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The relationship between riboflavin intake, serum homocysteine and thermolabile methylenetetrahydrofolate reductase genotype in young adults: The Northern Ireland Young Hearts Project. By M.C. McKINLEY[1], J.V. WOODSIDE[1], L.J. MURRAY[1], P.J. ROBSON[2], J.J. STRAIN[2], H. McNULTY[2], C.A.G. BOREHAM[3], A.S. WHITEHEAD[4] and I.S. YOUNG[1], [1]*Centre for Clinical and Population Sciences, Queen's University Belfast, Belfast BT12 6BJ, UK,* [2]*Northern Ireland Centre for Food and Health, University of Ulster, Coleraine BT52 1SA, UK,* [3]*School of Health Sciences, University of Ulster, Newtownabbey BT37 0QB, UK and* [4]*Department of Pharmacology and Center for Pharmacogenetics, University of Pennsylvania School of Medicine, Philadelphia, PA 19104, USA*

Methylenetetrahydrofolate reductase (MTHFR) is a riboflavin-dependent enzyme. Homozygosity for thermolabile MTHFR (TT) (a common C677T polymorphism), is associated with elevated total homocysteine (tHcy) concentrations. Data from adults indicate that this elevation in tHcy may be dependent on riboflavin status (Jacques *et al*. 2002; McNulty *et al*. 2002). The aim of the present study was to examine the relationship between riboflavin intake, tHcy concentrations and thermolabile MTHFR genotype in 402 young adults from Northern Ireland aged 20–25 years.

Habitual dietary intake was assessed using the diet-history method. Fasting blood samples were collected for determination of biochemical variables and for DNA extraction. Serum (tHcy) concentrations were measured by HPLC (Ubbink *et al.* 1991). MTHFR genotype was identified by PCR amplification followed by *HinF1* digestion (Frosst *et al*. 1995). Serum tHcy concentrations were skewed and therefore analyses were carried out using natural logarithm transformations. One-way ANOVA was used to examine the effect of genotype on tHcy concentrations. Two-way ANOVA was used to examine the interaction between genotype, riboflavin intake and tHcy. An independent-samples *t* test was used to examine differences in tHcy when the sample was split according to mean riboflavin intake.

As illustrated in the Table, tHcy concentrations (geometric mean and 95%CI; µmol/l) were significantly different across the genotypes in all subsets, with the exception of females whose dietary riboflavin intake was below the mean. There was no significant interaction between riboflavin intake, tHcy and MTHFR genotype in the sample as a whole or in males and females, which remained true even when the sample was split according to mean riboflavin intake. Serum tHcy was significantly higher ($P<0.02$) in subjects with a riboflavin intake less than or equal to the mean (1.9 mg/d) compared with those whose riboflavin intake was greater than the mean (8.75 (8.75, 9.73) *v*. 10.03 (10.15, 11.85)).

	Serum tHcy (µmol/l) according to thermolabile MTHFR genotype									
Genotype.....	CC (normal)			CT (heterozygous)			TT (homozygous)			
	n	Mean	95% CI	*n*	Mean	95% CI	*n*	Mean	95% CI	*P*
All	175	8.79	8.7, 9.6	173	9.13	9.1, 10.3	54	12.14	11.7, 16.8	0.000
Riboflavin intake <mean										
Total	83	9.08	8.8, 10.4	80	10.11	9.7, 12.0	27	13.48	12.0, 20.1	0.000
Males	48	9.42	8.9, 10.7	43	9.77	9.1, 12.0	11	16.48	11.9, 27.9	0.000
Females	35	9.64	8.8, 11.5	37	10.34	9.6, 12.0	16	11.51	8.8, 17.4	0.234
Riboflavin intake >mean										
Total	92	8.55	8.4, 9.3	93	8.52	8.4, 9.4	27	10.93	9.3, 15.5	0.001
Males	51	8.70	8.4, 9.3	52	8.75	8.3, 9.9	12	11.75	7.2, 20.2	0.003
Females	41	7.60	7.1, 8.9	41	8.00	7.2, 9.9	15	10.54	8.1, 15.2	0.005

Although data showed the expected trend, no significant interaction between riboflavin intake, tHcy and thermolabile MTHFR genotype was noted in this cohort of adolescents, it is possible that such an interaction may only become apparent on examination of riboflavin status.

Frosst P, Blom HJ, Milos R, Goyette P, Sheppard CA, Matthews RG, Boers GJ, den Heijer M, Kluijtmans LA & van den Heuvel LP (1995) *Nature Genetics* **10**, 111–113.

Jacques PF, Kalmbach R, Bagley PJ, Russo GT, Rogers G, Wilson PWF, Rosenberg IH & Selhub J (2002) *Journal of Nutrition* **132**, 283–288.

McNulty H, McKinley MC, Wilson B, McPartlin J, Strain JJ, Weir DG & Scott JM (2002) *American Journal of Clinical Nutrition* **76**, 436–441.

Ubbink JB, Hayward Vermaak WJ & Bissbort S (1991) *Journal of Chromatography* **565**, 441–446.

Effect of alcohol on homocysteine and B-vitamin concentration in healthy male volunteers. By J.V. WOODSIDE[1], A. GIBSON[1], I.S. YOUNG[1], P.C. SHARPE[1], C. MERCER[1], C.C. PATTERSON[1], L.A.J. KLUIJTMANS[2], A.S. WHITEHEAD[2] and A. EVANS[1], [1]*Centre for Clinical and Population Science, Queen's University Belfast, Belfast BT12 6BJ, UK and* [2]*Department of Pharmacology, University of Pennsylvania, Philadelphia*

There is little randomised controlled trial evidence regarding the relationship between total homocysteine (tHcy) levels and alcohol consumption, although a number of observational studies have suggested a positive association (Mennen *et al*. 2003). The aim of the present study was to assess the effect of an 8-week intervention with different types of alcohol on plasma tHcy and serum folate and cobalamin concentrations in healthy Northern Irish male volunteers. A secondary aim was to assess the effect of the intervention on tHcy according to methylenetetrahydrofolate reductase (MTHFR) genotype.

A randomised controlled cross-over intervention study measuring tHcy and serum folate and cobalamin concentrations was conducted in eighty-five male subjects (not using vitamin supplements) aged between 21 and 70 years recruited from hospital staff and members of the general public. Following a 2-week washout during which no alcohol was consumed, all subjects were administered 24 g alcohol (either 240 ml red wine or 60 ml vodka)/d for a 2-week period. Following a further 2-week washout, participants consumed the alternate intervention for 2 weeks. The study was not diet-controlled, although subjects were asked not to change their usual diet.

As there were no significant period or carry-over effects, paired samples *t* tests were used to compare the intervention groups. The Table shows the geometric means (*95% CI*) pre- and post-intervention in each intervention group.

		Vodka			Red wine			Vodka *v*. red wine
	n	Pre	Post	*P*	Pre	Post	*P*	*P* (unadjusted)
tHcy (µmol/l)	77	10.4 (*7.1,17.5*)	10.6 (*6.7,19.4*)	0.09	10.4 (*6.5,19.6*)	10.7 (*7.1,20.3*)	0.03	0.57
Cobalamin (pg/ml)	78	376 (*191,683*)	349 (*167,647*)	<0.001	368 (*187,703*)	349 (*181,695*)	<0.001	0.94
Folate (ng/ml)	78	4.9 (*2.3,11.5*)	4.4 (*2.2,8.8*)	<0.001	4.9 (*2.5,11.4*)	4.6 (*2.1,10.6*)	0.03	0.38

A significant increase in plasma tHcy was observed after the 2-week red wine intervention, and a non-significant increase in tHcy with vodka intervention. When the two interventions were compared, the change in tHcy did not differ between the vodka and red wine interventions. There were significant decreases in serum cobalamin and folate concentrations, and this decrease did not differ between interventions. The increase in tHcy observed in both interventions was significantly larger in thermolabile homozygotes for the MTHFR genotype compared with heterozygotes or non-thermolabile homozygotes ($P<0.05$).

This study showed that a 2-week alcohol intervention resulted in a decrease in folate and cobalamin status and an increase in plasma tHcy. The effect of alcohol intervention on tHcy, folate and cobalamin concentrations did not differ between the red wine and vodka intervention groups. The effect of alcohol consumption on tHcy may be dependent on thermolabile MTHFR genotype.

Mennen LI, de Courcy GP & Guilland J-C, Ducros V, Zarebska M, Bertrais S, Favier A, Hercberg S & Galan P (2003) *American Journal of Clinical Nutrition* **78**, 334–338.

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A comparison of lactulose and inulin as substrates for the hydrogen breath test in males. By M. CLEGG and A. SHAFAT, *Department of Physical Education and Sport Sciences, University of Limerick, Limerick, Republic of Ireland*

The H_2 breath test provides an indication of mouth to caecum transit time (MCTT). Lactulose, a non-absorbable carbohydrate, has been used widely to measure MCTT, as upon reaching the large intestine it is metabolised by colonic bacteria. H_2 is produced, as well as CH_4, CO_2 and other gases. These gases diffuse into the bloodstream and into the alveoli where they can be detected in end-exhalation breath. However, this method has been criticised as lactulose, due to its osmotic effects, draws fluid into the intestinal lumen and accelerates small intestinal transit. Inulin is also recognised to have potential for use in this test without the effects of accelerating transit (Geboes *et al*. 2003). The aim of the current study was to examine differences in MCTT when equal amounts of solid lactulose (L-S), solid inulin (IN) and lactulose in liquid form (L-L) were added to the test meal.

Ten healthy male volunteers (age 25.1 (SD 2.7) years, height 1.798 (SD 0.049) m, weight 78.3 (SD 6) kg) consented to participate in this study, approved by the University of Limerick Research Ethics Committee. All volunteers were asked to record their diet for a 24 h period using a weighed-food diary. Following a 12 h overnight fast they attended the laboratory and consumed, in a randomised order, a pancake meal supplemented with 12 g L-S or 12 g IN, or a plain pancake and 12 g L-L dissolved in water. Breath H_2 was tested every 10 min using a Micro Medical H_2 meter (Chatham, Kent, UK) for ≤8 h. MCTT was defined as a consecutive increase in breath H_2 over three consecutive readings of at least a cumulative 10 parts/10^6. The test procedure was repeated for the two other substrates with at least 5 d between test days. The food diary from the 24 h before the first test session was repeated for the 24 h before each of the next two test days. Statistical significance (P<0.05) was examined with SPSS (version 12.0; SPSS, Chicago, IL, USA) using repeated-measures ANOVA.

Fig. 1 depicts the MCTT of all volunteers for the three test meals. Three volunteers did not show an increase in breath H_2 after IN, one of which was a non-responder to all three tests, another also showed no increase for L-S. The shortest MCTT was for L-L (n 9; 85.3 (SD 42.8) min); L-S (n 8) had a longer transit time of 162.4 (SD 62.6) min, while IN (n 7) had the longest transit time (292.4 (SD 66.7) min). Differences existed between all three of the substrates, between IN and L-S (P=0.008) and between L-S and L-L (P=0.014).

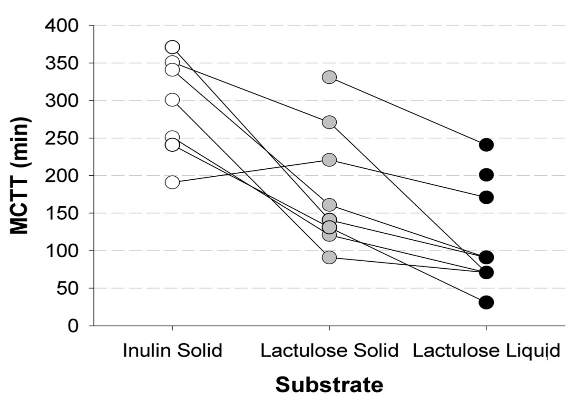

Fig. 1. MCTT for all volunteers for three test meals.

The L-L and L-S meals had a shorter MCTT than the IN meal. This finding supports work by Geboes *et al*. (2003) that demonstrates that lactulose accelerates MCTT. Furthermore, the L-L MCTT was shorter than the L-S MCTT, perhaps due to faster gastric emptying of liquids as there is no lag phase. The individuals who did not show any increase in breath H_2 had longer transit times for the two other substrates, suggesting that MCTT had not been reached at 8 h. The addition of gastric-emptying data will provide further distinction between small intestinal transit and gastric emptying and their roles in MCTT times.

Geboes KP, Luypaerts A, Rutgeerts P & Verbeke K (2003) *Alimentary Pharmacology and Therapeutics* **18**, 721–729.

Socio-economic examination of Irish data from pan-EU attitudinal surveys regarding food, nutrition, physical activity, body weight and health. By D.M.A. McCARTNEY, K.M. YOUNGER and J.M. KEARNEY, *School of Biological Sciences, Dublin Institute of Technology, Kevin Street, Dublin 8, Republic of Ireland*

Three pan-EU attitudinal surveys were conducted by the Institute for European Food Studies from 1995 to 2001. Two of these surveys examined attitudes to food, nutrition and health among adults aged 15–64 years (n 1009; Gibney *et al*. 1997) and among adults aged ≥55 years (n 466) respectively. The third survey examined the attitudes of adults aged 15–64 years to physical activity, body weight and health (n 1001; Kearney *et al*. 1999). Data from each of these studies was analysed by univariate cross-tabulation (χ^2), ANOVA and analysis of covariance. Attitudinal characteristics significantly associated with declining educational status and social class are shown in Tables 1 and 2 respectively.

Table 1. Attitudinal characteristics significantly associated with declining education

	Population group	Parameter	Significance: *P*
Diet-related	Adults aged 15–64 years	Lower selection of 'healthy eating' as an influence on food choice	<0.001
	Men aged 15–24 years	Greater % in the pre-contemplation stage regarding dietary change	0.007
	Women aged 15–24 years	Lower % in the action/maintenance stages regarding dietary change	0.021
	Adults aged 15–64 years	Greater awareness of the health effects of excessive alcohol intake	<0.001
Physical activity-related	Adults aged 15–64 years	Lower awareness of the health benefits of physical activity	<0.001
	Adults aged >55 years	Lower awareness of the health benefits of physical activity	0.015
	Adults aged 15–64 years	Lower variety of physical activities engaged in	0.004
	Adults aged 15–64 years	Lower intention to increase physical activity	<0.001
	Adults aged 15–64 years	Lower perception of work and study as barriers to physical activity	<0.001
	Adults aged 15–64 years	Greater perception of poor facilities as a barrier to physical activity	0.041
	Adults aged 15–64 years	Greater % in the pre-contemplation stage regarding physical activity	<0.001
General health-related	Adults aged 15–64 years	More fatalistic approach to health	0.002
	Adults aged 15–64 years	Greater level of contentment with current body weight	0.002

Table 2. Attitudinal characteristics significantly associated with declining social class

	Population group	Parameter	Significance: *P*
Diet-related	Adults aged 15–64 years	Lower selection of 'healthy eating' as an influence on food choice	<0.001
	Women aged 15–64 years	Greater selection of 'price' as an influence on food choice	0.005
Physical activity-related	Adults aged 15–64 years	Lower awareness of the health benefits of physical activity	0.005
	Adults aged 15–64 years	Lower variety of physical activities engaged in	0.008
	Adults aged 15–64 years	Lower intention to increase physical activity	0.011
	Adults aged 15–64 years	Lower perception of work and study as barriers to physical activity	0.017
	Adults aged 15–64 years	Greater perception of poor facilities as a barrier to physical activity	0.025
	Adults aged 15–64 years	Greater % in the pre-contemplation stage regarding physical activity	0.003
General health-related	Adults aged 15–64 years	More fatalistic approach to health	0.008

Apart from beliefs concerning alcohol, these findings confirm the existence of less-favourable attitudes regarding diet, physical activity, stage of change (Prochaska & DiClemente, 1983) and health among socio-economically-disadvantaged groups in Ireland.

