and women (Table 1).

Mean values for EI/BMR_{est} are given in Table 2. Overall, men had significantly higher values than women ($P < 0.05$) and this was consistent across all age groups. For all subjects combined, mean EI/BMR_{est} declined significantly ($P < 0.05$) with increasing BMI. When this was considered for age and sex groups, it tended to hold true between the normal and overweight BMI categories. However, EI/BMR_{est} tended not to decline between the overweight and obese category of BMI. These analyses are repeated in Table 3, where dieters and the unwell were excluded. Although the absolute values differ from Table 2, the main findings remain the same. Table 4 describes the contribution of 18 food groups to energy intake ranked according to level of contribution. The percentage of the population who consumed foods from each food category is also given. The top four food groups, which accounted for 50% of energy intake, were meat and meat products, breads and rolls, potatoes and potato products, and biscuits, cakes, pastries and puddings. By and large, this was consistent across all age and sex groups. The percentage of men and women who were classified as consumers of the different food groups tended to be broadly similar and generally constant across age groups. There were some differences between men and women and across the age groups, but these tended to be small within the overall picture. For example, a higher percentage of women were consumers of biscuits,

Table 2 Mean energy intake/estimated basal metabolic rate (EI/BMR_{est}) and standard deviations (SD) in Irish adults according to sex, age group and body mass index (BMI)

		All			Body mass index (BMI) categories† BMI ≤ 24.9 kg m^{-2}			BMI = 25–29.9 kg m^{-2}			BMI ≥ 30 kg m^{-2}		
Sex	Age group	*n*	Mean	(SD)	*n*	Mean	(SD)	*n*	Mean	(SD)	*n*	Mean	(SD)
All	Total	1369	1.38	(0.40)	566	1.49	(0.40)c	513	1.33	(0.37)d	233	1.20	(0.37)e
Men	18–64 years	655	1.45	(0.42)***	206	1.62	(0.39)c***	286	1.41	(0.40)d***	122	1.25	(0.40)e*
	18–35 years	249	1.50	(0.42)a***	109	1.63	(0.35)c***	99	1.46	(0.42)d***	32	1.29	(0.50)d*
	36–50 years	235	1.44	(0.42)ab**	58	1.64	(0.42)c**	107	1.42	(0.39)d***	53	1.26	(0.39)dNS
	51–64 years	171	1.36	(0.39)b**	39	1.57	(0.46)c*	80	1.34	(0.36)dNS	37	1.20	(0.30)dNS
Women	18–64 years	714	1.31	0.37	360	1.42	(0.39)c	227	1.22	(0.29)d	111	1.14	(0.34)d
	18–35 years	269	1.33	(0.38)a	176	1.42	(0.39)c	65	1.17	(0.31)d	24	1.03	(0.19)e
	36–50 years	285	1.34	(0.37)a	133	1.45	(0.38)c	106	1.22	(0.29)d	42	1.24	(0.33)d
	51–64 years	160	1.25	(0.36)b	51	1.34	(0.40)c	56	1.27	(0.27)cd	45	1.11	(0.38)d

† Body mass index calculated for 1312/1369 respondents for whom weight and height data were available.
Significant differences in EI/BMR_{est} between males and females in same age groups and/or BMI categories (*t*-test): ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$; NS, not significant.
[ab] Significant differences in EI/BMR_{est} between age groups within each sex, $P < 0.05$ (ANOVA), for the full sample (column 'All').
[cde] Significant differences in EI/BMR_{est} between BMI categories within each sex and age group, $P < 0.05$ (ANOVA) (rows).

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Table 3 Mean energy intake/estimated basal metabolic rate (EI/BMR_{est}) and standard deviations (SD) in Irish adults according to sex, age group and body mass index (BMI) excluding dieters and the unwell

