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ABSTRACTS OF COMMUNICATIONS

A Scientific Meeting was held at Western Infirmary, Glasgow, on Monday–Tuesday, 7–8 April 1997, when the following papers were presented.

All abstracts are prepared as camera-ready material by the authors.

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The effect of various dietary copper intakes on pyridinium crosslinks of collagen in the rat. By KEVIN CASHMAN, ANNETTE CREEDON and ALBERT FLYNN, *Department of Nutrition, University College, Cork, Ireland.*

An osteoporosis-like condition is a common feature of severe Cu deficiency induced in experimental animals. This may be a consequence of inadequate cross-linking of collagen caused by deficiency of lysyl oxidase, a Cu-dependent enzyme, leading to diminished tensile strength of bone. While severe or clinically-defined Cu deficiency in humans is not a public health problem, there is some concern that there may be widespread mild, sub-clinical Cu deficiencies in Western populations (Klevay, 1990). Thus, the objective of the present study was to examine the effects of dietary Cu intakes, ranging from a sub-optimal to a supplemental level, on bone mineral composition and on the pyridinium crosslinks of collagen in a rat model.

Twenty four 6-week old female rats, Wistar strain, average weight 155 g, were randomized into three groups (n 8/group), housed individually in metabolism cages and adapted for 1 week to an AIN-76 diet containing 7 mg Cu/kg. The rats were then placed on AIN-76 diets containing either about 2 (low), 7 (control), or about 18 (high) mg Cu/kg for a further 7 weeks. Pyridinium crosslinks (pyridinoline (Pyr) and deoxypyridinoline (Dpyr)) were measured by an HPLC method in 24 h urine samples throughout the study and in femurs at the end of the study. Femur mineral content, faecal, food and kidney Cu were measured using atomic absorption spectrometry after dry ashing. Apparent fractional Cu absorption was estimated as ((Cu intake - faecal Cu/Cu intake) x 100).

	Dietary Cu intake					
	Low		Control		High	
Variable	Mean	SE	Mean	SE	Mean	SE
Final body wt (g)	203.9[a]	3.9	199.3[a]	2.9	207.1[a]	2.4
Cu intake (μg/d)	34[a]	0.2	104[b]	0.3	274[c]	0.6
Apparent Cu absorption (%)	38.6[a]	5.2	30.8[b]	2.7	18.8[c]	3.1
Kidney Cu (μg/g wet wt)	3.2[a]	0.2	4.4[b]	0.1	5.1[c]	0.2
Femur Cu (μg/g dry wt)	1.12[a]	0.05	1.22[a]	0.03	1.20[a]	0.03
Mean urinary Pyr (nmol/d)*	5.4[a]	0.6	4.3[a]	0.5	5.1[a]	0.8
Mean urinary Dpyr (nmol/d)*	6.8[a]	1.6	5.5[a]	1.8	5.5[a]	1.1
Femur Pyr (nmol/g dry wt)	160.7[a]	11.2	197.1[a]	17.3	153.6[a]	5.3
Femur Dpyr (nmol/g dry wt)	264.3[a]	31.0	251.4[a]	23.0	233.4[a]	7.8

[a,b,c] Mean values within a row with unlike superscript letters were significantly different $P<0.05$ (ANOVA).

* Mean crosslink value over the 7 weeks of the study.

Cu intake by the rats ranged from about 34 to about 274 μg/d and as expected, apparent fractional absorption of Cu was significantly reduced with increasing Cu intake. Final body weights were similar in all groups and the reduced body weight associated with a severe Cu deficiency was not observed in the low Cu group. Kidney Cu levels were significantly different ($P < 0.05$) between the groups suggesting that Cu status was influenced by the different dietary Cu levels. Femur Ca, Mg, P, Zn, Fe and Mn contents were similar in all groups. In addition, femur Cu content was also similar in all groups. There were no significant differences in either urinary excretion of Pyr and Dpyr or femur Pyr and Dpyr content between the different Cu groups. In conclusion, reducing Cu intake from the recommended level to a sub-optimal level or increasing it to a supplemental level significantly altered Cu status of the animals, however, it had no significant effect on bone mineral composition or on pyridinium crosslinks of collagen suggesting that density of bone was not affected.

This work was supported by the Department of Agriculture, Food and Forestry, Dublin.

Klevay, L.M. (1990). In *Cu Bioavailability and Metabolism*, pp. 197-208, [C., Kies, editor]. New York: Plenum Publishing Corporation.

Effect of increased dietary sodium intake on biochemical markers of bone metabolism in healthy young women who are sodium sensitive and sodium non-sensitive in terms of urinary calcium excretion. By FIONA GINTY, ALBERT FLYNN and KEVIN CASHMAN, *Department of Nutrition , University College, Cork, Ireland.*

Increased Na intake has been proposed to promote bone resorption by increasing the renal excretion of Ca (Nordin *et al.* 1993). This hypothesis has come from evidence that urinary hydroxyproline (a biomarker of bone resorption) is significantly and positively associated with Na intake. However, hydroxyproline has since been surpassed in terms of sensitivity and specificity by alternative biomarkers of bone resorption known as pyridinium crosslinks of collagen. The objective of the present study was to examine the effect of increasing dietary Na intake from 2 to 5 g/d, whilst maintaining a constant Ca intake, on these biomarkers of bone resorption (pyridinoline (Pyr) and deoxypyridinoline (Dpyr)) in addition to markers of bone formation (serum osteocalcin and bone-specific alkaline phosphatase (B-Alkphase)).