Gibney MJ, Kearney M & Kearney JM (1997) *European Journal of Clinical Nutrition* **51**, Suppl. 2, S57–S58.
Kearney JM, Kearney, MJ, McElhone S & Gibney MJ (1999) *Public Health Nutrition* **2**, 79–86.
Prochaska JO & DiClemente CC (1983) *Journal of Consulting Psychology* **51**, 390–395.

A preload study to evaluate the effects of solid *v*. liquid, and water *v*. air on satiety and subsequent intakes. By P.A. Irvine, R.W. Welch, M.B.E. Livingstone, A. Dunne and A. Mullee, *Northern Ireland Centre for Food and Health (NICHE), School of Biomedical Sciences, University of Ulster, Coleraine BT52 1SA, UK*

The consumption of foodstuffs that give a relatively high satiety, and lead to decreased subsequent food intakes, may be one strategy to help prevent or alleviate overweight and obesity. Satiety is influenced by a number of foodstuff-related factors. For example, a comparison of isoenergetic portions of a range of foods has shown that satiety scores are positively correlated with, *inter alia*, protein, fibre and water contents, and portion weight (Holt *et al*. 1995). Preload studies have shown that increasing the volume of liquid or semi-solid preloads by incorporating non-nutrients (water or air) increases satiety and decreases energy intake (Rolls *et al*. 1999, 2000). However, the relative effects of solid and liquid foods on satiety and food intake remain unclear (Almiron-Roig *et al*. 2003), The aim of the present study was to compare the effects on satiety and food intakes of solid and liquid preloads that have identical ingredients and total volumes, but which contain different amounts of water or air.

The four preloads were: (1) solid gel, (served as a jelly) (2) solid foam, (served as a mousse) (3) liquid foam, (served as a shake) (4) liquid, (served as a drink). The preloads (925 kJ; 300 ml; 32 g CHO, 5 g fat, 14 g protein) were made with condensed milk, sugar, strawberry flavouring, egg-white powder, gelatine and boiled (solid) or fresh (liquid) pineapple juice. The total preload volume was made up to 300 ml with water (solid gel and liquid), or with 200 ml water into which 100 ml air was incorporated by whisking (solid foam and liquid foam). The present study was conducted using a repeated-measures randomised within-subjects cross-over design. Healthy female subjects (*n* 26; mean age 22.8 (SD 4.3) years; BMI 20–30 kg/m^2) participated on four occasions that were 1 week apart. On each occasion subjects consumed a standard breakfast at 09.00 hours, which provided 25% estimated energy intake. At 12.00 hours subjects were served one of four strawberry-flavoured preloads. Time taken to consume was standardised at 15 min. Satiety was self-reported using visual analogue scales completed before and after the preload. Subjects were offered an *ad libitum* lunch 15 min after consuming the preload, at which intakes were covertly weighed (see Table, which shows means with their standard errors for twenty-six subjects). The lunch meal consisted of cottage pie for the first course and peaches, pears served with fresh cream for the second course. Water was served as a drink. Data were analysed by ANOVA.

Compared with the liquid, the solid gel resulted in significantly ($P<0.05$) greater fullness and lower hunger immediately following consumption of the preload.

	Jelly		Mousse		Shake		Drink	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Total energy (kJ)	1896^{a}	113	$2099^{a,b}$	92	2221^{b}	106	2603^{c}	95
Weight of food (g)	495^{a}	28	$543^{a,b}$	24	579^{b}	27	667^{c}	23
Weight of drink (g)	236^{a}	27	265^{a}	19	277^{a}	23	264^{a}	20
Weight of food and drink (g)	731^{a}	41	808^{a}	38	856^{b}	40	$931^{b,c}$	35

a,b Mean values within a row with unlike superscript letters are significantly different ($P<0.05$).

Intakes of total energy, weight of food and weight of food and drink increased consistently in the order jelly<mousse<shake<drink. The liquid preload (drink) resulted in significantly higher intakes of energy than all other treatments, and in significantly higher intakes of weight of food and weight of food and drink than the solid treatments (jelly and mousse) ($P<0.05$). Overall, the results suggest that liquid preloads are less satiating than solid preloads. There were no clear differences detected between the non-nutrients (air and water) suggesting that the role of air in influencing satiety and food intake requires further investigation.

Almiron-Roig E, Chen Y & Drewnowski A (2003) *Obesity Reviews* **4**, 201–212.
Holt SHA, Miller JCB, Petocz P & Farmakalidis E (1995) *European Journal of Clinical Nutrition* **49**, 675–690.
Rolls BJ, Bell EA & Thorwart ML (1999) *American Journal of Clinical Nutrition* **70**, 448–455.
Rolls BJ, Bell EA & Waugh BA (2000) *American Journal of Clinical Nutrition* **72**, 361–368.

Predictors of asthma in children in Ireland: a multivariate analysis of dietary factors during pregnancy. By N. FITZ-SIMON[1], U. FALLON[1], M.R. SWEENEY[1], D. O'MAHONY[1], G. BURY[1], A.W. MURPHY[2] and C. KELLEHER[1] for the Lifeways Steering Group. [1]*School of Public Health and Population Science, University College, Dublin, Ireland and* [2]*Department of General Practice, National University of Ireland, Galway, Ireland*

Previous research has identified dietary factors including decreased consumption of vegetables and increased consumption of plant-based fats as contributing to the rise in asthma (Devereaux & Seaton, 2005). The objective of this analysis was to examine the association between mothers' diets in pregnancy and development of asthma in children.

This comprised a multivariate logistic analysis of the Lifeways cross-generational cohort study of families, a 3-year follow-up through General Practice of children born in maternity hospitals in Galway and Dublin. Babies (*n* 1016) were recruited in the ante-natal period and born between October 2001 and February 2003. Babies' and mothers' hospital medical records were available and mothers were asked to answer a standardised previously validated questionnaire at recruitment, which contained health status, social and demographic information, and a semi-quantitative food frequency questionnaire. This was used to calculate pregnant mothers' average daily consumption of fruit and vegetables, oily fish and added fat. By 2005 clinical record data were available for 691 children (68%). The main outcome measure was GP record of asthma by 3 years of age (which could be either a diagnosis or record of a single episode of asthma).

Of children 10.2% had a record of asthma. Children in the middle of the birth-weight range (3502 (SD 581)g) were at lower risk of asthma than those of low and high birth-weights. Boys, children born in Dublin, and children in low-income families were more likely to develop asthma. Children of mothers who reported high levels of fruit and vegetable consumption, low consumption of added fat and regular consumption of oily fish were at lower risk of asthma. Socio-demographic and lifestyle variables not significant were mother's age, medical insurance, child's means-tested General Medical Services eligibility, education levels of mother, father and mother's parents, breastfeeding, mother's smoking status at delivery, exposure to smoke in home, self-reported pollution in the environment and mould and damp in home.

Covariate	Definition	Adjusted Odds Ratio for Asthma	95% Confidence interval	*P* value
Added fats	<3 servings per day	0.43	(0.23, 0.80)	0.007
Fruit & vegetables	>7 servings per day	0.41	(0.18, 0.92)	0.032
Oily fish	At least weekly	0.43	(0.18, 1.0)	0.049
Birthweight	Standardised	1.29	(0.99, 1.68)	0.057
Birthweight squared	Standardised	1.17	(1.04, 1.32)	0.008
Gender	Boy	1.89	(1.04, 3.44)	0.038
Income	Low (<£300/week)	2.04	(1.06, 3.91)	0.032
Location	Galway	0.46	(0.24, 0.91)	0.025

After controlling for the effects of socio-demographic factors, the children of mothers who consumed low levels of added fats, high levels of fruit and vegetables, and oily fish at least weekly during pregnancy were at lower risk of developing asthma by age 3 years. The association of diet during pregnancy and later risk of asthma in offspring needs further investigation.

Devereux G & Seaton A (2005) *Journal of Allergy and Clinical Immunology* **115**, 1109–1117.

Dietary intakes in Irish infants from 12 to 18 months. By S. BOLAND, A. COLLINS, I. BLOSSFELD and M. KIELY, *Department of Food and Nutritional Sciences, University College, Cork, Republic of Ireland*

Little research on eating patterns, food and nutrient intakes and the adequacy of children's diets below the age of 2 years has been conducted to date. During the transition stage from 6 months to 18 months, infants progress from a milk-based diet to a varied diet including a range of adult foods, in part self-selected and in part provided by caregivers (Gidding *et al*. 2006). Although dietary guidelines for young children are not clearly defined, there is some evidence that nutritional imbalances are prevalent in preschool children in the USA. Picciano *et al*. (2000) have reported that the nutrient density of the diets of fifty-five children decreases during the transition phase from 12 months to 18 months.

We measured the dietary intakes and eating behaviours of Irish infants at 12 months (*n* 70) and 18 months (*n* 65). Initially, 100 women were recruited, with drop-out rates of 30% and 35% at the 12-month and 18-month stages respectively. Dietary intakes were estimated in their babies using 3 d weighed-food diaries at 12 and 18 months. Weight and head circumference were also obtained.

Weight and head circumference measurements increased significantly between 12 and 18 months ($P<0.001$), as did mean intakes of energy, protein, fat, carbohydrate and Na ($P<0.001$). Energy intakes were similar to those in other reports for this age-group. However, there were significant decreases in the energy-adjusted intakes of most minerals and vitamins. Intakes of vitamins D, E and K ($P<0.001$) and Fe and Ca ($P\leq0.02$) decreased between 12 and 18 months. Of the infants 56, 88, 60, 82, 83 and 89% did not meet the dietary reference intakes (Food and Nutrition Board, 2004) for vitamins D, E and K at 12 and 18 months respectively. In addition, 52% of infants exceeded the dietary reference intake for Na of 1 g/d at 18 months (Food and Nutrition Board, 2004).

Infant and follow-on formula made the biggest contribution to micronutrient intakes at 12 and 18 months. When consumers and non-consumers of follow-on formula were compared, non-consumers had significantly lower intakes (/MJ) of Fe, Zn and vitamin A, D, E and C at each time point ($P\leq0.025$). Non-consumers had lower intakes (/MJ) of folate at 12 months ($P\leq0.025$) and vitamin K at 12 and 18 months, although not significantly different. In contrast, Na intakes were higher among non-consumers at 12 and 18 months. The table describes the mean micronutrient intakes (/MJ energy) of Irish infants who were consumers or non-consumers of follow-on infant formula at 12 and 18 months.

	12 months		18 months	
Nutrient (/MJ)	Consumer (*n* 34)	Non-consumer (*n* 36)	Consumer (*n* 8)	Non-consumer (*n* 57)
Ca (mg)	231	239	185.8	212.9
Fe (mg)	2.6	1.5*	2.7	1.4*
Zn (mg)	1.6	1.2*	1.8	1.2*
Na (g)	186	207	230	278
Folate (μg)	40.5	36.0	38.5	35.4
Vitamin C (mg)	22.0	13.3*	22.7	13.8*
Vitamin A (μg)	121	83.4*	114.9	67.0*
Vitamin D (μg)	2.1	0.5*	2.0	0.31*
Vitamin E (mg)	1.6	0.9*	1.5	0.8*
Vitamin K (μg)	4.6	4.42	4.5	1.9

Mean values were significantly different from those for consumers: * $P<0.025$.

Despite an increase in energy intakes, the nutrient density of the diets decreased significantly from 12 to 18 months. Continued consumption of follow-on formula into the 2nd year of life offset the decrease in micronutrient intakes in the current group of infants.

Food and Nutrition Board (2004) *Dietary Reference Intakes*. Washington, DC: Institute of Medicine, National Academies Press.
Gidding SS, Dennison BA, Birch LL, Daniels SR, Gilman MW, Lichenstein AH, Rattay KT, Steinberger J, Stettler N & Van Horn L (2006) *Pediatrics* **117**, 544–559.
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Nutritional profiling schemes: evaluation using national dietary surveys. By J.L. O'NEILL[1], S.N. McCARTHY[1], C. QUINIO[2], J.-L. VOLATIER[2] and M.J. GIBNEY[1], [1]*Nutrition Unit, Division of Clinical and Molecular Sciences, Trinity College School of Medicine, Dublin, Republic of Ireland* and [2]*Direction de l'Évaluation des Risques Nutritionnels et Sanitaires, AFSSA (Agence Française de Sécurité Sanitaire des Aliments), Maisons Alfort, France*

Nutritional profiling schemes have been developed as a means to categorise foods based on fixed thresholds of one or more nutrients, e.g. fat, sugar, salt (O'Neill, 2004). Many different versions exist; however, the setting of nutritional profiles is a controversial and complex process. Nutritional criteria, thresholds and lack of validation should be taken into consideration. The aim of the present study, as part of a larger ILSI Europe evaluation study of different nutritional profiling schemes, was to determine an Irish reference population with 'healthy diets' and further identify 'reference foods' that positively or negatively contribute to a 'healthy diet'.

Food consumption was estimated using a 7 d food diary for a representative sample (*n* 1379) of 18–64-year-old Irish adults from the North/South Ireland Food Consumption Survey. Weight and height were measured and BMI calculated (Irish Universities Nutrition Alliance, 2006). First, to determine the 'reference population' with healthy diets, several of the Eurodiet (2001) criteria were chosen, total fat (<30% energy (EN)), saturated fat (<10% EN), fruit and vegetable intake (>400 g/d), Na (<6 g/d), total carbohydrates (>55% EN) and fibre intake (>25 g/d) and additionally BMI was included (21–22 kg/m^2). For each criterion a score of achievement was determined by the nutrient intake of the subject : the respective reference intake. A score between 0% and100% was achieved and a global score (healthy eating index) was then calculated as the sum of the scores for each of the different criteria. Quintiles of the healthy eating index were then formed. The final sample consisted of 1312 adults. The reference population was composed of those subjects in the 5th quintile of the healthy eating index.

The results confirmed that those subjects in the 1st quintile of the healthy eating index had a significantly higher BMI, % EN from total fat and from saturated fat when compared with the 5th quintile ($P<0.001$). In addition, those in the 1st quintile had a significantly lower % EN from carbohydrate, fibre and fruit and vegetable intakes (g/d; $P<0.001$). Furthermore, a greater percentage of those in the 5th quintile compared with the 1st quintile complied with the Eurodiet (2001) recommendations for fibre intake (g/d; 43 and 3 respectively), % EN from total fat (58 and 1 respectively), % EN from saturated fat (62 and 1 respectively), % EN from carbohydrate (77 and 0 respectively) and fruit and vegetable intake (g/d; 61 and 1 respectively).

Subsequently, to determine the 'reference foods', a list of the top 400 foods eaten in greatest amounts was generated. These foods were characterised into having a positive (foods consumed significantly more by individuals in the 5th than the 1st quintile of the healthy eating index), negative (foods consumed significantly less by individuals in the 5th than the 1st quintile) or no contribution to a healthy diet. To compare the mean food intakes of the 1st and 5th quintiles the Wilcoxon Mann-Whitney test was used.