					Body mass index (BMI) categories†								
		All			BMI ≤ 24.9 kg m^{-2}			BMI = 25–29.9 kg m^{-2}			BMI ≥ 30 kg m^{-2}		
Sex	Age group	*n*	Mean	(SD)	*n*	Mean	(SD)	*n*	Mean	(SD)	*n*	Mean	(SD)
All	Total	1200	1.42	(0.40)	526	1.52	(0.40)^{c}	433	1.37	(0.37)^{d}	188	1.24	(0.37)^{e}
Men	18–64 years	605	1.48	(0.41)***	201	1.63	(0.39)^{c***}	259	1.44	(0.39)^{d***}	106	1.29	(0.38)^{e*}
	18–35 years	237	1.52	(0.41)^{a***}	108	1.63	(0.36)^{c***}	93	1.48	(0.42)^{d***}	28	1.34	(0.47)^{d**}
	36–50 years	218	1.47	(0.41)^{ab*}	57	1.65	(0.42)^{c**}	99	1.46	(0.37)^{d***}	46	1.32	(0.36)^{dNS}
	51–64 years	150	1.40	(0.40)^{b*}	36	1.61	(0.45)^{c*}	67	1.36	(0.37)^{dNS}	32	1.21	(0.30)^{dNS}
Women	18–64 years	595	1.36	(0.38)	325	1.44	(0.39)^{c}	174	1.26	(0.29)^{d}	82	1.18	(0.36)^{d}
	18–35 years	235	1.36	(0.39)^{a}	163	1.44	(0.39)^{c}	52	1.21	(0.31)^{d}	17	0.96	(0.15)^{e}
	36–50 years	234	1.39	(0.38)^{a}	119	1.48	(0.38)^{c}	82	1.26	(0.29)^{d}	30	1.30	(0.35)^{d}
	51–64 years	126	1.30	(0.36)^{a}	43	1.38	(0.40)^{c}	40	1.32	(0.27)^{c}	35	1.19	(0.39)^{c}

† Body mass index calculated for 1147/1200 respondents for whom weight and height data were available.
Significant differences in EI/BMR_{est} between males and females in same age groups and/or BMI categories (*t*-test): ***, $P < 0.001$; **, $P < 0.01$; *, $P < 0.05$; NS, not significant.
[ab]Significant differences in EI/BMR_{est} between age groups within each sex, $P < 0.05$ (ANOVA), for the full sample (column 'All').
[cde]Significant differences in EI/BMR_{est} between BMI categories within each sex and age group, $P < 0.05$ (ANOVA) (rows).

cakes, pastries and puddings than men (94% vs. 88%), a lower percentage of women were consumers of alcoholic beverages (61% vs. 70%) and of eggs and egg dishes (68% vs. 77%) than men. Similarly, across age groups there were some differences. For example, the proportion of the population who consumed biscuits, cakes, pastries and puddings increased with age in both men and women, as did the percentage of respondents who consumed eggs and egg dishes and creams, ice creams and chilled desserts. The proportion of women who drank alcohol decreased with age (Table 4).

Discussion

This study is the first food intake survey that has collected data in the Republic of Ireland and Northern Ireland simultaneously, using the same methodology. Although there were some differences in energy intakes between the present study and the 1990 Irish National Nutrition Survey[7] and the 1988 Diet, Lifestyle and Health in Northern Ireland Survey[8] (differences of 0.3 to 1.2 MJ), energy intakes have not changed remarkably over the last decade in either the Republic of Ireland or Northern Ireland. It is necessary, however, to bear in mind that the method of food intake assessment used in each of the three surveys was different.

Energy intakes in this survey (11.0 MJ for men and 7.6 MJ for women) are comparable to the 1991 UK Dietary Reference Values (DRVs)[25], which are expressed as estimated average requirements (EARs) and assume a physical activity level (PAL), expressed as a multiple of BMR, of 1.4. The recent *Recommended Dietary Allowances for Ireland* (1999)[27] followed the 1993 *Nutrient and Energy Intakes for the European Community* recommendations[28] in expressing energy requirements in terms of actual body weight and ideal body weight (based on a BMI of 22 kg m^{-2}) with and without desirable PALs of 1.51 to 1.77. The energy intakes in the present survey are lower than these recommendations. The body weights collected in this survey are, however, much higher than those used in the recommendations and the PALs used in the recommendations are much higher than the mean PAL of 1.38 calculated from energy intakes in the present survey (Table 2). This suggests that these energy recommendations may need to be evaluated in the context of current energy intakes, actual PALs and body weights in the Republic of Ireland and Northern Ireland.

This paper examines the validity of energy intakes. EI/BMR_{est} has been used extensively as a measure of the validity of energy intakes in food intake studies[1,29–34]. Individuals with an EI/BMR_{est} below a certain cut-off limit have been categorised as underreporters[29,32,33,35–38], low energy reporters[39,40], misreporters[41], implausible reporters[31] or as individuals with 'underestimated energy intake'[42]. Goldberg *et al.*[6], using data from whole-body calorimetry and doubly labelled water studies to determine energy expenditure, proposed a series of cut-off limits for EI/BMR_{est} to evaluate energy intake data. These cut-offs represent the 95% confidence interval of agreement between EI/BMR_{est} and a PAL of 1.55, taking into account daily variations in energy intake, PALs and the precision of estimating BMR for sample sizes between 1 and 2000 with 1 to 28 days of food intake data. Energy intakes below these cut-offs have been described as being incompatible with long-term survival[6].