Twenty-nine healthy females (mean age 24 years) with no history of bone disease and no intake of medication that could affect bone and cartilage metabolism were screened initially for 4 weeks, in order to identify those subjects who were specifically Na sensitive and Na non-sensitive (in terms of urinary Ca excretion). Each subject consumed four diets, each for a 5 d period, providing increasing levels of Na (1, 2, 3, and 5 g/d) and a constant level of Ca (500 mg/d). First morning urine samples were collected for three consecutive days for each dietary regimen and analysed for Na and Ca (expressed relative to urinary creatinine). The correlation coefficients between urinary Ca and Na for each subject were analysed by single linear regression analysis. Eight individuals whose urinary Ca increased significantly ($P< 0.05$) in response to increased Na intake were deemed to be Na sensitive. Eight non-sensitive individuals showing no increase in urinary Ca excretion were also selected.

Subjects were randomly assigned to either a low-moderate Na (2 g/d) or high-Na diet (5 g/d) for 2 weeks after which they were crossed over to the opposite diets. Three consecutive first morning void urine samples were collected at the end of each of the 2 week dietary periods and analysed for urinary (Ur) Pyr and Dpyr, Ca, Na and creatinine (Cr). In addition, fasting blood samples were collected during each dietary period and analysed for serum osteocalcin and B-Alkphase.

	Sodium sensitive (n 8)				Sodium non-sensitive (n 8)			
	Low Na		High Na		Low Na		High Na	
Variable	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Ur Pyr (nmol/mmol Cr)	33.4	1.7	36.6	2.5	35.6	1.7	35.1	1.9
Ur Dpyr (nmol/mmol Cr)	8.3	0.5	8.9	0.5	9.1	0.6	9.2	0.7
Serum osteocalcin (μg/l)	16.2	2.1	16.1	2.4	16.1	2.4	12.7	1.7
Serum B-Alkphase (U/l)	14.4	1.4	16.0	0.9	17.6	1.9	16.7	1.5
Ur Na (mmol/mmol Cr)	5.5	0.6	10.5*	1.7	6.1	1.0	11.0*	1.4
Ur Ca (mmol/ mmol Cr)	0.15	0.02	0.30*	0.04	0.20	0.04	0.14	0.03

* Significantly different from the low Na period, $P<0.05$ (by Student's t- test).

As expected, in the Na sensitive group significant increases ($P < 0.05$) were seen for urinary Na and Ca excretion on changing from the low- to the high-Na diets and only urinary Na excretion was significantly increased ($P < 0.05$) in the non-sensitive group. There were no significant changes in any of the markers of bone formation or resorption for either the Na sensitive or the non-sensitive groups. Thus, in this short-term study the Na-induced renal hypercalciuria in the sensitive group was not accompanied by significantly increased bone resorption. This may be due to an adaptive response in which intestinal Ca absorption is increased by the action of parathyroid hormone, thus counteracting the calciuria and subsequently preventing bone loss. Alternatively, the lack of effect on these biomarkers may be due to a sufficient Ca-buffering capacity of the skeletal exchangeable Ca pool, which would prevent bone resorption in the short-term but possibly not in the longer term.

This work was supported by the Department of Agriculture, Food and Forestry, Dublin.

Nordin, B.E.C., Need, A., Morris, H.A. & Horowitz, M. (1993). *Journal of Nutrition* **123**, 1615-1622.

Osteoporotic X-ray signs and calcium intake among Beijing adolescent girls. By XUEQIN DU,[1] HEATHER GREENFIELD,[1] DAVID R. FRASER[2] and KEYOU GE,[3] *[1]University of New South Wales, Australia, [2]University of Sydney, Australia, [3]Chinese Academy of Preventive Medicine, China*

To determine Ca and vitamin D status of Beijing adolescent girls, a cross-sectional study was conducted among a random sample of 1300 girls aged 12-14 years from September 1995 to March 1996 in Beijing. All subjects were recruited without bone, liver and kidney diseases. Data for over 1000 variables were obtained including: diet, anthropometry, u.v. exposure (badge), clinical and biochemical examinations, pubertal ratings and X-rays of hand and wrist. The X-rays were read blind independently by two paediatric radiologists.

	Osteoporotic X-ray signs			
	Positive (*n* 44)		Negative (*n* 926)	
	Mean	SE	Mean	SE
Age (years)	12.8	0.07	12.9	0.02
Height (m)	1.56*	0.01	1.54	0.002
Weight (kg)	49.2	1.72	46.0	0.31
Bone age (years)	14.7***	0.16	13.7	0.05
Menarche (% yes)	86 **	-	66	-
Tanner stage (breast)	3.58	0.13	3.30	0.03
Tanner stage (pubic hair)	2.62	0.20	2.27	0.05
Ca intake (mg/d)	308*	21	367	7
Plasma Ca, winter (mmol/l)	2.31	0.03	2.30	0.01
Plasma 25OHD, winter (nmol/l)	15.8	1.66	12.8	0.31
u.v. dose, winter (mJ/cm^{2}UVB per d)	16	2	20	1
u.v. dose, summer (mJ/cm^{2}UVB per d)	41	5	43	2

Mean values were significantly different: * $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$

Preliminary results showed that Ca and vitamin D status were generally low in winter, with prevalence rates of clinical and subclinical vitamin D deficiencies at 6 % and 51 %, respectively. Although there was no radiological evidence of rickets, in 4 % of the girls there were radiological signs of osteoporosis at the metaphyses of radius and/or ulna as well as in the phalanges and metacarpals. The Table shows that subjects with osteoporotic X-ray signs were taller, had a higher bone age and menarche rate, but a lower Ca intake, indicating that they were growing faster and were more mature for the same age than the girls without osteoporotic signs. Though plasma 25-hydroxycholecalciferol levels were similar in the two groups, the osteoporotic group had a trend of less u.v. exposure, implying that they had less outdoor physical activity which may also have contributed to the X-ray signs. The preliminary results suggest that low Ca intakes may be associated with the osteoporotic X-ray signs among Beijing adolescent girls. Further studies of the metacarpal index together with the bone mineral content data for these girls are required to determine the relevance of these X-ray signs.