Ninety-three foods were shown to make a positive contribution to a healthy diet ($P<0.05$). These foodstuffs were generally those that are expected to be associated with a healthy diet, such as breakfast cereals, wholemeal breads, fish, fruit and vegetables, polyunsaturated fat spread, semi-skimmed milk and yoghurt. Twenty-six foods were found to have a negative contribution to a healthy diet ($P<0.05$). These foodstuffs were generally those that are expected to be associated with an unhealthy diet, such as meat and meat products, fried chips, white bread, whole milk, fried eggs, butter, confectionery, potato crisps and cola. There were 284 foods that made no contribution. These foodstuffs included gravy, ketchup, cornflakes, pizza, onions, boiled eggs and digestive biscuits.

The present study demonstrates a practical approach to looking at consumption patterns and how these patterns relate to the achievement of a healthy diet. The foods identified as being determinants of healthy diets and those of unhealthy diets can now be used with the various food profiling schemes as part of an evaluation process.

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Dietary energy density (ED) in Irish children aged 5–12 years. By J. WALTON, E.M. HANNON and A. FLYNN, *Department of Food and Nutritional Sciences, University College Cork, Cork, Republic of Ireland*

The objective of this study was to estimate firstly dietary energy and then macronutrient, fibre and food group intakes by tertile of energy density in Irish children aged 5–12 years. Analysis was based on The National Children's Food Survey (NCFS) which was carried out between April 2003 and April 2004 to establish a database of habitual food and drink consumption in a representative sample of Irish children aged 5–12 years. A 7 d weighed-food record was used to collect food intake data from 594 children (293 boys, 301 girls). Analysis of dietary intake data was carried out using WISP© (Tinuviel Software, Llanfechell, Anglesey, UK), which is based on the 6th edition of *McCance and Widdowson's The Composition of* Foods (Food Standards Agency, 2002).

Dietary ED (kJ (kcal)/g) was calculated (a) including all foods and beverages (4.56 kJ (1.09 kcal)/g), (b) excluding water (5.35 (1.28 kcal)/g), (c) excluding drinks containing ≤21 kJ (5 kcal)/100 g (5.56 kJ (1.33 kcal)/g), (d) excluding all beverages (8.20 kJ (1.96 kcal)/g). Boys and girls were classified separately into tertiles based on their dietary ED, which when calculated excluded drinks containing ≤21 kJ (5 kcal)/100 g (i.e. method c). Mean daily total energy (TE) from macronutrients (%), dietary fibre (DF; (g and g/10 MJ) and food group intakes (g), by tertile of dietary ED are reported for boys and girls.

	Boys			Girls		
Tertile of ED.......	Low	Medium	High	Low	Medium	High
N.......	97	98	98	100	101	100
Macronutrients and fibre						
TE (%) from: Fat	32.0[a]	33.6[b]	34.6[b,c]	33.3[a]	34.0[a,b]	36.0[c]
Carbohydrate	53.3	52.3	51.8	52.2[a]	51.7	50.5[b]
Total sugars	25.9[a,b]	24.6[b]	22.2[c]	25.9[a]	23.6[b]	21.5[c]
Protein	14.2[a]	13.6	13.0[b]	14.0[a,b]	13.8[b]	13.0[c]
DF: g	13.8	13.1	12.8	11.9	11.7	11.4
g/10 MJ	18.8	17.5	17.4	18.0	17.9	16.8
Food groups						
Ready-to-eat breakfast cereals (g)	36.0	36.8	38.9	22.4	24.9	25.6
Bread (g)	78.1	76.2	86.1	69.2	68.2	71.5
Dairy products (g)	435[a]	352[b]	272[c]	368[a]	291[b]	222[c]
Vegetables (g)	56.3[a]	39.9[b]	31.1[b,c]	46.2[a]	42.5	31.4[b]
Potatoes (g)	75.4[a]	51.9[b]	42.4[b,c]	60.1[a]	43.1[b]	44.1[b,c]
Fruit (g)	90.1[a]	64.2[b]	52.4[b,c]	89.6[a]	65.8[b]	52.6[b,c]
Carbonated beverages (g)	161	175[a]	123[b]	160[a]	117	91[b]
Confectionery and snacks (g) (including biscuits, cakes, chocolate and savoury snacks)	60.4[a]	74.3[b]	77.4[b,c]	60.5[a]	67.8	77.6[b]

[a,b,c] Mean intakes with different superscript letters were significantly different between tertiles (*P*<0.05).

Mean daily TE (%) from fat increased and that from carbohydrate (girls only), total sugars and protein decreased with increasing tertile of ED. Mean daily intake (g) of confectionery increased and that of dairy products, vegetables, potatoes, fruit and carbonated beverages decreased with increasing tertile of ED. Since using energy density to guide food choices may lead to food patterns more consistent with dietary guidelines, policy level initiatives should be devised to help ensure that low-energy-dense diets are affordable and accessible to all.

The project was funded by the Irish Govt under the National Development Plan 2000–2006.

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Sodium intakes from food sources in Irish adults aged 18–64 years and Irish children aged 5–12 years. By R. MOLONEY, E.M. HANNON, M. KIELY and A. FLYNN, *Department of Food and Nutritional Sciences, University College Cork, Ireland*

Na intakes from food sources (i.e. excluding Na in salt added in cooking or at the table) were estimated using data from a representative sample of adults (Republic of Ireland only) aged 18–64 years in the North/South Ireland Food Consumption Survey (NSIFCS; 1997–9) and from a representative sample of Irish children aged 5–12 years in the National Children's Food Survey (NCFS; 2003–4; www.iuna.net). Estimated food records (7 d; NSIFCS) and 7 d weighed records (NCFS) were used to collect food intake data from 958 adults (475 men, 483 women) and 594 children (293 boys, 301 girls) respectively. Analysis of dietary intake data was carried out using WISP© (Tinuviel Software, Anglesey, UK), which is based on the 5th (NSIFCS; Holland *et al*. 1995) and 6th (NCFS) editions (Food Standards Agency, 2002) of *McCance and Widdowson's The Composition of Foods*. Under-reporters (UR's) were excluded from the analysis. Adults with a ratio of Energy Intake (EI) to Basal Metabolic Rate (BMR) <1.05 (Black, 2000) were classified as UR's. In children, BMR was predicted for each child from standard equations using measured body weight & height (Schofield *et al.* 1985). Minimum energy intake cut-off points, calculated as multiples of BMR (Torun *et al.* 1996), were used to identify UR's.

	Adults (*n=776*)		Children (*n=401*)	
Food Groups	Na (g/d)	% total	Na (g/d)	% total
Meat & fish	0.97	29.8	0.57	25.2
Cured/processed meats	0.67	20.5	0.40	17.4
Meat/meat dishes	0.23	6.9	0.14	6.1
Fish/fish dishes	0.08	2.4	0.04	1.7
Bread & rolls	0.84	25.9	0.46	20.9
Milk & milk products	0.27	8.5	0.24	11.0
Soups, sauces & miscellaneous foods	0.23	7.0	0.13	5.7
Spreading fats	0.19	5.9	0.06	2.8
Biscuits/cakes/pastries/confectionary	0.15	4.5	0.20	9.6
Breakfast cereals	0.14	4.2	0.18	8.4
Ready to eat breakfast cereals	0.13	4.1	0.18	8.3
Other	Trace	0.1	Trace	0.1
Vegetables/processed vegetables	0.13	4.0	0.08	3.5
Savouries (e.g. pizza, mixed pasta dishes)	0.09	2.9	0.13	5.8
Other foods	0.24	7.3	0.15	7.1
Total	3.25	100.0	2.2	100.0

Mean daily salt intakes (Na * 2.5; g) from food sources only (5–6 year olds, 4.7; 7–10 year olds, 5.7; 11–12 year olds, 6.4; 18–64 year olds, 8) exceed target levels (5–6 year olds, 3; 7–10 year olds, 5; 11–12 year olds, 6; 18–64 year olds, 6) for total salt established by the Food Safety Authority of Ireland (2005) for all age groups. Meat & fish (especially cured & processed meats) and bread & rolls are the main contributors to food salt intakes. Estimated salt intake from food sources only are lower (15–20% in adults) than total salt intake which can only be measured from urinary Na excretion.

This project was funded by the Irish Government under the National Development Plan 2000–2006.

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Contribution of fortified foods (FF) to nutrient intakes in Irish children aged 5–12 years. By E.M. HANNON and A. FLYNN, *Department of Food and Nutritional Science, University College Cork, Cork, Republic of Ireland*

The aim of this study was to estimate the % contribution of FF to macro and micronutrient intakes and to estimate the impact of fortification on the prevalence of inadequate intake and risk of excess intake of micronutrients in Irish children aged 5–12 years. Analysis is based on the National Children's Food Survey, carried out between April 2003 and April 2004, which established a database of habitual food and drink consumption in a representative sample of 594 (293 boys, 301 girls) Irish children aged 5–12 years. A 7-d weighed food record was used to collect food intake data and analysis of dietary intake data was carried out using WISP© (Tinuviel Software, Llanfechell, Anglesey, UK), which is based on the 6th edition of *McCance and Widdowson's The Composition of Foods* (Food Standards Agency, 2002). In the total population FF, i.e. containing one or more added nutrients (*n* 189; 9.7% the 1945 food codes consumed), contribute on average 9% to mean daily energy intakes. For the purposes of the present study fortification refers to the voluntary addition of nutrients to foods and excludes mandatory fortification (Hannon *et al*. 2006).

In relation to their % contribution to mean daily intakes (MDI) of energy, FF contribute lower percentages of MDI of protein (6) total fat (2.8), saturated fat (2.4), monounsaturated fat (2) and polyunsaturated fat (5.9), higher percentages of MDI of total carbohydrate (13.3) and starch (17.6) and the same percentage of MDI of total sugars (9). Relative to their contribution to energy intakes, FF contribute higher percentages of MDI of Fe (33), folate (30), vitamin B_6 and thiamin (28), riboflavin (26), niacin (21), vitamin D and pantothenic acid (15), Na (12), Mg and vitamin E (11), Ca, Cu, biotin and vitamin B_{12} (9–10). The percentage with MDI less than the average requirement (AR; Food Safety Authority of Ireland, 1999) is reported as an estimate of the prevalence of inadequate intakes (Carriquiry, 1999) in consumers of fortified foods (boys 99%, girls 97%), including and excluding added nutrients.

	Percentage with MDI<AR			
	Boys (*n* 290)		Girls (*n* 293)	
	Added nutrients not included	Added nutrients included	Added nutrients not included	Added nutrients included
Vitamin A	23	22	26	24
Riboflavin	21	8	23	13
Vitamin B_6	13	3	17	3
Folate	57	20	67	35
Vitamin C	13	10	13	10
Ca	32	28	42	35
Fe	75	28	85	51

The impact of fortification on risk of excess intake of micronutrients was assessed by examining the 95th percentile (P95) of intake as a % of the tolerable upper intake level (UL) (EFSA, 2006). The P95 (% UL) increased from 72% to 76% for retinol, from 25% to 34% for vitamin B6 and from 24% to 25% for vitamin D, excluding and including 'added nutrient', respectively. Voluntary fortification of foods significantly improves adequacy of intake of riboflavin, B6, folate & iron and does not contribute to an increased risk of adverse effects from excessive intake of any micronutrient.

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Contribution of nutritional supplements to micronutrient intakes in Irish children aged 5–12 years. By E. WALSH, E.M. HANNON and A. FLYNN, *Department of Food and Nutritional Science, University College Cork, Cork, Republic of Ireland*

The National Children's Food Survey (NCFS) was carried out between April 2003 and April 2004 to establish a database of habitual food and drink consumption in a representative sample of Irish children aged 5–12 years. A 7 d weighed food record was used to collect food intake data from 594 children (293 boys, 301 girls). Analysis of dietary intake data was carried out using WISP© (Tinuviel Software, Llanfechell, Anglesey, UK), which is based on the 6th edition of *McCance and Widdowson's The Composition of Foods* (Food Standards Agency, 2002). The objectives of this study were to estimate the prevalence of supplement use and the contribution of supplements to mean daily intakes and adequacy of micronutrients. Nutritional supplement use was recorded by the respondent and/or their parents or guardians in the food diary, and current supplement use was also assessed in a self-administered questionnaire, completed by a parent or guardian. New food codes for all nutritional supplements (*n* 57) consumed by respondents during the survey were added to the food composition database.

About 27% of boys (*n* 80) and 22% of girls (*n* 66) consumed a nutritional supplement at least once during the 7 d of recording. Of the fifty-seven nutritional supplements consumed during the NCFS, 44% (*n* 25) were multivitamins and minerals, 19% (*n* 11) were multivitamins, 14% (*n* 8) were fish or cod liver oils and 12% (*n* 7) were vitamin C supplements. Among users, supplements contributed significantly to mean daily micronutrient intakes (%) for vitamin C (37, *n* 123), vitamin D (69, *n* 108), retinol (60, *n* 106), vitamin E (44, *n* 74), vitamin B_6 (32, *n* 52), thiamin (34, *n* 49), riboflavin (34, *n* 49), niacin (22, *n* 44), vitamin B_{12} (24, *n* 44), Fe (28, *n* 42), folate (32, *n* 41), Ca (12, *n* 32), Zn (20, *n* 29), Mg (7, *n* 23), Mn (12, *n* 21), Cu (22%, *n* 21) and carotene (31, *n* 8). The percentage with mean daily intakes (MDI) greater then the average requirement (AR; Food Safety Authority of Ireland, 1999) is reported as an estimate of the prevalence of inadequate intakes (Carriquiry, 1999), in both supplement users (from all sources and from food sources only, excluding supplements) and non-users, for selected micronutrients.

	Percentage with MDI<AR		
	Supplement users (*n* 146)		
Micronutrient	Food and supplements	Food only	Non-users (*n* 448)
Ca	26.7	28.8	33.0
Fe	28.8	32.9	44.0
Zn	26.0	29.5	33.5
Vitamin C	1.4	6.8	11.4
Folate	15.1	17.1	30.8
Riboflavin	7.5	12.3	11.6
Vitamin A	9.6	23.3	28.1

In users the removal of supplements from the analysis resulted in increases in the percentage with MDI<AR of between 2 and 5 for all micronutrients, except vitamin A, for which the increase was 13. The percentage with MDI<AR from food sources only was lower in users compared with non-users for Ca, Zn, vitamin C and vitamin A (by between 4 and 5), but especially for Fe (users 33, non-users 44) and folate (users 17, non-users 31).

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Determinants of 25-hydroxyvitamin D levels in a representative sample of Northern Irish adolescents. By T. HILL[1], A. COTTER[1], J. WALLACE[3], P.J. ROBSON[3], C. BOREHAM[3], W. DUBITZKY[3], L. MURRAY[4], A. FLYNN[1], M. KIELY[1] and K.D. CASHMAN[1,2], [1]*Department of Food and Nutritional Science and* [2]*Department of Medicine, University College, Cork, Republic of Ireland,* [3]*Northern Ireland Centre for Food and Health, University of Ulster, Coleraine, UK and* [4]*Department of Epidemiology and Public Health, Queens University, Belfast, UK*

Suboptimal vitamin D status, as measured by serum 25-hydroxyvitamin D (S-25(OH)D), is considered to be an important determinant of peak bone mass in adolescents. We have recently shown that suboptimal S-25(OH)D levels are quite common in this group of adolescents, especially during wintertime and springtime (Hill *et al*. 2005). The objective of the present study was to investigate the determinants of S-25(OH)D levels in these adolescents throughout the year.