For a sample size of 1500 with 7 days of food intake data, Goldberg *et al.*[6] proposed a minimum mean EI/BMR_{est} of 1.53. The mean EI/BMR_{est} in the present study was lower than this at 1.38 (1.45 in males, 1.31 in females) (Table 2) and continued to be lower than 1.53 when dieters and the unwell were excluded (1.42) (Table 3). However, the mean EI/BMR_{est} in this study was comparable to that of other surveys. The mean EI/BMR_{est} of 37 published studies of food intake was 1.43[1]. Similarly low

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Table 4 Percentage contribution of 18 food groups to mean daily energy intakes in Irish adults and the percentage consumers (% cons) of each food group according to sex and age group

			Men								Women							
	All $n = 1379$		18–64 years $n = 662$		18–35 years $n = 253$		36–50 years $n = 236$		51–64 years $n = 173$		18–64 years $n = 717$		18–35 years $n = 269$		36–50 years $n = 286$		51–64 years $n = 162$	
Food groups	%	% cons	%	% cons	%	% cons	%	% cons	%	% cons	%	% cons	%	% cons	%	% cons	%	% cons
Meat & meat products	16	98	17	99	18	99	17	99	16	98	15	98	15	95	15	100	15	100
Breads & rolls	14	100	14	100	13	100	15	100	16	100	14	99	14	99	14	100	15	99
Potatoes & potato products	11	99	12	100	13	100	12	99	12	100	10	99	11	99	9	99	9	98
Biscuits, cakes, pastries & puddings	9	91	7	88	6	81	8	91	9	93	9	94	7	89	10	97	11	97
Milk & yoghurt	7	98	7	99	7	98	7	100	6	99	8	98	7	97	8	989	9	99
Sugars, preserves, confectionery & savoury snacks	7	95	7	96	8	98	6	95	6	94	7	95	8	96	6	95	6	91
Butter, spreading fats & oils	6	97	6	98	5	99	7	99	7	98	6	96	5	95	6	95	7	97
Alcoholic beverages	5	65	6	70	7	74	5	68	6	66	3	61	4	70	3	64	1	39
Breakfast cereals	4	73	3	72	3	70	4	77	4	71	4	74	4	71	4	75	5	75
Vegetables & vegetable dishes including pulses	4	99	4	99	3	99	4	100	3	100	5	99	5	99	5	100	4	100
Fruit, fruit juice, nuts & seeds, herbs & spices	3	86	3	82	2	80	3	83	3	84	4	89	3	89	4	91	4	89
Flours, grains, starches, rice, pasta & savouries	3	76	3	73	4	80	3	74	2	61	3	80	4	85	4	84	2	61
Cheese	2	74	2	72	2	73	2	74	2	67	2	76	2	78	2	78	2	70
Eggs & egg dishes	2	72	2	77	1	73	2	79	2	80	2	68	2	65	2	71	2	69
Fish & fish dishes	2	68	2	71	2	65	2	72	2	78	2	66	2	57	3	70	3	72
Non-alcoholic beverages	2	100	2	99	3	100	1	99	1	99	2	100	3	100	1	100	1	99
Soups, sauces & miscellaneous foods	2	97	2	97	2	96	1	97	1	97	2	98	2	99	2	98	2	95
Creams, ice creams & chilled desserts	1	58	1	55	1	48	1	59	2	62	1	61	2	56	2	66	2	62
Total (%)	100		100		100		100		100		100		100		100		100	
Mean daily energy intake (MJ)			11.0		11.6		11.0		10.1		7.6		7.7		7.8		7.3	

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mean EI/BMR_{est} values have been seen in national food surveys in Sweden ($EI/BMR_{est} = 1.35$ in males, 1.33 in females)[43] and in Germany (mean $EI/BMR_{est} = 1.5$ in males, 1.4 in females)[44] that collected food intakes by means of a 7-day food diary.