We are indebted to Prof. Wang Yunzhao (Beijing Ji Shui Tan Hospital) and Dr. Vimala Nayanar (Prince of Wales Hospital, Sydney) for their reports on the X-rays; to Ms. Angelika Trube (University of Sydney) for her technical assistance in biochemical tests; and to all other participants. This project is supported in part by the Dairy R&D Corporation, Australia.

Human milk immunoglobulin A (IgA) concentrations during the first year of lactation. By Helen M.L. ARTHUR[1], James E.G. BUNN[2,3], Julian E. THOMAS[2,3] and Lawrence T. WEAVER[1,3], *Department of Child Health, University of Glasgow[1], Department of Child Health, University of Newcastle[2], and MRC Dunn Nutrition Uni,t Cambridge[3].*

Human milk is rich in immunoprotective factors, which play a role in the prevention of microbial infection in the sucking infant. Among these is IgA which acts at the mucosal surface to protect the epithelium from microbial and food antigens. There have been earlier studies of the changes in IgA concentrations in human milk throughout lactation (Prentice *et al.* 1984), but none has measured inter-breast variation, nor sequentially through every month of lactation and during each season of the year. The aim of the present study was to measure the concentration of total IgA in the milk secreted by both breasts, throughout the first year of lactation in a cohort of mothers of infants at high risk of infection.

Sixty-five Gambian women resident in the rural village of Keneba, the site of the MRC Dunn Nutrition Unit's overseas research station, were studied monthly from the 4th to 52nd postpartum week. Samples of milk (5 ml) were obtained from each breast by manual expression immediately before the baby was suckled. Milk intakes were measured by test weighing before and after feeds over 12 h. Samples were stored at -20° until analysis by ELISA, using a goat anti-human a-chain specific IgA (Sigma, Poole, Dorset), with a human colostral standard.

Milk samples (*n* 1590) were measured (798 from right breast and 792 from left breast). The median concentration of IgA for all samples was 708 (interquartile range 422-1105) mg/l; from milk obtained from the left breast was 785 (interquartile range 458-1247) mg/l and from the right breast was 645 (interquartile range 388-1011) mg/l ($p<0.001$). The Table shows the changes in milk ingested (mean and SD), total IgA concentration (median and interquartile range) and total IgA ingested/12h (median and interquartile range) throughout the first year of lactation.

Age (weeks)...	8-9	16-17	27-28	39-40	51-52
Milk intake (g/12h)	376 (98)	358 (96)	334 (96)	343 (106)	312 (94)
Total IgA conc (mg/l)	625 (376-959)	666 (399-1125)	680 (451-1008)	715 (359-1063)	746 (408-1067)
IgA intake (mg/12h)	242 (172-392)	279 (151-363)	221 (157-333)	258 (138-393)	208 (151-336)

There were no significant changes in milk or IgA intakes with infant age, in the whole sample. However within mothers there were changes over time, but with significant concordance of IgA concentrations between the two breasts, showing 'tracking' of the output of the left and right breasts ($p<0.001$). During the dry season (December - May) median IgA was significantly higher at 853 (interquartile range 571-1254) mg/l than during the rainy season (June - November) when it was 518 (interquartile range 311-909) mg/l ($p<0.0001$). There were no significant differences in weight of milk ingested throughout the seasons, nor significant relations between maternal age or parity, and milk IgA concentrations or amounts ingested.

IgA secretion is maintained by mothers throughout the first year of lactation. It varies with season. Although there are differences in output between the two breasts, changes over time run parallel suggesting control of secretion above the level of the mammary gland. Sustained IgA secretion is likely to aid protection of sucking infants from microbial infection.

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Free-choice feeding and energy metabolism of growing broilers at moderate (20°) and high (30°) ambient temperatures. By M.A. AL-HARTHI and M.G. MACLEOD, *Roslin Institute (Edinburgh), Roslin, Midlothian EH25 9PS*

Offering broiler chickens a choice between low- and high-protein diets has been tested several times as a way of alleviating the growth depression associated with high ambient temperature. The responses of the birds have been variable, as has the success of the technique if judged by production criteria (Cowan & Michie, 1977; Mastika & Cumming, 1987). In the present experiment, two dietary treatments (a complete compound diet and a choice between wheat meal and a high protein concentrate) were applied at each of two temperatures (20° and 30°). The complete diet contained 250 g crude protein (CP) and 11.6 MJ apparent metabolisable energy (AME) per kg. The choice-fed birds were offered wheat meal (110 g CP and 12.8 MJ AME/kg) in one feeder and a high protein mixture (460 g CP and 9.7 MJ AME/kg) in the other. The latter diet contained all the ingredients of the complete diet other than wheat meal. Eight 40-d-old male broilers were exposed individually to each treatment combination for a total of 6 d in open-circuit calorimeters (Lundy *et al.* 1978). The first 3 d were allowed for the birds to become accustomed to the experimental set-up and the measurements tabulated below are the means of the second 3 d period.