Serum samples for the present study were obtained from the Northern Ireland Young Heart's Project (Gallagher *et al*. 2002). S-25(OH)D was estimated by enzyme-immunoassay (IDS Ltd, Boldon, Tyne and Wear, UK). In total, the determinants of S-25(OH)D levels were examined in 912 adolescents aged either 12 or 15 years at the time of blood sampling (457 boys and 455 girls). A multiple linear regression model was fitted between natural logarithm transformed values of S-25(OH)D and possible explanatory variables. The following categorical variables were included: season (coded as: 0 winter–spring, 1 summer–autumn), gender (coded as: 0 females, 1 males), age-group (coded as: 0 15 year olds, 1 12 year olds), pubertal status (coded as: 0 post-pubertal, 1 prepubertal), smoking (coded as: 0 non-smoker, 1 smoker). The following continuous numerical variables were included: total vitamin D intake (μg/d; from food and supplements), Ca intake (mg/d; from food and supplements), BMI (kg/m^2) and physical activity score (1–100).

	B	SE	Significance (*P*)	95% CI for B	
Vitamin D intake*†	0.083	0.018	<0.001	0.048	0.118
Season, summer–autumn	0.447	0.027	<0.001	0.393	0.500
Physical activity score	0.002	0.001	0.018	0.000	0.004
Ca intake*†	0.000	0.036	0.993	−0.071	0.070
Smoking	−0.026	0.040	0.519	−0.105	0.053
Age-group, 12-yearolds	0.100	0.065	0.123	−0.027	0.227
BMI	0.004	0.004	0.247	−0.003	0.012
Pubertal status, prepubertal	−0.056	0.066	0.400	−0.185	0.074
Gender, males	0.001	0.029	0.962	−0.056	0.058

* ln values were used for dietary data.
† Dietary data was obtained using a one month diet history method.

Median (SD) daily calcium intakes in the entire group of adolescents (*n* 912) was 907 (390) mg. Summer–autumn season and vitamin D intake had strong positive associations with S-25(OH)D levels ($P<0.001$). Physical activity score had a weaker but significant positive association ($P=0.018$) with S-25(OH)D levels in these subjects. The other possible explanatory variables that were included in the model had non-significant associations ($P>0.05$) with S-25(OH)D. Approximately 25% of the total variation in S-25(OH)D levels were explained by the variables included in the model.

In conclusion, increasing total vitamin D intake is a dietary-based strategy, which may protect against suboptimal vitamin D status in adolescents, particularly in winter months.

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Maternal vitamin D insufficiency during pregnancy in an ethnically-diverse population. By L. BROUGH[1], G.A. REES[1], M.A. CRAWFORD[1], P. TIMMS[2] and T. VENTON[2], [1]*Institute of Brain Chemistry and Human Nutrition, London Metropolitan University, 166–220 Holloway Road, London N7 8DB, UK and* [2]*Homerton Hospital, Homerton Row, London E9 6SR, UK*

Low maternal vitamin D status during pregnancy can result in adverse effects on the infant such as rickets (Prentice, 2003). Hackney in the East End of London has an ethnically-diverse population with high levels of social and economic deprivation. Previous research in Hackney has shown that many women during pregnancy have poor micronutrient status (Rees *et al*. 2005) and low dietary intakes for many micronutrients, including vitamin D (Doyle, 1999). The major source of vitamin D is from sun exposure; however, highly-pigmented skin is less effective at producing vitamin D. Also some ethnic minorities restrict exposure to sunlight by covering up with clothing for cultural or religious reasons. This study aimed to investigate vitamin D status in an ethnically diverse group living in Hackney.

As part of a larger study concerning nutrition during pregnancy 2383 women were identified as potential participants at their first antenatal appointment at the Homerton Hospital, Hackney. 402 women agreed to take part; gestation varied between 5 and 17 weeks (mean 11 weeks and 5 d).

Venous blood samples were taken with the participants' consent. Vitamin D status was assessed on 145 samples (gestation ranged from 7 to 17 weeks (mean 12 weeks and 1 d)) at the Homerton Hospital using blood plasma stored at −70°C. The amount of 25-hydroxycholecalciferol in plasma was measured directly using HPLC with UV detection using internal standards from Chromsystems (Manchester, UK). These participants were ethnically diverse comprising (%): Caucasian, 41; Asian, 15; African, 27; West Indian, 10; others, 8.

A plasma 25-hydroxycholecalciferol concentration <50 nmol/l is regarded as insufficient, although this is controversial. Using this definition there was considerable ethnic variation concerning prevalence of insufficiency. There were also significant differences in median vitamin D concentrations by ethnicity during the summer ($P<0.001$; Kruskall-Wallis) but not the winter.

		Plasma 25-hydroxycholecalciferol (nmol/l)				
		n	Median	IQR	Range	Percentage <50 nmol/l
Winter	African	19	37.0	16.0	9–73	84
	Asian	13	31.0	36.0	9–74	85
	Caucasian	28	43.5	24.0	11–87	57
	West Indian	10	35.0	40	19–70	70
	Other	6	35.0	17	19–43	100
	Whole group	*76*	*38.0*	*26.3*	*9–87*	*74*
Summer	African	20	34.0	20.0	15–75	85
	Asian	9	26.0	27.0	9–44	100
	Caucasian	31	52.0	49.0	20–146	39
	West Indian	4	39.0	37.0	28–72	75
	Other	5	35.0	14.0	22–39	100
	Whole group	*69*	*40.0*	*27.5*	*9–146*	*67*

* Summer is defined as April to September and Winter is defined as October to March.

The present study demonstrates considerable vitamin D insufficiency amongst this population that could result in adverse Ca handling for both mother and fetus. These results corroborate a previous study showing the poor vitamin D status during pregnancy of women from ethnic minorities in the UK (Datta *et al*. 2002). This is of concern in the light of a recent study showing that childhood bone mass at age 9 years is related to maternal vitamin D status during pregnancy (Javaid *et al*. 2006).

Further research is required to better understand the extent of vitamin D insufficiency during pregnancy and the need for targeted intervention studies to prevent low circulating concentrations of vitamin D during pregnancy.

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Assessment of 25-hydroxyvitamin D and 1,25-dihydroxycholecalciferol concentrations in male and female patients with multiple sclerosis and control volunteers. By M.S. BARNES[1], M.P. BONHAM[1], P.J. ROBSON[1], J.J. STRAIN[1], A.S. LOWE-STRONG[2], J. EATON-EVANS[1], F. GINTY[3] and J.M.W. WALLACE[1], [1]*Northern Ireland Centre for Food & Health (NICHE), University of Ulster, Coleraine BT52 1SA, UK,* [2]*Health & Rehabilitation Sciences Research Institute, University of Ulster, Jordanstown BT37 0QB, UK and* [3]*MRC Human Nutrition Research, Elsie Widdowson Laboratory, Cambridge CB1 9NL, UK*

Epidemiological studies have shown that populations who have insufficient UV exposure and consume diets low in vitamin D have low vitamin D status, as evidenced by low plasma 25-hydroxyvitamin D (25(OH)D) concentrations (Munger *et al*. 2004; Soilu-Hanninen *et al*. 2005). Many of these populations also report increased incidence of the autoimmune disorder multiple sclerosis (MS). 1,25-Dihydroxycholecalciferol (1,25$(OH)_2D_3$), the hormonally-active form of vitamin D, is a potent immunoregulatory molecule that may play a role in MS, but to date no study has assessed 1,25$(OH)_2D_3$ concentrations in individuals with this condition.

Twenty-nine individuals with MS and twenty-two healthy age- and sex-matched control volunteers were sampled concurrently in early spring, the nadir for vitamin D status. Non-fasting blood samples were collected in early afternoon within a 2 hr period to minimise variation. Plasma concentrations of 25(OH)D and 1,25$(OH)_2D_3$ were measured using commercially available ELISA and RIA kits respectively (IDS Ltd, UK).

	Individuals with MS (*n* 29) (ten males, nineteen females)		Control volunteers (*n* 22) (ten males, twelve females)		
	Mean	SD	Mean	SD	*P* value‡
Plasma 25(OH)D (nmol/l)					
All	69.1	40.0	67.1	28.8	0.831
Males (*n* 20)	50.2	15.3	59.5	19.8	0.253
Females (*n* 31)	79.1	45.4*	73.4	34.2	0.713
Plasma 1,25$(OH)_2D_3$ (pmol/l)					
All	92.3	37.4	80.3	26.1	0.353
Males (*n* 20)	70.4	28.7	67.5	14.4	0.778
Females (*n* 31)	103.8	36.8*	91.0	29.3†	0.319

Mean values were significantly higher than those for males with MS: * P=0.019.
Mean values were significantly higher than those for male control volunteers: † P=0.032.
‡ Obtained from independent samples *t* tests.

There were no significant differences in the concentrations of either metabolite between individuals with MS and control volunteers. However, women with MS had significantly higher 25(OH)D and 1,25$(OH)_2D_3$ concentrations than men with MS. Significant positive correlations between 25(OH)D and 1,25$(OH)_2D_3$ concentrations were observed in all subjects (r 0.564, P=0.000). Subsequent analysis revealed that the correlation was driven by women with MS (r 0.677, P=0.001). While plasma 25(OH)D concentrations >50 nmol/l are thought to be adequate for bone health, it is thought that concentrations >100 nmol/l may be required for optimal immune function (Vieth, 2004).

Circulating concentrations of vitamin D metabolites were not altered in individuals with MS, relative to apparently-healthy control volunteers. However, given the results of a recent study on an animal model of MS, experimental autoimmune encephalomyelitis, we cannot rule out the possibility that vitamin D metabolism may be altered at a local level within the central nervous system (Spach & Hayes, 2005). We speculate that our observation of sex differences in vitamin D metabolism may be mediated through the action of sex hormones, most likely oestrogen. This hypothesis requires further investigation.

Munger KL, Zhang SM, O'Reilly E, Hernan MA, Olek MJ, Willett WC & Ascherio A (2004) *Neurology* **62**, 60–65.
Soilu-Hanninen M, Airas L, Mononen I, Heikkila A, Viljanen M & Hanninen A (2005) *Multiple Sclerosis* **11**, 266–271.
Spach KM & Hayes CE (2005) *Journal of Immunology* **175**, 4119–4126.
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Vitamin K status and bone health indices in Danish girls. By E.M. OCONNOR[1], C. MØLGAARD[3], K.F. MICHAELSEN[3], J. JAKOBSEN[4], C.J.E. LAMBERG-ALLARDT[5] and K.D. CASHMAN[1,2], [1]*Department of Food and Nutritional Sciences and* [2]*Department of Medicine, University College Cork, Cork, Republic of Ireland,* [3]*Department of Human Nutrition, Centre for Advanced Food Studies, The Royal Veterinary and Agricultural University, Frederiksberg, Denmark,* [4]*Danish Institute for Food and Veterinary Research, Söborg, Denmark and* [5]*Calcium Research Unit, Department of Applied Chemistry and Microbiology, University of Helsinki, Finland*

There has been much research into the role of vitamin K in adult bone health (Weber, 2001); however, less is known about the impact of vitamin K status on childhood bone health. Recent cross-sectional data suggest that better vitamin K status in young girls (aged 3–16 years) is associated with a reduced rate of bone turnover, even though it is not associated with bone mineral content (BMC; Kalkwarf *et al*. 2004). The objective of the present study was to investigate the relationship between the percentage of undercarboxylated osteocalcin (%ucOC) in serum, as an index of vitamin K status (Szulc *et al*. 1993), and BMC and biochemical indices of bone resorption in peri-pubertal Danish girls. This peri-pubertal stage is a dynamic period of bone development and, as such, may represent an important window of opportunity for vitamin K status to modulate childhood bone health.

Baseline data on serum 25-hydroxyvitamin D, urinary pyridinoline and deoxypyridinoline (markers of bone resorption) as well as BMC of the total body and lumbar spine from 223 healthy Danish girls (aged 11–12 years), who participated in a 12-month vitamin D intervention trial (as part of the OPTIFORD project (www.optiford.org)), were used for the present study. Serum (intact) osteocalcin as well as ucOC levels were assessed using an ELISA (Metra™ Osteocalcin EIA Kit, Quidel Corporation, CA, USA). ucOC was expressed as the percentage of total osteocalcin.

	Serum %ucOC		
Bone health index	β	SE	*P* values
Urinary pyridinoline	−0.209	0.142	0.143
Urinary deoxypyridinoline	−0.072	0.128	0.575
BMC total body	−0.045	0.017	0.016
BMC lumbar spine	−0.055	(0.026)	0.037

Regression coefficients (β) were generated from natural log-transformed data. All regression models included pubertal maturation, weight, vitamin D status, dietary Ca and bone area (for BMC relationships).

There was an inverse relationship between serum %ucOC and 25-hydroxyvitamin D (r=−0.143; P=0.035). Our findings suggest that better vitamin K status was associated with increased BMC after adjustment for possible confounders including vitamin D status, but not bone resorption, in healthy peri-pubertal Danish girls. There is a need for well-designed randomised phylloquinone-supplementation trials in children and adolescents to confirm epidemiological findings of an association between vitamin K status and bone health indices.

The study was supported with funding from the European Commission Fifth Framework Programme (OPTIFORD Contract no. QLK1-CT-2000-00623) and the National Development Plan (2000–2006) Dublin, Republic of Ireland.

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Moderate energy restriction influences bone turnover in overweight young adults over a period of 8 weeks. By A. LUCEY[1], G. PASCHOS[1], K.D. CASHMAN[1,2], J.A. MARTINéZ[3], I. THORSDOTTIR[4] and M. KIELY[1], [1]*Department of Food and Nutritional Sciences and* [2]*Department of Medicine, University College Cork, Republic of Ireland,* [3]*Department of Physiology and Nutrition, University of Navarra, Spain and* [4]*Unit for Nutrition Research, Landspitali University Hospital, Iceland*

A high *n*-6:*n*-3 fatty acids in the diet is associated with low bone mineral density in men and women >45 years old (Weiss *et al.* 2005). Moderate energy restriction increases bone resorption in obese post-menopausal women (Ricci *et al.* 2001). The aim of the present study was twofold: to investigate the effect of energy restriction and weight loss on biomarkers of bone metabolism and to see if the inclusion of fish and/or fish oil in the diet had any influence on these markers. Thus, in addition to following a strict hypoenergetic diet for 8 weeks (30% energy restriction relative to requirements), 248 men and women aged 20–40 years, BMI 27–33 kg/m^2, from Iceland, Spain and Ireland were randomised to one of four groups: (1) placebo (sunflower oil capsules) 3 g/d; (2) 3×150 g portions of cod/week; (3) 3×150 g portions of salmon/week; (4) fish oil capsules 3 g/d during January–May 2005.

Body weight and composition, biomarkers of bone formation (serum osteocalcin (OC) and bone-specific alkaline phosphatase (BAP)) and bone resorption (serum crosslaps (CTx) and urinary N-telopeptide of type I collagen (NTx)) were measured at baseline and end point.

Of the participants 94% (*n* 233) lost weight during the study. Their mean weight loss was 5.4 (SD 2.8) kg (fat loss 3.6 (SD 2.1) kg and lean mass loss 1.8 (SD 1.7) kg). Serum levels of CTx increased, level of BAP increased (after adjusting for % weight loss), OC decreased and there was no change in NTx from baseline to end point. As there was no difference in the response of the bone biomarkers across the 4 dietary groups, data from the sample as a whole are presented below.