In classifying individuals as underreporters/low energy reporters/misreporters, the cut-off limit proposed by Goldberg *et al.*[6] for a sample size of 1 has been used by many investigators[31,32,37,39,40,42]. The cut-off relevant to the NSIFCS was 1.10 and 25% of respondents had an EI/BMR_{est} below this value (20% of men, 29% of women). Again, this is comparable to the results of other surveys. In a Swedish food survey[43], 26% of respondents had an EI/BMR_{est} below 1.10 and in the MRC National Survey of Health and Development in the UK[40], 21% of the non-dieting sample had an EI/BMR_{est} below 1.10. In the Dietary and Nutritional Survey of British Adults[30], 49% of women and 29% of men had an EI/BMR_{est} below 1.2. Recent work has shown that the aforementioned cut-offs do not identify all underreporters[45] as the assumed PAL of 1.55 is lower than that reported in many age and sex groups[46]. It was suggested that different cut-offs relating to different activity levels are necessary to correctly identify individuals as low energy reporters[45].

This issue of energy underreporting was taken into consideration in the development of the food diary protocol for this study. The keeping of a food diary requires a high level of participation by the respondent[5]. The fact that a fieldworker visited each respondent up to four times, and in some cases more frequently, allowed the fieldworker to motivate and encourage the respondent in the completion of the food diary. It also helped reduce errors in food intake data collection related to both the omission of items eaten/drunk and the difficulties encountered by respondents in quantifying foods. Despite this intensive fieldworker involvement, mean EI/BMR_{est} values and the proportion of the population identified as underreporters (EI/BMR_{est} below 1.10) in this survey were not remarkably different from those reported in other large surveys of food intake.

In the evaluation of EI/BMR_{est} results many investigators exclude dieters and/or those who said their eating habits were affected by their health during the survey[39,40], as these respondents are expected to have lower energy intakes than others. In this survey, 161 respondents (12%) were considered to be dieters and a further 10 respondents reported reduced food intake due to being unwell. After excluding these 171 (12.4%) respondents, mean EI/BMR_{est} did increase from 1.38 to 1.42 and the proportion of the sample with an EI/BMR_{est} below 1.10 decreased from 25% to 21%. Nonetheless, excluding dieters and the unwell certainly did not account for all of the low energy reporters. The question used to identify dieters may not have been exclusive in capturing all dieters as, in another question, 324 additional respondents (23% of the sample) reported that they had either reduced their calorie or fat intake or had made other dietary changes to lose weight during the previous year. These individuals were not categorised as dieters in the present study.

EI/BMR_{est} is not consistent within populations. In many food intake surveys those who were overweight or obese were more likely to report lower than expected energy intakes than those whose weight was normal[1,29,31,32,34,36,37,39,47–50]. Indeed, BMI has been shown to be an independent predictor of low EI/BMR_{est} in large dietary surveys in different countries[35,39,40]. Other investigators showed that women[31,36,51,52] and the weight conscious[36,53] also reported low energy intakes. In this study, women had a significantly lower ($P < 0.001$) mean EI/BMR_{est} than men and EI/BMR_{est} decreased significantly ($P < 0.05$) with increasing BMI in both men and women. Although measured BMR increases with increasing BMI[54], Heshka *et al.* showed that predictive equations overestimate the resting metabolic rate in obese subjects[55]. Hence, the possible subsequent underestimation of EI/BMR_{est} in obese individuals has important implications for the interpretation of energy underreporting in this group.

The main food group sources of energy are presented in Table 4. The intake of foods and food groups and the number of individuals consuming various foods provide useful data for qualitative food-based dietary guidelines (FBDGs)[56]. In the development of FBDGs, food intakes are compared between those with different intakes of a target nutrient to determine which foods positively or negatively discriminate towards a diet high or low in that nutrient[57]. Differences in food intakes between underreporters and acceptable reporters have been documented[36,39,40]. Becker *et al.*[38] addressed this issue specifically in relation to FBDGs using food intake data from the Kilkenny Health project which had been collected on 1212 adults by food-frequency questionnaire in 1985 and 1991. When each food group was subdivided into a low-intake and a high-intake group, underreporters were either over-represented in the low-intake group or over-represented in the high-intake group for many foods. Food intakes in the present study need to be examined further taking lower than expected energy intakes into consideration.

In summary, energy intakes in the Republic of Ireland and Northern Ireland have not changed remarkably in the last 10 to 12 years. There is evidence of underreporting, however, as the mean EI/BMR_{est} was 1.38 and 25% of the population had an EI/BMR_{est} below 1.10. Additional multivariate analysis of these data is required to further identify subgroups in the population reporting lower than expected energy intakes and to evaluate the effect of low energy intakes on the analysis of the consumption of various foods and food groups.

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