	20°		30°		Standard error
	Complete diet	Free choice	Complete diet	Free choice	of difference
Food intake (g/d)	151[a]	124[b]	117[b]	115[b]	6.2
Protein intake (g/d)	38[a]	26[bc]	30[b]	22[c]	1.8
Growth rate (g/d)	67[a]	45[b]	43[b]	36[b]	9.5
AME intake (kJ/d)	1692[a]	1494[b]	1370[b]	1402[b]	68.8
Heat production (kJ/d)	1162[a]	1036[b]	917[c]	867[c]	41.0
E retained as protein (kJ/d)	412[a]	274[bc]	325[b]	244[c]	24.0
E retained as fat (kJ/d)	119[b]	184[b]	128[b]	291[a]	39.0
Total energy (E) retained (kJ/d)	531[a]	458[a]	453[a]	535[a]	54.0

[abc] Values in the same row not sharing a common superscript were significantly different, $P<0.05$ (ANOVA).

Free choice feeding gave lower food and protein intakes than the complete diet, especially at 20° (Table). Choice feeding also produced a lower rate of weight gain, as a consequence of the reduced total food intake and the reduced proportion of protein in the chosen combination of foods. The latter effect also led to a significant decrease in the quantity and proportion of energy retained as protein and contributed to a corresponding increase in the proportion of energy retained as fat. Energy retention as fat was influenced by three factors: energy intake, diet composition (CP:AME ratio) and ambient temperature. The greatest fat retention was, therefore, obtained in the birds on choice feeding and kept at 30°, which selected a lower CP:AME ratio and also had lower thermoregulatory heat production. The bird's "preferred" rate of protein growth may be lower than the target set by the poultry industry and attained by commercial compound diets, so choice feeding does not necessarily sustain maximum growth rate even at high temperature.

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Effects of a traditional anti-diabetic plant, *Sambucus nigra* (elder), on glucose metabolism and insulin secretion *in vitro*. By ALISON M. GRAY and PETER R. FLATT, *School of Biomedical Sciences, University of Ulster, Coleraine BT52 1SA*

The use of antihyperglycaemic plant treatments for diabetes mellitus largely disappeared in occidental societies with the introduction of insulin and oral hypoglycaemic drugs. However, such plants may provide valuable clues for the development of new oral hypoglycaemic agents, or serve as simple dietary adjuncts in the treatment of diabetes. *Sambucus nigra* (elder) has been used in the past as a traditional remedy for diabetes in Europe (Palaiseul, 1983). The present study was undertaken to investigate the possible mechanism of effect of elder. The effects of an aqueous extract of elder (1 g elder/40 ml; prepared by 15 min decoction of dried elder flowers) on glucose uptake and metabolism by isolated mouse abdominal muscle and on insulin secretion by BRIN-BD11 cells was investigated.

Extract (1 mg/ml) increased 2-deoxy-[1-^{3}H]glucose transport, glucose oxidation and incorporation of glucose into muscle glycogen compared with control but did not significantly alter total lactate production within the preparation (Table). Insulin (10^{-8}M) exerted similar metabolic effects which were not increased by combination with extract (Table).

	Control		Insulin (10^{-8}M)		Extract (1 mg/ml)		Insulin (10^{-8}M) + Extract (1 mg/ml)	
	Mean (*n*)	SE	Mean (*n*)	SE	Mean (*n*)	SE	Mean (*n*)	SE
Glucose uptake (dpm/mg per hr)	172 (6)	11	339 *** (6)	34	287 * (6)	46	351 ** (6)	22
Glucose oxidation (nmol/mg per hr)	0.42 (10)	0.03	0.63 ** (10)	0.06	0.63 ** (10)	0.05	0.748 ** (10)	0.0 8
Incorporation of glucose into glycogen (nmol/mg per hr)	0.18 (10)	0.02	0.36 ** (10)	0.05	0.29 * (10)	0.05	0.41 ** (10)	0.0 7
Total lacate production (nmol/mg per hr)	38 (9)	1.9	41 (8)	2.3	41 (8)	3.0	44 (6)	3.8

Mean values were significantly different from control: *P<0.05, **P<0.01, ***P<0.001

In acute 20 min incubations, 0.25 - 1 mg/ml (n 6) of elder extract induced a stepwise 5.7 - 18.2 fold increase in insulin secretion by BRIN-BD11 cells at 1.1 mM-glucose (control, 0 mg/ml extract; 1.4 (SE 0.5) ng/10^6 cells per 20 min, P<0.05). Diazoxide (0.5 mM) completely abolished the effect of 0.5 mg/ml extract (P<0.001) and prior exposure to extract (0.5 mg/ml) did not alter subsequent submaximal stimulation of insulin secretion by 10 mM-L-alanine. However, at 5 mg/ml and greater concentrations extract was toxic as determined by modified neutral red assay. The stimulatory effect of extract was potentiated by the presence of high glucose (16.7 mM; P<0.05) but was unaltered by the presence of 1 mM-3-isobutyl-1-methylxanthine, a phosphodiesterase inhibitor. The insulin secretory response with 10 mM-L-alanine was diminished by the presence of extract (P<0.001) as was insulin secretion by completely depolarized cells (16.7 mM-glucose + 25 mM-KCl). Activity of extract was heat stable, unaltered by overnight exposure to acid or alkali (0.1 M-HCl or 0.1 M-NaOH) and entirely retained in an acetone soluble fraction. Activity decreased 41% with dialysis (molecular weight cut-off <2000 Da), possibly indicating a role for low molecular mass ions in the insulin secretory activity of extract. Despite the presence of activity in an aqueous extract, sequential solvent extractions indicated that activity was due to the cumulative effect of more than one active constituent that was likely to be more non-polar in nature.