	Baseline			Endpoint			
Bone Marker	Mean	SD	Median	Mean	SD	Median	*P*
Markers of Bone Formation		(*n*=233)			(*n*=233)		
OC (ng/ml)	8.76	1.9	8.48	8.61	2.2	8.21	0.042
BAP (U/L)	20.70	6.5	19.79	21.06	7.3	19.67	0.016*
Markers of Bone Resorption							
NTx (nM BCE/mM creatinine)	45.59	29.9	37.10	48.33	30.5	41.59	0.097
CTx (ng/ml)	0.51	0.3	0.46	0.59	0.3	0.53	0.00

* Increase in BAP after adjusting for % weight loss.

There were significant interactions between weight loss and BAP and CTx ($P \leq 0.001$). Linear regression analysis (adjusting for age and month of entry into study) identified increased weight loss (%) as a significant predictor for the increase in BAP (adjusted R^2 0.041, P=0.001) and CTx (adjusted R^2 0.063, P<0.001) during the intervention. Decreases in lean body mass (kg; adjusted R^2 0.059, P<0.001) and fat mass (kg; adjusted R^2 0.031, P=0.005) were predictors for the percentage change in BAP, and the decrease in fat mass (kg) was a predictor for the change in CTx (adjusted R^2 0.021, P=0.016). The response of the bone markers to the weight-loss intervention was similar across the 4 intervention groups.

In conclusion, the current study suggests that a 30% energy-restricted diet which resulted in weight loss and changes in body composition increases biomarkers of bone formation and bone resorption in young overweight adults. This preliminary analysis shows that fish or fish oil did not influence biomarkers of bone turnover.

The *YOUNG* study is part of the SeafoodPLUS Integrated Project, which is funded by the EC through the 6th Framework Programme Contract no. FOOD-CT-2004-506359.

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Salmon intake reduces CCR5 expression by human CD8+ T lymphocytes. By G.K. PASCHOS[1], P. SCULLY[2], A. LUCEY[1], K. GALVIN[1], K.D. CASHMAN[1,2] and M. KIELY[1], [1]*Department of Food and Nutritional Sciences and* [2]*Department of Medicine, University College Cork, Cork, Republic of Ireland*

The chemokine receptor CCR5 is a G protein-coupled receptor responsible for leucocyte activation and recruitment to sites of inflammation (Murphy *et al.* 2000). Incorporation of *n*-3 fatty acids in the membrane of cells is found to change the expression of proteins on the membrane (Fan *et al.* 2004). The aim of the present study was to assess the effect of dietary *n*-3 fatty acids from fish intake on the expression of CCR5 by $CD4^+$ and $CD8^+$ T lymphocytes.

Nineteen volunteers aged between 25 and 41 years, with a BMI between 27.3 and 32.6 kg/m^2, received nutritional advice to adhere to an energy-restricted diet (30% energy deficit relative to requirements) and were randomly distributed to one of three dietary interventions for a period of 8 weeks: control group, 3 g sunflower oil (*n* 4); cod group, 140 g cod three times per week (*n* 6); salmon group, 140 g salmon three times per week (*n* 9). The cod and salmon groups served as the low- and high-*n*-3 fatty acid fish groups respectively. Mononuclear cells were isolated from peripheral blood and then stained with fluorescent anti-CD3, anti-CCR5 and anti-CD4 or anti-CD8 antibodies. Stained cells were then examined by flow cytometry for the expression of CCR5 by $CD4^+$ and $CD8^+$ T lymphocytes. The fatty acid composition of the membrane of mononuclear cells was analysed before and after the intervention using solid-phase extraction and a modified protocol of the Folch method. Lipid extracts from the phospholipid phase of the cells were analysed by GC.

The fatty acid composition of the membrane of mononuclear cells was comparable between the three groups before the intervention. Salmon intake increased the proportion of EPA in the membrane (P=0.003). There were no significant changes in the fatty acid composition of the membrane in the control and cod groups. There was no change in the expression of CCR5 by $CD4^+$ cells over the intervention in any of the groups. There was a reduction in CCR5 expression by $CD8^+$ cells in the salmon group compared with the control and cod group, after adjustment for age and weight reduction during the intervention (P=0.024), shown in the Fig. 1. The reduction in CCR5 expression by $CD8^+$ T lymphocytes in the salmon group was related to the increase in the proportion of EPA in the membrane of mononuclear cells (r 0.817, P=0.007), shown in Fig. 2.

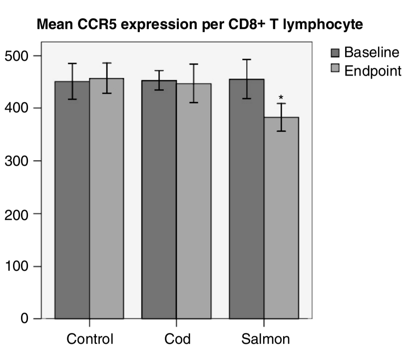

Fig. 1.

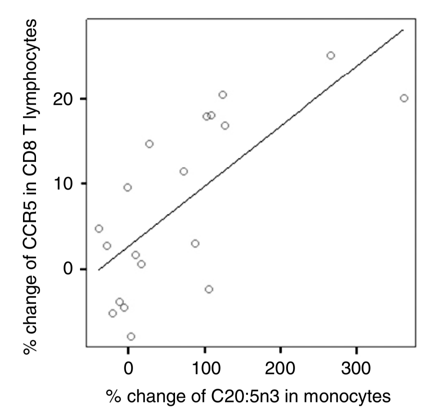

Fig. 2.

In conclusion, salmon intake reduces the expression of CCR5 on $CD8^+$ T lymphocytes, possibly by increasing the percentage EPA in the membrane of the cells. Our finding suggests a decreasing effect of salmon intake in cytotoxic T leucocyte activation and recruitment to sites of inflammation.

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Eating habits of Liverpool primary schoolchildren 2000–5. By B. JOHNSON[1], A.F. HACKETT[2], L.M. BODDY[2] and L. LAMB[3], [1]*South Liverpool Primary Care Trust, Abercromby Health Centre, Grove Street, Liverpool L7 7HG, UK,* [2]*Liverpool John Moores University, Faculty of Education, Community and Leisure, Barkhill Road, Liverpool L17 6BD, UK and* [3]*Education & Leisure Services, Liverpool City Council, Millennium House, Victoria Street Liverpool L1 6JH, UK*

What children eat is at the centre of a national debate that includes rising levels of obesity, sedentary lifestyle and school food. Many studies have commented on the poor eating habits of British children (Gregory & Lowe, 2000), including those in Liverpool (Hackett *et al*. 2002), which have been amongst the worst in Europe (Vereecken & Maes, 2000). SportsLinx is an on-going project that has collected data on dietary intake, fitness and nutritional status for cohorts of 9–10-year-old children in Liverpool (Taylor *et al*. 2004). Dietary data were collected annually from approximately 3000 children in school Year 5 (separate cohorts) over a period of 5 years (from 2000–1 to 2004–5) using a food-intake questionnaire in which children indicate whether or not they have eaten the foods listed (Johnson *et al*. 2001). Scores for the intake of key foods were calculated for positive markers (n=19, foods that children would normally be encouraged to eat more of, or more often, such as fruit and vegetables) and negative markers (n=25, foods that children would normally be encouraged to eat less of, or less often, such as sweets and sugared soft drinks). Scores were calculated by adding up the number of foods in each group which each child claimed to have consumed (Hackett *et al.* 2002).

	Mean score for positive-marker foods (*n* 19)				Mean score for negative-marker foods (*n* 25)			
School year	Boys	SE	Girls	SE	Boys	SD	Girls	SE
2000–1	3.4	0.06	3.6	0.06	9.4	0.16	9.4	0.14
2001–2	3.6	0.06	3.9	0.06	9.3	0.16	9.3	0.17
2002–3	4.3	0.14	4.2	0.13	9.7	0.14	9.3*	0.13
2003–4	4.5	0.06	4.5	0.06	9.6	0.12	8.9**	0.11
2004–5	5.4	0.07	5.5	0.06	9.4	0.12	8.4**	0.11

Mean values were significant different from the corresponding values for boys: * $P<0.05$, ** $P<0.01$.

The Table describes modest decreases in the negative-marker food score over the last 5 years in girls (ANOVA p<0.05) but not in boys (p>0.05). Both boys and girls reported increases in the mean number of positive foods consumed over the 5-year period (ANOVA p<0.05). The apparent improvement in reported eating habits is encouraging and tentatively suggests that some changes are occurring in Liverpool (although this may be in reporting food intake and not in actual consumption). The data also indicate that there is still much to do to improve the eating habits of Liverpool primary schoolchildren.

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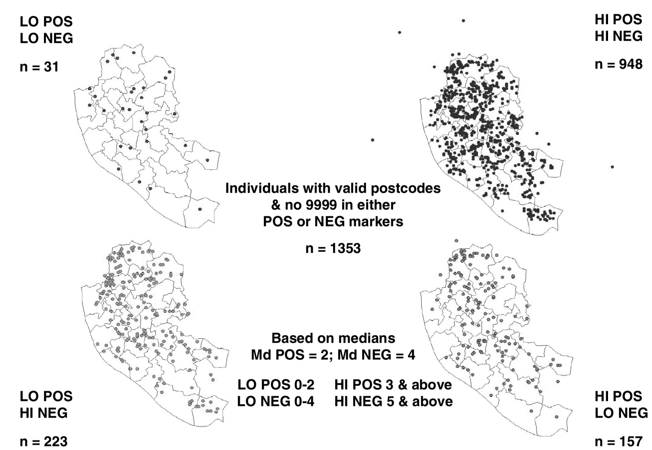
Vereecken C & Maes L (2000) *Health and Health Behaviour Among our Young People*, pp. 83–89. Copenhagen: WHO Europe.

A map of the eating habits of 10-year-old children in Liverpool: a preliminary study. By A.F. HACKETT[1], L.M. BODDY[1], J. BOOTHBY[2], B. JOHNSON[3] and G. STRATTON[1], [1]*Liverpool John Moores University, Faculty of Education, Community and Leisure, Barkhill Road, Liverpool L17 6BD, UK,* [2]*Liverpool John Moores University, Faculty of Media and Social Science, Clarence St, Liverpool L3 5UG, UK and* [3]*South Liverpool Primary Care Trust, Abercromby Health Centre, Grove Street, Liverpool L7 7HG, UK*

SportsLinx is an annual project that assesses the diet, fitness and nutritional status of an entire cohort of 9–10-year-old children in Liverpool (Taylor *et al*. 2004). The eating habits of these children leave a lot to be desired and the prevalence of overweight and obesity in Liverpool children is high (Dummer *et al.* 2005). One aim of SportsLinx is to contribute to the understanding of such problems, and there is evidence that geographical distribution may be important (Dummer *et al*. 2005).

A food-intake questionnaire, evaluated for validity and reliability, was used to record the intake of a list of key foods (Johnson *et al.* 1999; Johnson *et al*. 2001); positive markers (19 foods that children would normally be encouraged to eat more of, or more often, such as fruit and vegetables; POS) and negative markers (25 foods that children would normally be encouraged to eat less of, or less often, such as sweets and sugared soft drinks; NEG). A geographical information system (ArcView[Tm]; v3.2, Environmental Systems Research Institute, California) was used to map the intake of POS and NEG scores for boys and girls according to their home postcode using a geostatistical procedure; kernal smoothed density boundary free density (KSD) estimations (Dummer, 2002). Data from 1535 children collected between 2004–5 were plotted.

The Figure shows the raw distribution of number of children in relation to the electoral wards of Liverpool who ate above (HI) and below (LO) the median number of both marker foods. The children in the LO POS–HI NEG group would be those who might be considered to need to improve their diet the most, and those in the HI POS–LO NEG group appeared to have a more positive pattern of intake.



The present paper shows the principle of mapping dietary data and suggests that habits are not evenly distributed around the city. The KSD process identified 'hotspots' of less and more desirable eating habits. Two such areas had almost identical socio-economic profiles but were very different environmentally, for example the former having many foods outlets and latter few, the reverse was true for 'green' open space. The distribution may be related to a variety of factors, including food supply.

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Dummer T, Gibbon M, Hackett A, Stratton G & Taylor S (2005) *Public Health Nutrition* **8**, 636–641.
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Self-reported weight and height: response rates from Irish schoolchildren. By C.N.M. KELLY, M. MOLCHO, C. KELLEHER and S. NIC GABHAINN, *Health Promotion Research Centre, 12 Distillery Road, National University of Ireland, Galway, Republic of Ireland*

Self-reports of weight and height are an important health surveillance tool, although it is recognised that a bias of under-reporting of weight and over-reporting of height is likely, and thus these data alone cannot be relied on to detect weight problems (Elgar *et al*. 2005). However, the association between overweight and obesity with lifestyle habits in youth is not different when based on measured or self-reported heights and weights (Strauss, 1999). The Health Behaviour in School-aged Children (HBSC) survey uses self-reports of weight and height to examine such associations.

As part of the 2002 HBSC survey, self-reports of weight and height were collected from 8424 Irish schoolchildren aged 10–17 years. Of the Irish children surveyed 43% did not report their weight or height. Conversely, in some countries BMI could be calculated for 98% of those surveyed. Children may be more aware of their height and weight in some countries than in others due to cultural differences. Moreover, in some countries children have preventive medical examinations completed in school in which their heights and weights are measured. Both factors may help account for the differences in response rates.

In an attempt to understand the high rate of missing data in Ireland, a study was undertaken involving a total of 143 pupils, from seven classrooms across three schools (aged 12–14 years). Both parental and pupil consent were received for all participants. In each classroom pupils completed a short self-report questionnaire and participated in facilitated classroom discussion on the items included in the questionnaire. These items included questions on height and weight, but also questions on whether pupils had weighing scales in their home and when they had last checked their height and weight. In addition, those who did not answer the questions on height and weight were presented with an open question asking them why not. Data collection took place in September 2005.

Only 39% of students recorded their weight and/or height. The reasons the students did not respond are provided in the table. In the subsequent classroom discussions, few questioned the relevance of these questions to the study of youth health, but pupils did point out that the questions were potentially sensitive, personal and possibly embarrassing, especially for those who are overweight. This was particularly the case for the question on weight rather than height. Nevertheless, the classroom discussion confirmed that the most frequent explanation for these missing data were that children simply did not know the answers.

Reasons for missing data on weight and height	Non-responders (%)
Do not know weight/height	56
Question too personal	16
Had not checked recently	11
Forgotten	9
Did not know without clothes	3
Too embarrassed	2
Did not think about it	2

The extent of missing data in this and similar self-report studies has obvious implications for the usefulness of these datasets. There would be substantial practical and ethical difficulties in attempting to reduce the missing data through pre-warning children or parents of the questions or conducing direct measurement in schools. It is therefore crucial that we investigate and report on the likely extent of error in population estimates based on such limited datasets.

HBSC Ireland was funded by the Department of Health and Children. We thank all the children and schools for taking part.

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Relative validity of a food-frequency questionnaire for preschool children compared with a 4 d diet diary. By L.C.A. CRAIG and G. McNEILL, *Department of Environmental and Occupational Medicine, University of Aberdeen, Aberdeen AB25 2ZP, UK and Rowett Research Institute, Aberdeen, AB21 9SB, UK*

Semi-quantitative food-frequency questionnaires (FFQ) are often used in large epidemiological studies to rank individuals in terms of nutrient intakes in order to assess odds ratios or relative risks of diseases in relation to nutrient intakes. To have confidence in the results of such studies we need to know the validity of the questionnaire. The aim of the present study was to assess the relative validity of a parent-completed 121-item semi-quantitative FFQ for preschool children (Scottish Collaborative Group version C1) with non-weighed-diet diaries.

Parents of children attending twenty-five nurseries in Aberdeen city, Scotland were invited to take part in the study. Eighty parents completed diet diaries for their children, who were on average 4.2 (SD 0.5) years. Parents completed the FFQ on average 2.2 (SD 1.2) months after completing the diet diary, as the FFQ asks about intake over the past 2–3 months and so would encompass the period of the diary. The FFQ contained a small-portion measure for each food and nine choices for frequency of consumption ranging from ‘rarely or never’ to ‘7 or more per day’. As the diet diary was non-weighed, the booklet contained some pictures of foods to help with portion estimation along with instructions of useful measures for different foods (Nelson *et al*. 2002). The upper and lower 2.5 percentiles of energy intake from FFQ were excluded from the analysis to remove outliers (four subjects). Energy-adjusted nutrient intakes were calculated as the residuals from the regression of nutrient intake *v*. energy intake. Nutrient intakes from supplements were not included in the analyses. Relative agreement was assessed using Spearman rank correlation coefficients and cross-classification of the percentage of subjects in the same and opposite thirds of intake, the results of which are shown in the Table.

	FFQ		Diet diary		Spearman rank correlation		Percentage agreement	
	Median	Interquartile range	Median	Interquartile range	r_s	P	Same thirds	Opposite thirds
Energy (kJ)	6360	5675–8465	5481	4722–6219	0.38	0.001	44.7	7.9
Fat: g	55	46–72	50	42–56	0.31	0.007	47.4	18.4
% energy	33	29–35	35	32–37	0.32	0.004	46.1	14.4
SFA: g	26	21–35	21	17–26	0.31	0.006	44.8	15.8
% energy	15	12–17	14	13–17	0.34	0.003	36.9	15.8
Sugar: g	112	94–140	95	77–111	0.27	0.021	46.1	19.7
% energy	27	24–30	28	25–32	0.25	0.030	48.7	17.1
NSP (g)	10	7–13	7	5–9	0.47	0.000	47.4	10.6
Vitamin E (mg)	5.4	4.6–7.1	3.6	3.1–4.3	0.53	0.000	52.6	7.8
Vitamin D (μg)	1.3	1.0–1.8	0.8	0.5–1.3	0.31	0.007	40.8	17.1
Vitamin C (mg)	107.5	74.3–141.5	85.3	56.0–117.5	0.28	0.013	53.9	14.5
Retinol (μg)	310.0	213.5–381.5	236.5	144.5–283.8	0.27	0.016	40.8	14.5
β-Carotene (μg)	1997.1	1046.3–2803.5	916.0	364.8–1876	0.52	0.000	48.6	6.6
Fe (mg)	7.8	6.7–9.7	5.5	4.6–6.9	0.52	0.000	46.0	6.5
Ca (mg)	904.5	666.5–1206.8	764.0	585.5–913.8	0.39	0.001	47.4	15.8
Zn (mg)	6.9	5.4–8.8	4.9	4.1–6.1	0.37	0.001	40.8	11.9

The smallest differences for absolute intakes between the FFQ and the diet dairy were for percentage energy from fat, saturated fat (SFA) and sugar. It has been recommended that for good relative agreement Spearman correlation coefficients should be >0.5 with >50% of subjects correctly classified and <10% grossly misclassified into thirds (Masson *et al*. 2003). For this FFQ Spearman rank correlation coefficients ranged from 0.25 to 0.53 and were >0.5 for vitamin E, β-carotene and Fe. The percentage of subjects classified in the same thirds ranged from 36.9 to 53.9 and was >50 for vitamin C and vitamin E. The percentage of subjects classified in opposite thirds ranged from 6.5 to 19.7 and was lowest for Fe, with β-carotene, vitamin E and energy also being <10. Studies using the questionnaire should take account of the validity for the nutrients of interest.

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Nelson M, Atkinson M & Meyer J (2002) *A Photographic Atlas of Food Portion Sizes*. London: Food Standards Agency Publications.

Maternal education is associated with mis-reporting of energy intake in parent records of child's diet. By L. JOHNSON[1], A.P. MANDER[1], L.B. JONES[2], P.M. EMMETT[2] and S.A. JEBB[1], [1]*MRC Human Nutrition Research, Cambridge CB1 9NL, UK and* [2]*ALSPAC, University of Bristol BS8 1TQ, UK*

It is widely recognized that dietary data is susceptible to reporting errors. In most dietary surveys energy intake (EI) is biased towards under-reporting and this phenomenon is more common in overweight adults and children (Livingstone & Robson, 2000). For studies of young children, where the parent is the primary record-keeper, parental characteristics may also be important. In adults higher rates of under-reporting of EI have been associated with less education (Maurer *et al*. 2006); however, the effect of maternal education on the validity of their child's diet record is unknown.

Diet data were collected in a random subsample of children from a prospective cohort study in Avon, England (*n* 801) at age 7 years using 3 d unweighed diet diaries completed by the parents. Mis-reporting was assessed using EI:estimated energy requirements (EER; calculated using body weight; Torun, 2005). Reported EI <79 % EER or >121 % EER was lying outside the range of normal measurement error (CV_t from Black & Cole, 2000) and was defined as under-reporting (UR) or over-reporting (OR) respectively.

Mean EI:EER was 0.99 (SD 0.20) and 72.2 % of children had plausible reports (PR) of EI, 14.4 % under-reported and 13.5 % over-reported. UR children were taller and heavier, and had a higher BMI and waist circumference as well as a higher prevalence of overweight (International Obesity Task Force BMI cut-off) compared with PR and OR. Parental BMI were significantly greater in UR children. Children of mothers with the lowest education (Certificate of Secondary Education; CSE) were more likely to be classed as UR and degree-educated mothers had a larger proportion of children with EI biased towards OR.

		UR		PR		OR	
		Median	IQR	Median	IQR	Median	IQR
Height (m)‡		1.272^{a}	0.060	1.254^{b}	0.051	1.240^{c}	0.044
Weight (kg)		27.6^{a}	24.2–32.4	24.6^{b}	22.6–27.4	23.4^{c}	21.8–25.8
BMI (kg/m^2)		17.1^{a}	15.6–19.5	15.7^{b}	14.9–16.8	15.4^{c}	14.6–16.3
Waist circumference (cm)		58.5^{a}	55.1–64.5	55.6^{b}	53.2–58.2	54.5^{c}	52.6–57.0
Prevalence of overweight children (%)*		45		10.4		0.9	
Maternal BMI (kg/m^2)		23.07^{a}	21.5–26.9	22.32^{b,c}	20.7–24.4	21.64^{b,c}	20.2–23.4
Paternal BMI (kg/m^2)		26.08^{a}	23.9–28.7	24.84^{b}	23.2–26.7	24.39^{c}	21.6–25.7
Maternal education (ME)†	% with CSE	16.8		8.1		5.7	
	% with Degree	8.8		18.3		25.0	

IQR, interquartile range. ^{a,b,c} Values within a row with unlike superscript letters were significantly different (P<0.05; t and Mann Whitney U tests). * P<0.0001. † P=0.006. ‡ Mean differences and standard deviations by misreporting group by χ^2 test.

Multiple regression showed that the association between EI:EER and ME was independent of maternal BMI (maternal BMI β −0.01, P=0.0004; ME β 0.02, P=0.005). Paternal education (PE) was related to EI:EER in the same way; however, after adjustment for paternal BMI the association was no longer significant (paternal BMI β −0.013, P<0.0001; PE β 0.009, P=0.140). Differential UR by ME will lead to bias in diet survey data. Research is necessary to identify the causes of under-reporting in families with less education in order to improve diet records in this group and clarify relationships between diet, family education and health outcomes.

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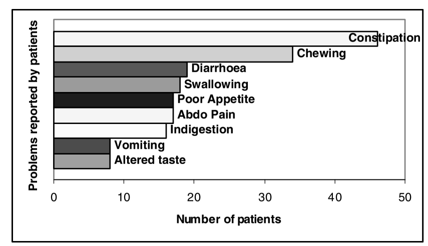
Torun B (2005) *Public Health Nutrition* **8**, 968–993.

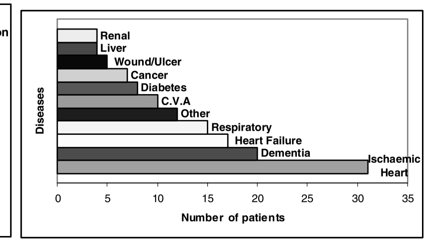
Oral nutritional supplements in the community in Ireland: who is using them? By S. KENNELLY[1], S. SUGRUE[2], N.P. KENNEDY[3], G. FLANAGAN[1] and C. GLENNON[1], [1]*Community Nutrition & Dietetics Department, Health Service Executive Dublin Mid Leinster, Pearse House, 28 Pearse Street, Co. Westmeath, Republic of Ireland,* [2]*Department of Biological Sciences, Dublin Institute of Technology Kevin Street, Dublin, Republic of Ireland and* [3]*Department of Clinical Medicine, Trinity College Dublin, Republic of Ireland*

Increasing health service spending on oral nutritional supplements (ONS) has focused attention on their use. A review of evidence for the use of ONS in the community has revealed that their beneficial effects are significantly greater in undernourished patients (BMI <20 kg/m^2; Stratton *et al*. 2003). There are few data available describing the use of ONS in the community in the Republic of Ireland. The aim of this study was to obtain baseline information on patients prescribed ONS by a group of general medical practitioners (GP) in Co. Westmeath.

GP were considered eligible if they had >500 patients with a medical card, and had facilities for a dietetic clinic at their practice. A total of ten of seventeen eligible GP participated in the study. During a 3-month study period participating GP referred all adult patients prescribed ONS, excluding special ONS (e.g. for metabolic disorders). Eighty-nine patients were referred, of whom seventy-eight (sixteen male, sixty-two female, mean age 79 years) consented and were assessed by a dietitian. The majority were seen in their own home, others in nursing homes or in their GP's surgery. Nutritional risk was assessed using the Malnutrition Universal Screening Tool (MUST; Malnutrition Advisory Group, 2000).

Twenty-eight patients lived in nursing homes or state residential homes, and fifty lived in their own home or a relative's home (of these twenty-seven lived alone). The majority (sixty-three of seventy-eight) of patients, were ambulant. The remainder (fifteen of seventy-eight) were either chair-bound or bed-bound. Data shown below describes gastrointestinal disturbances and other problems affecting appetite reported by patients, and also the range of diseases experienced among patients.





According to the MUST results, thirty-one of seventy-eight patients were at 'low risk', eighteen of seventy-eight was at 'medium risk', and twenty-nine of seventy-eights were at 'high risk' of malnutrition. Notably, only thirty-six of seventy-eight had a BMI <20 kg/m^2. Of fifty-three patients in whom weight and height could be measured nine of fifty-three were overweight (BMI 24.9–29.9 kg/m^2) and five of fifty-three were obese (BMI >30 kg/m^2). Fifty-six of seventy-eight patients were prescribed ONS for >6 months. Milk-based high-energy sip feeds were the most-commonly-prescribed supplements (Fifty-six of seventy-eight).

In the present study the majority of patients prescribed ONS in the community were older females and many had multiple chronic diseases. ONS were being prescribed to many patients who were not classified by MUST to be at significant risk of malnutrition and some were overweight or obese. The present study supports the need for structured evidence-based assessment of patients before the prescribing of ONS in the community.

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Dietary fibre (DF) and NSP intake in Irish children aged 5–12 years. By C. DEASY, J. WALTON, E.M. HANNON and A. FLYNN, *Department of Food and Nutritional Science, University College Cork, Cork, Republic of Ireland*

The National Children's Food Survey (NCFS) was carried out between April 2003 and April 2004 to establish a database of habitual food and drink consumption in a representative sample of Irish children aged 5–12 years. A 7 d weighed-food record was used to collect food intake data from 594 children (293 boys, 301 girls). Analysis of dietary intake data was carried out using WISP© (Tinuviel Software, Llanfechell, Anglesey, UK) which is based on the 6th edition of *McCance and Widdowson's The Composition of Foods* (Food Standards Agency, 2002). Mean daily DF and NSP (expressed in g and g/10 MJ energy) intakes are reported. In 5–8 ($P<0.05$) and 9–12 ($P<0.001$) year olds mean daily DF and NSP intakes (g) were significantly higher in boys compared with girls and intakes (g) increased with age in both boys ($P<0.001$) and girls ($P<0.05$). There were no significant differences in mean nutrient density of intakes for DF or NSP between boys and girls or between age-groups.

	Boys				Girls			
Age-group (years)..	5–8 (*n* 145)		9–12 (*n* 148)		5–8 (*n* 151)		9–12 (*n* 150)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
DF: g/d	12.2^{a}*	4.0	14.2^{b}**	4.4	11.2^{c}	3.2	12.1^{d}	3.7
g/10 MJ per d	17.9	4.3	17.9	4.7	17.7	4.2	17.5	4.1
NSP: g/d	9.2^{a}*	3.1	10.8^{b}**	3.7	8.5^{c}	2.5	9.2^{d}	2.9
g/10 MJ perd	13.5	3.4	13.7	4.0	13.3	3.3	13.2	3.2

^{a,b,c,d} Values in rows with unlike superscript letters were significantly different: ^{a,b} $P<0.001$, ^{c,d} $P<0.05$.
Mean values were significantly higher than those for girls: * $P<0.05$, ** $P<0.001$.

The contribution (g and %) of food groups to mean daily DF intakes by age and sex are reported.

	Boys				Girls			
Age-group (years).......	5–8 (*n* 145)		9–12 (*n* 148)		5–8 (*n* 151)		9–12 (*n* 150)	
	g	%	g	%	g	%	g	%
Bread and rolls	2.5	21.3	2.9	20.4	2.3	20.4	2.7	22.2
Potatoes and potato products	1.8	15.6	2.2	16.5	1.6	14.5	2.0	17.2
Breakfast cereals	1.9	14.9	2.5	16.6	1.4	12.3	1.3	10.3
Vegetables and vegetable dishes	1.5	11.1	1.6	11.1	1.4	11.8	1.3	9.7
Fruit and fruit juices	1.4	11.1	1.1	7.8	1.3	11.3	1.2	9.6
Sugars, confectionery, preserves and savoury snacks	0.9	7.7	1.1	8.0	0.9	8.8	1.0	8.7
Grains, rice, pasta and savouries	0.8	7.0	1.1	7.7	1.0	9.2	1.1	9.0
Biscuits, cakes and pastries	0.6	5.4	0.7	5.5	0.6	5.5	0.6	5.6
Other food groups	0.8	6.0	0.9	6.6	0.7	6.2	0.9	7.7
Total	12.2	100	14.2	100	11.2	100	12.0	100

The main dietary sources of DF were bread, potatoes, breakfast cereals, vegetables and fruit. A higher percentage of girls compared with boys did not meet the American Health Foundation recommendation (Williams *et al*. 1995) of a DF intake (g) ≥ their age+5, especially in those aged 9–12 years (9–12 years: girls, 83, boys: 68, 5–8 years: girls, 55; boys, 48,). There is a need for public health measures to address the high prevalence of inadequate DF intake in Irish children.

The project was funded by the Irish Government under the National Development Plan 2000–2006.