These results indicate that elder contains components that exert both extrapancreatic and pancreatic actions which merit further evaluation in the treatment of diabetes.

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Nutrient sources of phylloquinone (vitamin K_1) in Scottish men and women. By S.T. FENTON[1], R. J. PRICE[1], C. BOLTON-SMITH[1], D. HARRINGTON[2] and M.J. SHEARER[2], *[1]Cardiovascular Epidemiology Unit, University of Dundee, Ninewells Hospital and Medical School, Dundee DD1 9SY. [2]Vitamin K Research Unit, Haemophilia Centre, St Thomas' Hospital, London SE1 7EH*

The main dietary form of vitamin K is phylloquinone (K_1) (Shearer *et al.* 1996).Vitamin K is essential for the γ carboxylation of glutamate residues of certain proteins that play important roles in haemostasis and possibly in the control of bone metabolism and vascular calcification (Shearer, 1995;Vermeer *et al.* 1995).

Dietary K_1 intake has only recently been determined in a UK population group (Price *et al.* 1996), due to the previous lack of basic food compositional data. Using this new database, the diets of thirty-four men (mean age 35.1, SD 8.22 years) and thirty-eight women (33.8, SD 7.11 years) were analysed from 7 d weighed food diaries recorded at each season of the year. The percentage contributions of food groups to total K_1 intake are reported in the Table.

	Smokers (*n* 29)		Non Smokers (*n* 43)		Men (*n* 34)		Women (*n* 38)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Cereals: Total	12.0		15.3		14.7		13.3	
Bread/rolls/chapatis	3.3	1.89	3.9	1.79	3.9	2.12	3.4	1.55
Breakfast cereals	0.6	1.01	1.5	1.98	1.0	1.64	1.3	1.78
Biscuits/crackers	1.5	1.34	1.7	1.82	1.6	1.90	1.7	1.40
Puddings/cakes	5.2	3.91	6.3	4.86	6.3	5.12	5.6	3.92
Savoury dishes	1.5	2.16	1.8	2.99	2.0	3.15	1.4	2.17
Dairy products: Total	3.5		3.9		4.3		3.3	
Milks	1.4	1.44	1.4	2.85	1.8	3.29	1.0	0.93
Vegetable and vegetable dishes: Total	48.5		47.3		46.1		49.2	
Potatoes (+ chips)	9.4	6.40	4.3	3.65	7.1	5.42	5.7	5.58
Peas, beans, lentils	5.8	7.10	4.0	2.43	5.9	6.48	3.6	2.53
Green vegetables *	26.7	18.69	29.5	14.68	24.6	16.27	31.7	15.89
Vegetable dishes	6.6	5.66	9.6	8.15	8.5	8.86	8.3	5.81
Meats/meat products: total	7.7		4.6		8.3		3.7	
Red meat, offal, lamb	1.7	1.74	0.7	0.81	1.6	1.61	0.64	0.81
Meat dishes	6.0	6.44	3.9	3.97	6.7	6.68	3.0	2.27
Fruit/fruit juices: total	2.0		5.9		3.1		5.6	
Fish/fish dishes: total	2.7		2.1		2.1		2.5	
Fats/ oils: total	6.0	4.65	4.1	4.8	5.6	6.14	5.2	3.05
Miscellaneous								
Soups	4.3	2.99	6.1	5.48	5.0	4.71	5.67	4.73
Crisps/savoury snack	2.6	2.88	1.0	1.26	1.0	1.04	2.3	2.72
Sauces	4.8	4.79	3.2	3.56	3.7	4.65	4.0	3.70
Other: Total †	4.8	0.87	4.5	0.77	5.1	0.86	4.1	0.75
Phylloquinone intake μg/d	65	45	77	29	76	43	69	30

*Includes root and other vegetables;

† Other includes Eggs, egg dishes, nuts & seeds, herbs and spices, confectionery, beverages.

The single main source of K_1 is green leafy vegetables with an overall mean of 28% coming from the green and other vegetables food group. This included root and other vegetables that are known to have negligible K_1 amounts. The majority of K_1 coming from mixed dishes and the cereals and miscellaneous groups represents K_1 from the constituent fats. Thus fats from all sources contribute about 30% of total K_1 intake in this population. These results accord well with data from the USA (Booth *et al.* 1996).

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Correlation of fruit and vegetable intake of 8-9 year old children and their mothers: preliminary results from a study of family eating patterns. By W.L. WRIEDEN and P. LONGBOTTOM, *School of Management and Consumer Studies, University of Dundee, DD1 4HT*

Understanding the development of food patterns and eating habits is of crucial importance to the promotion of good health. It is often stated that food preferences are instilled in the early years of life and there is some evidence to support this (Birch & Marlin, 1982). Family eating habits would therefore be expected to influence the food intake of children. Wardle (1995) reviewed the research findings on parent-child similarities in diet and concluded that there was little information on parent-child similarity in the consumption of actual foods, although intakes of some nutrients have been correlated within families.