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Fortified food (FF) consumption in Irish children aged 5–12 years. By E.M. HANNON and A. FLYNN, *Department of Food and Nutritional Science, University College Cork, Cork, Republic of Ireland*

The aim of this study was to estimate the frequency of addition of micronutrients to foods and the amount of each micronutrient in an average serving of FF. Percent of total energy from all FF (i.e. foods fortified with one or more micronutrients) and from foods fortified with individual nutrients is also estimated. Analysis is based on the National Children's Food Survey (NCFS), carried out between April 2003 and April 2004, which established a database of habitual food and drink consumption in a representative sample of 594 Irish children (293 boys, 301 girls) aged 5–12 years. A 7 d weighed-food record was used to collect food intake data and analysis of dietary intake data was carried out using WISP© (Tinuviel Software, Llanfechell, Anglesey, UK) which is based on the 6th edition of *McCance and Widdowson's The Composition of Foods* (Food Standards Agency, 2002).

Of the 1945 food codes consumed in the NCFS, 189 (9.7%) were voluntarily fortified by food manufacturers, i.e. one or more micronutrients were added (Hannon *et al*. 2006). Over half (56%) of all fortified foods were breakfast cereals or cereal bars and 20% were drinks of different varieties, e.g. fruit juices, squashes and carbonated beverages. The number of foods containing each added nutrient and the percentage (median and 25th (P25) and 75th (P75) percentile) of the EC RDA (European Commission, 1990) in an average serving (estimated from the quantity per eating occasion recorded) is reported.

Micronutrient	No. of foods containing added nutrient	Percentage of the EC RDA in an average serving		
		Median	P25	P75
Niacin	143	33	21	33
Thiamin	139	33	22	33
Vitamin B_6	137	33	21	33
Riboflavin	132	32	21	34
Folic acid	127	33	25	40
Vitamin B_{12}	122	33	25	39
Fe	114	22	20	33
Pantothenic acid	74	33	21	39
Ca	60	22	13	27
Vitamin D	44	29	16	39
Vitamin C	42	43	33	82
Vitamin E	28	30	14	48
Retinol	17	23	10	64
Biotin	16	34	28	82
Carotene	5		No EC RDA	
I	3	15	15	15

In FF consumers (99% of boys and 97% of girls), the percentage of the total mean daily intake (MDI) of energy from FF was 9.9 (P95 22.3) in boys and 8.4 (P95 18.3) in girls. In consumers (94% of boys and 90% of girls), fortified ready-to-eat breakfast cereals contributed 8.1% (P95 18.5%) of the MDI of energy in boys and 6.3% (P95 16.0%) in girls.

Among consumers of foods fortified with specific nutrients, the percentage energy from foods fortified with that nutrient was between 7 and 8 for vitamins B_6 (*n* 558) and B_{12} (*n* 550), riboflavin (*n* 572), thiamin (*n* 573), folic acid (*n* 565), Fe (*n* 565) and niacin (*n* 577), with P95 values of between 16 and 18. Among consumers, mean percentage energy from foods fortified with vitamin D (*n* 258) and retinol (*n* 111), among consumers was 3.6 (P95 11.3) and 2.0 (P95 8.3) respectively.

Niacin, vitamins B1, B6, B2, folic acid, vitamin B12 and iron were the nutrients most frequently added to foods (added to between 60 and 77% of all FF). Median values for % EC RDA in an average serving of FF ranged from 15% (I) and 22% (Ca and Fe) to 43% for vitamin C. A European Commission proposal for a regulation on the addition of vitamins and minerals to foods with a view to harmonising legislation throughout member states of the EU (Commission of the European Communities, 2003), is expected to be adopted in 2006. Estimates of % energy from FF are important for setting maximum levels of addition of nutrients to foods (Flynn *et al*. 2003). In consumers, % energy from all fortified foods was 9% (P95: 20%), but for foods fortified with individual nutrients was lower than this (mean: 2–8%, P95: 7–18%).

The project was funded by the Irish Govt under the National Development Plan 2000–2006.

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The relationship between fruit, vegetable and fruit juice consumption at adolescence and subsequent respiratory health in early adulthood: The Northern Ireland Young Hearts Project. By C.E. NEVILLE[1], J.V. WOODSIDE[1], M.C. McKINLEY[1], L.J. MURRAY[1], G.W. CRAN[1], C.A.G. BOREHAM[2] and P.G. McCARRON[1], [1]*Centre for Clinical and Population Sciences, Queen's University Belfast, Belfast BT12 6BJ, UK and* [2]*School of Health Sciences, University of Ulster, Newtownabbey BT37 0QB, UK*

An accumulating, but as yet inconsistent, body of evidence suggests that dietary intake is associated with lung function (McKeever *et al*. 2002; Kelly *et al*. 2003). Fruit and vegetables have been shown to have a positive effect on lung function primarily through their antioxidant properties (Schunemann *et al*. 2001). Beneficial effects of fruit and vegetable intake on respiratory health have been widely documented in older age-groups, but few population-based studies have examined the association between intake and lung function in younger age-groups. The aim of the present study was to assess the relationship between fruit, vegetable and fruit juice consumption at age 12 and 15 years and lung function in early adulthood. Habitual dietary intake was assessed using the diet-history method in 485 adolescents from Northern Ireland aged 12–15 years. Anthropometric measurements were taken and lifestyle factors were assessed by questionnaire. When subjects were aged 20–25 years, forced vital capacity (FVC; ml) and forced expiratory volume in 1 s (FEV1; ml) were measured using the Microlab 3300 spirometer (Micro Medical Ltd., Chatham, Kent, UK). Gender-specific multivariable linear regression models were constructed with lung function measurements as the dependent variables. Explanatory variables included fruit, vegetables and fruit juice (all expressed as g/100 g per d), with adjustment for the potential confounders: age; height; weight; BMI; social class; education; physical activity; smoking status; pack years of smoking; total daily energy intake.

In the multivariable analysis, there were no associations between fruit or fruit juice intake and lung function measurements in either gender. Total vegetable intake in adolescent females was positively associated with FVC and FEV1. The multivariable models explained ≤52.7 and ≤45.9% of the observed variance of FVC and FEV1 in females respectively. The Table shows results from the multivariable regression analyses for fruit, vegetable and fruit juice intake (g/100 g per d) *v*. FVC (ml) and FEV1 (ml).

	Males (*n* 247)				Females (*n* 238)			
	FVC		FEV1		FVC		FEV1	
	B†	SE	B	SE	B	SE	B	SE
Multivariable analysis:								
Vegetable intake	77.29	99.25	69.18	83.59	256.14**	83.28	165.89*	70.38
Fruit intake	37.99	42.06	−10.79	35.43	−19.64	28.31	−3.97	23.93
Fruit juice intake	57.45	41.47	25.95	34.93	13.20	34.94	26.06	29.53

* $P<0.05$, ** $P<0.01$. † Values are unstandardised regression coefficients.

Our results suggest that in females a high vegetable intake at adolescence may be predictive of respiratory health in young adulthood. These results offer some support for the hypothesis that early-life fruit and vegetable intake is beneficial to respiratory health in young adulthood.

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Fruit and vegetable consumption and blood pressure: The Northern Ireland Young Hearts Project. By C. McGARTLAND[1], J.V. WOODSIDE[1], P. ROBSON[2], L. MURRAY[3], G. CRAN[3], D. WATKINS[4], M. ROONEY[5], J. SAVAGE [4] and C. BOREHAM [6], [1]*Department of Medicine, Nutrition and Metabolism Group, Queen's University of Belfast, Belfast BT12 6BJ, UK,* [2]*Northern Ireland Centre for Diet and Health (NICHE), University of Ulster, Coleraine BT52 1SA, UK,* [3]*Department of Epidemiology, Queen's University of Belfast BT12 6BJ, UK,* [4]*Department of Child Health, Queen's University of Belfast BT12 6BJ, UK,* [5]*Queens Orthopaedic Building, Musgrave Park Hospital, Belfast BT9 7JB, UK and* [6]*Department of Life and Health Sciences, University of Ulster, Newtonabbey BT37 0QB, UK*

High blood pressure (BP) is an important risk factor for CVD and, therefore, it is important to control this condition. Diets characterised by high intakes of fruit and vegetables have been shown to reduce BP in adults (Apple, 1997). The effects of similar diets on children's BP are unknown. High intakes of fruit and vegetables may be an effective tool for lowering BP from an early age. We examined the association between fruit and vegetables and BP in a random sample of adolescents in Northern Ireland.

Young Hearts 2000 is the second in a series of large cross-sectional epidemiological studies performed in a representative sample of Northern Irish adolescents. This study included 493 boys and 614 girls aged either 12 years or 15 years. BP readings were carried out by one observer using the Hawksley random-zero sphygmomanometer (Lancing, Sussex, UK). Habitual fruit and vegetable intakes and calcium and sodium intakes were assessed using the diet-history method. Adjusted regression modelling was used to investigate the influence of fruit and vegetable intake on BP.

	Diastolic BP mmHg		Fruit g/day		Vegetable g/day		Sodium mg/day		Calcium g/day		Physical Activity[a]	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
12 yr old boys	61.6	8.5	143	147	61	43	3340	1595	1045	394	32	16
12 yr old girls	61.6	9.1	178	164	55	35	2904	1062	883	316	21	14
15 yr old boys	60.9	9.2	144	152	70	53	3814	1257	1151	454	28	15
15 yr old girls	62.1	8.5	163	155	59	46	2812	1079	864	344	18	13

[a]=highest possible activity score is 100.

Girls consuming a higher intake of vegetables had by on average 1.8 mmHg ($P<0.02$) lower blood pressure than girls consuming lower intakes of vegetables. After adjustment for height, weight, age, pubertal status, sodium intake, calcium intake, physical activity, alcohol intake, social class and smoking the association remained with girls consuming higher intakes of vegetables, having by on average 1.9 mmHg ($P<0.02$) lower blood pressure than girls consuming lower intakes of vegetables. Sodium intake was positively associated with BP in boys (B 0.001, $P<0.02$), no association was observed in girls. Positive associations were observed between higher social class and lower diastolic BP in girls and boys respectively (B 0.092; $P<0.05$ and B 0.106; $P<0.05$ respectively). No associations were observed between physical activity and diastolic BP. No associations were observed between vegetable intake and diastolic BP in boys or between fruit and calcium intake and diastolic BP in either gender.

A diet rich in vegetables may be important for controlling BP in girls. It is possible that an overall healthier lifestyle may contribute to the observed association, although we attempted to account for this factor by including social class and physical activity in the regression model. It is also possible that a combination of dietary, physical and lifestyle factors may be involved, making it difficult to pinpoint specific effects. However, the major determinants of adult BP seem to be set in early life, therefore potential modifiable determinants need to be ascertained (Watkins, 2004). Prospective and intervention studies are therefore required in children in order to clarify the association in order to make evidence-based public health recommendations.

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Comparisons of body-weight status in British Bangladeshi and Indian children residing in London. By D. SAMANI, T. ANWAR and H.D. McCARTHY, *Institute for Health Research & Policy, London Metropolitan University, Holloway Rd, London N7 8DB, UK*

Individuals from South Asian backgrounds in the UK are at greater risk for obesity-related ill health including type 2 diabetes and CVD compared with Caucasians (Whincup *et al*. 2002). The cause of this difference remains unclear, although evidence suggests it may be related, in part, to growth and body fatness in childhood (Khunti & Samani, 2004). Furthermore, it is unknown whether this risk for South Asians is the same irrespective of country of origin, despite variations in diet, cultural patterns and religion. This cross-sectional study compared levels of underweight, overweight and obesity between children from Indian and Bangladeshi backgrounds in London.

Bangladeshi children from East London (*n* 151) and Indian children from North West London (*n* 139) aged between 5 and 11 years participated in the study. Height, weight and waist circumference (WC) were measured. BMI (kg/m^2) was calculated and converted to standard deviation scores (SDS) based on the 1990 UK reference data (Cole *et al*. 1995). Similarly, WC was compared with the current UK WC reference data (McCarthy *et al*. 2001). The proportion of children falling below the 2nd centile (underweight), exceeding the 91st (overweight) and 98th (obese) centiles for BMI was calculated separately in boys and girls.

	Boys			Girls		
	Bangladeshi	Indian	*P*	Bangladeshi	Indian	*P*
n	70	61		81	78	
Height SDS	−0.253	−0.210	NS	0.011	−0.432	<0.01
Height centile	42.3	44.6	NS	49.6	38.4	0.02
BMI SDS	−0.186	−0.228	NS	−0.426	−0.715	NS
BMI centile	45.2	43.9	NS	38.2	32.0	NS
WC (cm)	58.0	55.7	NS	56.4	53.6	0.01

	Boys			Girls		
	Bangladeshi	Indian	HSE 2002	Bangaldeshi	Indian	HSE 2002
Underweight %	15.7	8.2	–	9.9	12.8	–
Overweight %	21.4	13.1	14–20*	13.6	7.7	18–24*
Obese %	12.9	4.9	4.3–8.1*	4.9	2.6	6.6–11*

* 85th and 95th centile cut-offs.

These findings indicate that underweight prevalence is substantially higher in children from South Asian backgrounds residing in London than would be expected based on the 1990 UK reference data. This disparity is likely to be due, in part, to socio-economic factors, as the schools are located in two of the poorest areas of London. This malnutrition coexists alongside significant levels of overweight and obesity compared with the expected 9 and 2% respectively. However, these levels are lower than current estimates based on national data obtained predominantly from Caucasian children (Sproston & Primatesta, 2003). As BMI was used as a proxy for body fatness, the assumption is, however, that a given BMI range relates to an equivalent extent of body fatness in all ethnic groups. Measurement of both total and upper body fatness in South Asian children may yield more useful explanations for the increased obesity-related morbidity observed in individuals from South Asian background.

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What is the best measure of fatness during a weight-management programme in obese children? By D. SAMANI[1], S. O'CALLAGHAN[2] and H.D. McCARTHY[1], [1]*Institute for Health Research & Policy, London Metropolitan University, Holloway Rd, London N7 8DB, UK and* [2]*Cultural Services, London Borough of Tower Hamlets, London UK*

Given the high prevalence of obesity in children in the UK (Health Survey for England; McCarthy *et al*. 2003; Sproston & Primatesta, 2004), there is a need for effective weight-management programmes for those classed as clinically obese. However, it must be remembered that linear growth during childhood is continuous, and any body fat loss could be masked by gains in fat-free mass and stature, and must be factored in when evaluating the success of a weight-management programme. In the present study we examined changes in BMI, waist circumference, fat mass and percentage fat mass in a group of children following a weight-management programme.

A total of twenty-nine children aged between 8 and 15 years were selected for analysis in the study. They had been recruited onto a 12-week weight-management programme consisting of twice-weekly exercise and dietary advice sessions. The referral criterion was a BMI >98th centile. At the start and end of the programme, height, weight and waist circumference (WC) were measured. Body composition was estimated using a tetra polar bioelectrical impedance analyser (Tanita BC418MA; ScaleSmart, Leicester, Leics., UK). BMI (kg/m^2) was calculated and converted to standard deviation scores using the 1990 UK reference data (Cole *et al*. 1995). All measures of body fatness were compared between the start and finish of the programme using a *t* test for paired data.

Significant increases in mean height and fat-free mass were observed (+1.7 cm, *P*<0.001 and +1.7 kg, *P*<0.01 respectively). Mean body weight increased by 0.62 kg and fat mass decreased by 1.0 kg; NS). For the group as a whole the percentage body fat decreased significantly (–1.7%, *P*<0.05). Although mean BMI decreased by 0.31 units (NS) mean BMI standard deviation score remained >3.0. In those children for whom WC measurement was collected at both time points (*n*18) mean WC decreased significantly (–2.2 cm, *P*<0.05).