In a pilot study designed to test the methods for a Scottish study of family eating patterns, diet and dental health, mothers (n 13) and their 8-9-year-old children kept a 4 d dietary record. The children's food was weighed and mothers completed records using food photographs (Geekie *et al.* 1997). All families were from Dundee and came from a range of socio-economic backgrounds. The mothers ranged in age from 26 to 42 years and were all married with the exception of one divorcee. The intakes of total fruit and vegetables (excluding potatoes but allowing for one serving of fruit juice per d as suggested by Williams, 1995) showed a significant positive correlation for the mothers and their children using Spearman's rank correlation (r_s). Similarly the weight of chips consumed, daily intakes of energy (kJ), NSP (g) and vitamin C (mg), were also shown to correlate. However there was no significant correlation for the percentage of energy from non-milk extrinsic sugars (NMES), total sugars or fat.

	r_s	P value
Fruit and Vegetables (g)	0.857	<0.001
Chips (g)	0.723	<0.01
Energy (kJ)	0.692	<0.01
Fat (% energy)	0.368	NS
Total sugars (% energy)	0.423	NS
NMES (% energy)	0.011	NS
NSP (g)	0.617	<0.05
Vitamin C (mg)	0.577	<0.05

The results for this group of 8-9-year-olds show that strong positive correlations were seen for vitamin C and NSP as well as two of the main sources of these nutrients. Median daily intakes of fruit and vegetables were 180 g for adults and 236 g for children. However median intakes of mothers and their children where mothers had educational qualifications equivalent to 'A' level or above (n 8) were over four times those for mothers with lower or no educational qualifications (n 5). The influence of parents on children's fruit and vegetable intakes should not be underestimated and further aspects of this relationship will be examined in the main study.

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Nutrient intake in Scottish adolescents. By N.R. BELTON[1], A.D.L. MACVEAN[1], N.D. RICHARDS[2], R.A. ELTON[1], W.M.U. MOFFAT[1] and T. F. BEATTIE[1], *[1]Department of Child Life and Health, University of Edinburgh EH9 1UW and [2]Department of Child Health, University of Nottingham NG7 2UH*

Nutrient intakes were estimated in 387 Scottish teenagers aged 16 years (M 153, F 234) by the food frequency method using the Tinuviel Diet Q questionnaire (Tinuviel Software, Warrington, Cheshire) which is based on a questionnaire designed by Fehily (Yarnell *et al.* 1983). Data were collected in the 1986 sweep of the UK British Cohort Study 1970 cohort. Results are shown in the Table and compared to Recommended Nutrient Intakes (RNIs) (Department of Health 1991).

	Males					Females				
Nutrient	Mean	SD	Min	Max	RNI	Mean	SD	Min	Max	RNI
Energy (kcal)	2591	376	1632	4064		2018	346	1030	3179	
Energy (MJ)	10.88	1.57	6.85	17.03		8.47	1.45	4.33	13.31	
Protein (g)	88.3	13.4	52.9	131.6	55.2	74.8	12.0	39.1	107.2	45
Total fat (g)	121.4	22.1	59.8	179.0		93.6	20.5	44.9	180.2	
Carbohydrate (g)	299.0	42.8	189.7	460.4		227.7	39.7	108.0	324.6	
Sugars (g)	112.6	25.3	54.6	185.6		96.8	21.9	41.2	158.9	
Starch (g)	185.4	28.5	87.3	273.5		130.0	25.8	56.2	200.9	
Englyst fibre (g)	15.9	4.1	5.7	27.3		13.5	3.7	4.0	25.2	
Sodium (mg)	3421	647	1635	6019		2594	535	1494	4306	
Potassium (mg)	3245	536	1409	4665	3500	2716	467	1262	4334	3500
Calcium (mg)	999	192	460	1525	1000	880	157	297	1349	800
Magnesium (mg)	301	61	157	475	300	245	45	135	449	300
Phosphorus (mg)	1397	230	774	2126	775	1197	186	593	1864	625
Iron (mg)	12.9	2.2	8.3	20.6	11.3	10.4	2.2	5.1	19.9	14.8
Copper (mg)	1.48	0.40	0.75	3.45	1	1.14	0.37	0.53	4.15	1
Zinc (mg)	10.5	1.8	5.5	15.8	9.5	8.9	1.6	5.3	13.2	7
Retinol (μg)	1044	811	157	5869		937	1039	228	9713	
Carotene (μg)	1172	746	210	3413		1203	775	203	3443	
Folate (μg)	274	62	143	487	200	220	50	85	344	200
Vitamin C (mg)	64	21	9	124	40	63	20	19	125	40
Vitamin D (μg)	3.63	1.48	0.89	9.98		2.81	1.21	0.40	8.08	
Vitamin E (mg)	5.13	2.02	2.08	13.33		4.16	1.26	1.90	8.52	
P:S ratio	0.36	0.13	0.16	0.97		0.34	0.11	0.15	1.07	
Percentage energy from:										
Protein	13.7	1.5	9.6	18.9		15.0	2.0	10.2	22.2	
Fat	42.1	3.6	25.9	52.8		41.6	3.7	29.4	53.0	
Saturated fat	17.5	2.5	9.5	23.0		17.4	2.3	11.3	25.2	
Polyunsaturated fat	6.0	1.5	3.5	13.3		5.8	1.4	3.2	15.2	
Monounsaturated fat	15.4	1.9	9.3	20.0		15.1	2.0	9.7	22.3	
Carbohydrate	43.4	3.2	33.5	53.6		42.4	3.4	33.0	50.9	
Starch	26.9	2.7	20.1	38.5		24.2	3.1	15.1	34.1	
Sugars	16.3	3.1	9.2	29.1		18.0	2.9	10.1	29.6	
Alcohol	0.90	1.96	0.00	9.50		1.10	2.69	0.00	18.20	

P:S ratio, polyunsaturated:saturated fat ratio

Although intake of most nutrients compared well with RNIs, there are many causes for concern in these results and thus room for improvement in adolescent diets. Of particular concern was that 50% of the males and 32% of the females were below the RNI for Ca and that 22% of the males and 98% of the females were below the RNI for Fe (65% of the females were also below the Estmated Average Requirement). Not entirely unexpectedly but nevertheless regrettable was that the average percentage energy from fat, about 42%, was well above that recommended (35%) and that the P:S ratio was well below that recommended (1.0). The percentage of energy from sugars was also very high.