Vriable (mean)	Start	End	Change	Significance (*P*)
Age (yrs)	11.41	11.69	+0.28	0.003
Height (cm)	150.6	152.3	+1.7	0.001
Weight (kg)	72.46	73.08	+0.62	0.149
BMI	31.89	31.58	−0.31	0.139
BMI SDS	3.13	3.05	−0.08	0.004
BMI centile	99.74	99.68	−0.06	0.168
WC (cm) (*n*,18)	94.4	92.2	−2.2	0.049
%BF	40.9	39.2	−1.7	0.010
FM (kg)	30.9	29.9	−1.0	0.073
FFM (kg)	42.1	43.8	+1.7	0.001

When monitoring measures of body fatness in children participating in a weight-management programme, the contribution from increases in height to gains in fat-free mass and total body mass over the course of the programme should not be overlooked. Monitoring BMI alone or BMI centile, may not reflect true changes in body composition. This normal aspect of growth may mask decreases in body fatness, which may not be reflected in changes in BMI. Thus, the effectiveness of a weight-management programme may not be readily apparent on initial evaluation, and could thus also impact on motivation of participants and their families. Furthermore, taking a WC measurement may give a better indication of fat loss, and more specifically upper body fat loss (McCarthy *et al*. 2001).

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Fish consumption as part of an energy-restricted diet reduces serum markers of inflammation. By G.K. PASCHOS[1], A. LUCEY[1], I. THORSDOTTIR[3], J.A. MARTINEZ[4], K.D. CASHMAN[1,2] and M. KIELY[1], [1]*Department of Food and Nutritional Sciences and* [2]*Department of Medicine, University College Cork, Republic of Ireland,* [3]*Department of Clinical Nutrition, Landspitali-University Hospital, Iceland and* [4]*Department of Physiology and Nutrition, University of Navarra, Spain*

Body weight and body fatness are related to serum levels of C-reactive protein (CRP) and IL-6. Supplementation of the diet with *n*-3 fatty acids may reduce serum CRP and IL-6 concentrations (Esposito *et al*. 2004). The aim of the present study was to examine the independent effects of dietary fish and *n*-3 fatty acid intake from fish, as part of a hypoenergetic diet, on serum levels of CRP and IL-6.

Male and female volunteers (*n* 274) aged 20–40 years, with a BMI between 27 and 33 kg/m^2, were recruited in three centres (Iceland, Spain, Republic of Ireland). Volunteers received nutritional advice to adhere to an energy-restricted diet (30 % energy deficit relative to requirements) and randomly distributed to one of four dietary interventions for a period of 8 weeks: control group 3 g sunflower oil/d (*n* 66); cod group, 140 g cod three times per week (*n* 68); salmon group, 140 g salmon three times per week (*n* 73); Fish oil group, 3 g fish oil/d (*n* 67). The cod and salmon groups served as the low- and high-*n*-3 fatty acid fish groups respectively. Cod consumption provided about 0.2 g EPA and about 0.4 g DHA/week and salmon provided about 4.7 g EPA and about 8.3 g DHA/week. The fish oil group received 4.8 g EPA and 3.2 g DHA/week.

We applied a repeated-measures ANOVA model to distinguish between the effects of fish, *n*-3 fatty acids and energy restriction on the circulating levels of CRP and IL-6 in serum. There were no differences in baseline serum CRP and IL-6 levels between the four intervention groups. CRP levels were reduced in the different intervention groups, but the magnitude in the reduction in CRP levels from baseline to end point between the intervention groups was not significantly different. There was an independent effect of weight loss on CRP levels, and both percentage weight loss and percentage reduction in fat mass were related to the extent of CRP reduction (*r* 0.216 and 0.223, P<0.001 respectively). The reduction in serum IL-6 was higher (P=0.021) in the salmon group compared with the fish oil group, after adjustment for weight loss. No independent effects of weight loss or changes in body composition on the reduction in serum IL-6 were observed.

	CRP					IL-6				
	Baseline		End point			Baseline		End point		
	Median	P25, P75	Median	P25, P75	Change from baseline (%)	Median	P25, P75	Median	P25, P75	Change from baseline (%)
Control	1.44	0.71, 3.74	1.15*	0.49, 2.13	−14.2	1.19	0.74, 1.63	1.04	0.78, 1.94	−3.72
Cod	1.52	0.83, 2.93	1.01*	0.51, 2.58	−31.4	1.30	0.95, 1.91	1.09*	0.85, 1.51	−9.18
Salmon	1.49	0.83, 3.24	1.10*	0.46, 2.34	−22.9	1.19	0.91, 1.76	1.07*†	0.76, 1.55	−12.32
Fish oil	1.70	0.84, 3.53	1.40*	0.52, 3.54	−18.4	1.42	0.97, 1.87	1.31	0.83, 2.24	−7.73

P25, P75, 25th and 75th percentiles respectively. Median values were significantly different from those at baseline: * P<0.05. Median value was significantly different from that for the fish oil group: † P=0.021.

An increased intake of salmon but not fish oil supplementation as part of an energy-restricted diet reduces circulating IL-6 levels independently of the effect of the resulting weight loss. Serum CRP levels are reduced as a result of the weight loss and fat mass reduction, while *n*-3 fatty acids from fish intake have no independent effect on the CRP reduction. In conclusion, an energy-restricted diet rich in fish may reduce biochemical markers of inflammation due to the increased fish intake as well as the weight loss and reduction in fat mass.

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Esposito K, Marfella R, Ciotola M, Di Palo C, Giugliano F, Giugliano G, D'Armiento M, D'Andrea F & Giugliano D (2004) *Journal of the American Medical Association* **292**, 1440–1446.

Breast-feeding rates and factors affecting breast-feeding initiation in a group of women with and without diabetes. By H. DEVINE[1], K. YOUNGER[1], R. TARRANT[1], S. DALY[2] and J. KEARNEY[1], [1]*School of Biological Sciences, Dublin Institute of Technology, Dublin, Republic of Ireland and* [2]*Coombe Women's Hospital, Dublin, Republic of Ireland.*

The benefits of breast-feeding are well documented and exclusive breast-feeding is now advised for all infants for the first 6 months of life (WHO, 2001). Additional benefits to infants of diabetic mothers may include reduced risk of diabetes and obesity and a reduced risk of diabetes for the mothers themselves. Currently, there are no data on breast-feeding outcomes in Irish women with diabetes mellitus (DM). The present study aimed to compare breast-feeding rates and factors affecting breast-feeding initiation in a group of women with and without DM in the Republic of Ireland.

The data for this study was obtained from a study taking place in the Coombe Women's Hospital Dublin, investigating the diet of infants born in Ireland. The diabetic subjects (*n* 38) were matched with 38 control subjects using age, education level and health insurance status as comparison criteria. Information was gathered during the third trimester of pregnancy and 6 weeks and 6 months post-delivery. The questionnaires included information on intended and current feeding methods and factors that influenced feeding choice. The questionnaires were based on evidence-based research papers.

Within the diabetic group 10 women had type 1 DM, while 28 had gestational DM. Of these 28 women, 17 were treated with insulin and 11 with diet alone.

There were significant differences between the diabetic and control groups for the demographic and biomedical factors shown in the table below.

Characteristic	Diabetics	Controls	*P*
Ethnicity			
White Caucasian	26/38	35/38	0.016
Black African	6/38	3/38	
Asian	6/38	0/38	
Infant Rooming-in	23/38	32/38	0.040

There were no significant differences in breastfeeding rates at discharge between women with DM (19/38) and control women (20/38). These rates at discharge are comparable with breast-feeding initiation rates previously described from studies in the Republic of Ireland of 51 % (Twomey *et al*. 2000; Ward, 2004). Breast-feeding rates at 6 weeks and 6 months from birth remained comparable between the two groups. Within the diabetic group however, women treated with insulin were less likely to breastfeed than those treated with diet alone (P=0.032). This difference may be explained by hospital policy calling for the admission to the neonatal unit of all infants born to women treated with insulin.

Women with DM breast-fed as often as, and for as long as, control women despite the fact that women with DM were less likely to have their infant 'rooming-in' with them (P<0.05), a factor that was significantly related to non-initiation of breast-feeding in that group. However, a greater proportion of non-Irish-national women within the DM group may in part explain the comparable breast-feeding rates between women with DM and control women. There were twelve non-Irish national women in the DM group and three in the control group. Being of African or Asian decent showed a trend toward positively affecting breastfeeding initiation rates within the diabetic group (P=0.95).

The present study has demonstrated comparable breastfeeding rates between diabetic and controls. Diabetic women who do not have their infant rooming-in with them may require additional breastfeeding support. This includes all women treated with insulin during their pregnancy. Confirmation of these results in a larger study that allows for separate analysis of type 1 DM and gestational diabetics, whilst controlling for confounding factors such as ethnicity, may lead to the recognition of this sub-group of women as one in need of additional breastfeeding support.

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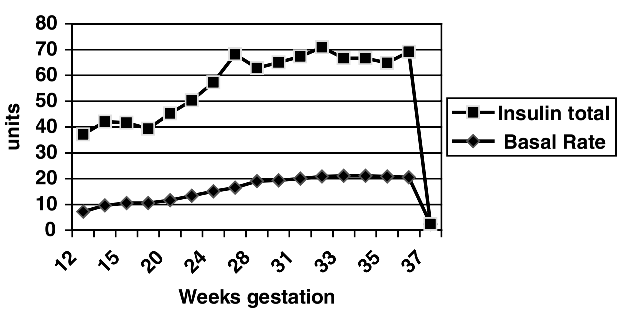
An illustration of post-partum hypoglycaemia in respect to breastfeeding for women with type 1 diabetes – a case study. By J.C. ABAYOMI[1&3], G. MORRISON[2], K. McFADDEN[1], T. PUREWAL[2], A.F. HACKETT[3], [1]*Liverpool Women's Hospital, Crown Street, Liverpool L8 7SS,* [2]*Royal Liverpool Hospital, Prescot Street, Liverpool L7 8XP,* [3]*Liverpool John Moores University, Faculty of Education, Community and Leisure, Barkhill Road, Liverpool L17 6BD, UK*

Most UK women stop breastfeeding (BF) early post-partum, because of poor BF management. This is particularly true for women with type 1 diabetes (DM1). Maternal hypoglycaemia increases secretion of adrenalin, inhibiting lactogenesis and interfering with 'let-down' (Walker, 2002). Strict diabetic control during pregnancy, labour, delivery and postnatally greatly assists the establishment of successful BF (Neubauer *et al.* 1993). Using Continuous Subcutaneous Insulin Infusion (CSII) the metabolic control and insulin requirements of a woman with DM1 were observed.



This is a case study of a 32 year-old multiparous woman, who commenced CSII at 11 weeks gestation. The figure shows the total and basal insulin requirements during pregnancy. At 36 weeks gestation she required a basal insulin rate of 20.5 units per day; HbA1c was 7.1 %. Following delivery at 37 weeks she only required 2.4 units for the first 24 hours (0.1 unit per hour). Some minor hypoglycaemia occurred initially, whilst BF but was corrected by: Encouraging additional carbohydrate snacks prior to or during BF and reducing the carbohydrate to insulin ratio for an insulin bolus given with these snacks from 1 u: 10 g to 1 u: 20 g. Many women with DM1 experience hypoglycaemia following delivery of the placenta, where little or no insulin is required as a result of hormone depletion, which may last for several hours (Fagen, 1998). With traditional injection therapy, this individual was likely to have been continuously hypoglycaemic, seriously impairing her ability to breastfeed. CSII may improve metabolic control associated with lactation in diabetes and so aid mothers with DM1 to establish and sustain BF more successfully.

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Ethnic differences between questionnaire-reported and 3 d dietary-recall estimations of fruit and vegetable consumption in girls aged 12–16 years. By A. SURUJLAL-HARRY, G.A. REES, S. BAKHSHI and A. BAKER, *London Metropolitan University, Calcutta House, Old Castle Street, London, E1 7NT, UK*

The present study formed one component of a larger study aimed at increasing fruit, vegetable and wholegrain-cereal intake in teenage girls. This component aimed to collect baseline data on fruit and vegetable intake from the participants who were predominantly from ethnic-minority and low-income groups.

Schools in London and Coventry with a high ethnic diversity of pupils were approached to take part. Of seventy-seven schools contacted eight (five in London and three in Coventry) participated in the study. A questionnaire on eating behaviour and psychological barriers and promoters to healthy eating was administered to girls aged 12–16 years, and in addition three 24 h dietary recalls were taken from students. The student's reported intake was obtained from the questionnaire and from the 24 h recalls. The 24 h recalls were assessed by both a nutritionist and a registered dietitian.

The relevant sections of the questionnaire were completed by 823 girls, of whom 10 % were of mixed ethnicity, 54 % were white, 16 % were black and 18 % were Asian. The free school meal entitlement ranged from 3 % to 46 % for the selected schools (UK average 14.8 %; Department for Education & Skills, 2005).

The results for daily reported fruit and vegetable consumption from the questionnaire and recall are:

Portions consumed daily	Questionnaire (% total)	Dietary recall (% total)
≤One	17	30
>One to two	24	45
>Two to three	20	14
>Three to four	18	7
>Four to five	9	2
>Five	12	2

A Pearson correlation test between questionnaire-reported and recall-reported fruit and vegetable consumption was significant ($P<0.001$) with a medium strength relationship (r 0.463).

The results of the comparison of ethnic groups are:

Portions consumed daily	White (% total)		Mixed ethnicity (% total)		Asian (% total)		Black (% total)	
	Questionnaire (*n* 424)	Recall (*n* 410)	Questionnaire (*n* 78)	Recall (*n* 71)	Questionnaire (*n* 150)	Recall (*n* 143)	Questionnaire (*n*124)	Recall (*n* 109)
None	3	6	1	5	2	6	6	8
≤One	11	22	12	23	12	28	28	28
>One to two	25	44	18	48	26	43	17	45
>Two to three	18	16	16	14	26	11	19	10
>Three to four	17	7	21	6	17	9	15	6
>Four to five	9	3	11	2	6	1	5	2
>Five	17	2	21	2	11	2	10	1

ANOVA conducted on the data found that there were significant differences between the ethnic groups for their reported intakes by questionnaire ($P<0.001$) and recall ($P=0.033$) for daily fruit and vegetable consumption. *Post hoc* tests (Scheffe) revealed that white girls ($P=0.007$) and girls of mixed ethnicity ($P=0.003$) reported on their questionnaire that they were eating more fruit and vegetables compared with black girls.

Our study found that there was a significant correlation between intake reported on the questionnaire and the intake reported on the recall, with the questionnaire providing higher estimates of fruit and vegetable intake than the 3 d recall. In terms of daily consumption of fruit and vegetables among the different ethnic groups, black girls reported on the questionnaire that they were consuming fewer portions of fruit and vegetables compared with white girls and girls of mixed ethnicity. However, this difference was not seen on the *post hoc* test for the dietary-recall data. Thus, the ethnic differences in fruit and vegetable intake were greater when assessed by questionnaire than when assessed by dietary recall. Our study also indicates that there is a need for nutritional interventions to target teenage girls from all ethnic groups in the UK to increase consumption of fruit and vegetables.

This intervention study was commissioned by the Foods Standards Agency.

Department for Education and Skills (2005) Trends in Education and Skills. http://www.dfes.gov.uk (accessed January 2005)