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Selenium status and selenoprotein function in a Scottish population. By K.M.BROWN, K.PICKARD, F.NICOL, AND J.R.ARTHUR, *Micronutrients and Lipid Metabolsim, Rowett Research Institute, Aberdeen AB21 9SB*

Se status is reported to have declined significantly in the UK between 1974 and 1991 (Diplock 1993) which may be of great importance in relation to Se supplementation decreasing the incidence of cancer (Clark *et al* 1997). Plasma and erythrocyte Se concentrations are used to reflect short- and long-term Se status respectively, but a more precise definition of status is the effect on selenoprotein function *in vivo*. To determine the effect of Se intake on functional Se status and its short-term variation, we measured plasma and erythrocyte Se concentrations and the activity of glutathione peroxidase (*EC* 1.11.1.9; GSH-Px) in 60 healthy subjects (mean age 44(SD7)years) from a population with low Se intake over a 3 week period. The study is part of a longer term Se supplementation trial which will be reported at a later date. Ethical permission was granted by the Joint Ethical Committee of Grampian Health Board and University of Aberdeen.

A mean 10% intra-individual variation was observed for plasma and erythrocyte Se concentration and enzyme activity in fasting samples taken at 14 and 21 day intervals (Table 1). Inter-individual variation was higher over the same time interval, but mean Se concentration and enzyme activity were similar (Table 1). Plasma Se levels were significantly lower than in most other European countries ($P<0.02$), and levels in erythrocytes half the value previously reported for a UK population (Campbell *et al* 1989).

	Day 0	Day 14	Day 21	
	Mean SD (%cv) [1]	Mean SD (%cv) [1]	Mean SD (%cv) [1]	Intra-individual %cv SD
Plasma GSH-Px mU/ml	694 183 (26.4)	637 173 (27.2)	651 151 (23.2)	7.68 4.8
Erythrocye GSH-Px U/gHb	61.4 10.0 (16.3)	70.8 9.1 (13.0)	71.1 17 (25.0)	12.66 8.3
Plasma Se µmol/L	1.01 0.2 (20.6)	1.12 0.17 (15.7)	1.16 0.16 (13.8)	10.83 8.9
Erythrocyte Se µmol/L	0.70 0.13 (19.2)	0.67 0.13 (21.4)	0.68 0.13 (20.8)	10.13 8.2

[1] Representing inter-individual coefficient of variation

A significant linear correlation ($r^2 = 0.441$, $P<0.01$) between blood Se concentration and cytosolic GSH-Px activity was observed for Se concentrations below 1.2 µmol/L, indicative of low to moderate Se status. Se concentrations below this value were observed in 77% of the study population.

Poor Se status could not be attributed to an old age related decline because of the relatively young population studied, but did reflect the low dietary intake of Se. The functional effect of a low Se status remains to be assessed.

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Copper and glutathione peroxidase (GSHPx) responses in lambs given a sustained-release rumen bolus. By R. GORDON HEMINGWAY, JAMES J. PARKINS and NORMAN S. RITCHIE. *Department of Veterinary Clinical Studies, Glasgow University Veterinary School, Bearsden, Glasgow G61 1QH*

A polymer-coated bolus with a separate inert grinder containing (as inorganic salts) 5300 mg Cu, 50 mg Se, 90 mg Co, 100 mg I, 4700 mg Zn and 3250 mg Mn with 81 mg retinol, 216 mg cholecalciferol and 800 iu dl-α-tocopherol acetate ('Small-Trace', Agrimin Ltd. DN20 0SP) significantly increased plasma Cu concentrations and GSHPx activity in 70 kg ewes over at least 4 months. Mean liver Cu concentrations were increased from 139 to 487 mg/kg DM. (Ritchie *et al.* 1997). Such a multi-nutrient bolus would be useful for growing lambs but it is possible that there could be an undue increase in liver Cu concentration for some breeds of sheep.

Eight Texel x Greyface weaned lambs (about 20 kg live weight) at grass were given a bolus (B) as described. A further eight lambs were untreated (U). Blood samples were obtained initially and after 65 d. Bolus and inert grinder residues and liver samples were collected from all the lambs at slaughter in groups of four per treatment as they reached about 40 kg live weight after 80 or 103 d.

Mean plasma Cu concentrations (μmol Cu/l) (*n* 8) were initially 15.6 (B) and 15.3 (U) (SED 1.55, NS). After 65 d these increased to 17.9 (B) and 15.7 (U) (SED 1.20, NS). Mean GSHPx activity (units/ml erythrocytes at 37^0) (*n* 8) were initially 46 (B) and 52 (U) (SED 14.9, NS). After 65 d these significantly increased to 204 (B) and decreased to 13 (U) (SED 28.4, $P<0.001$). Overall (*n* 8) mean liver copper concentrations (mg/kg DM) were 831 (B) and 216 (U) (SED 84.4, $P<0.001$). Liver Cu concentration was significantly ($P<0.001$) correlated (*r* 0.93) with bolus matrix weight loss (liver Cu (mg/kg DM) = 241 + 31.9 x matrix loss (g)).

The mean losses of bolus matrix (*n* 4) were 16.2 (SE 3.53)g after 80 d and 20.1 (SE 2.75)g after 103 d. These were in good agreement with the mean losses (*n* 6) of 15.4 g, 17.1 g and 23.7 g recorded after 43 d, 83, d and 139 d for boluses given to 70 kg ewes at grass (Ritchie *et al.* 1997). The estimated life of the entire 30 g bolus matrix is about 215 days.

It is concluded that the bolus should be administered with caution to growing lambs of about 20 kg live weight. The size (cylindrical, 19 mm diameter, 55 mm length) is increased to 73 mm by the temporary attachment of a dense grinder. This accelerates movement through the rumen to the reticulum where the grinder is rapidly separated from the bolus. Thereafter, both grinder and bolus remain together in the reticulum. The extent of Cu accumulation in the liver suggests an increase of about 950 mg Cu/kg DM from the entire bolus for this size of lamb. Construction of a smaller size of bolus with a reduced Cu content combined with the use of a more appropriately designed administration gun could overcome these difficulties with lambs of this live weight.

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Secretion of milk with mastitis-like appearance from cows and sows given sesame expeller meal.

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Sesame (*S. indicum)* is widely grown in tropical countries. Oil extracted from the seeds may be used to replace olive oil. The seeds are used in cooking for flavouring and decoration and in ethnic foods. Varied allergic reactions following consumption similar to, but less frequent than, those associated with peanuts have been reported for human subjects (Department of Health 1996, Sporick & Hill 1996). Following oil extraction, the resulting protein and energy-rich expeller cake (containing about 120 g residual oil /kg) may be used as a feed for farm livestock.

In 1965 an animal feed manufacturer reported that inclusion of a particular consignment of sesame expeller meal in a dairy production compound feed had spontaneously led to the secretion of milk with mastitis-like appearance at the next milking time in many of the of cows in about twenty separate herds. Giving typically 6-8 kg /cow per d supplied 300-400 g sesame meal. Many of the cows rapidly became restless and showed signs of discomfort.

Four healthy cows were milked at 06.00 hours. Each was given 0.5 kg suspected sesame meal at 08.00 hours. By 10.00 hours each cow became agitated, with frequent, restless movement of the hind legs and a markedly arched back. The udders were hard and the body temperature was elevated. Milk withdrawn from the udders contained multiple small, white coagulations typical of mastitis milk. It contained increased concentrations of Na, Cl and urea with a reduced lactose concentration. All are typical of milk from udders with tissue damage. There were no bacteriological changes. Other feed was refused during the day and milking at 16.00 hours was only partial and difficult. On the following day normal feed and hay were offered and the milk was substantially normal 36 hours after the event.

Oil was extracted from the sesame meal and 50 ml was given orally by bottle to each of four other cows. No allergic signs were observed. Further sesame meal was dried at 80° for 2 d to partially denature protein and 0.5 kg was given to four other cows. Whilst the same allergic signs were observed they were markedly less severe and the cows ate normally later in the day.

No further investigations were made and no definitive conclusions were possible. The offending feed had been immediately withdrawn from all the farms with no opportunity to determine if continued use would lead to disappearance of the symptoms. It might be speculated that the sesame meal was contaminated. Mycotoxins arising from mouldy feeds (including sesame) have induced both fever and mastitis in dairy cows (Haggblom *et al.* 1990). A wide variety of Fusarium toxins have been reported in sesame seed by Mirocha *et al.* 1976).

Following these events, the sudden onset of milk with mastitis-like appearance in many of the lactating sows in a large herd was reported. They had hard and somewhat inflamed udders and were in obvious discomfort. These allergic signs appeared shortly after the sows were given their first feed of a new purchase of compound feed. It was subsequently discovered that one ingredient was the same previously implicated consignment of sesame expeller meal. Alternative feed was given to the sows which returned to normal over the next 2 d.

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Dietary modifications to increase food utilization and growth rate in broiler chickens exposed to high ambient temperature (30°). By M.A. AL-HARTHI and M.G. MACLEOD, *Roslin Institute (Edinburgh), Roslin, Midlothian EH25 9PS*

High ambient temperature decreases food intake and consequently growth rate in broiler chickens. It is usually assumed that the reduced food intake results firstly from a decrease in energy requirements for thermoregulation and secondly from the need to minimize heat stress by reducing the heat increment of feeding. However, there is an alternative hypothesis that high temperature reduces the ability of the alimentary canal to break down and propel food, possibly because of the redirection of blood flow to the periphery. An indication of this is that food passage rate is decreased by high ambient temperature (Savory, 1986). The present experiment aimed to separate the heat production and digestion effects of high temperature by measurement of heat production in birds fed on diets treated in ways which would be expected to affect the amount of work done by the alimentary tract. A further treatment was to increase dietary protein concentration, which would be expected to permit greater protein synthesis on reduced food intake. The control diet was a typical, coarsely ground mash containing 256 g crude protein (CP) and 11.6 MJ apparent metabolizable energy (AME) per kg. Diet 2 involved soaking the control diet freshly each day in twice its weight of water. For diet 3, the same feed was finely ground to pass a 1 mm screen before being mixed daily with twice its weight of water. To make up diet 4, NaCl (20 g/kg) was added to diet 3 (Na ion concentration is known to affect absorption). Diet 5 was a high-protein formulation (380 g CP and 11.4 MJ AME per kg), which was also ground and soaked. Ten individual Ross Broiler males were given each diet from 47 to 54 d of age, while continuously housed in open-circuit calorimeter chambers (Lundy *et al.* 1978) controlled at 30°. AME was measured by total collection.

	Diet 1 Control	Diet 2 Wetted (W)	Diet 3 W+ ground (G)	Diet 4 W+G+NaCl	Diet 5 W+G+ high protein	SED
Food intake (g DM/d)	84^{c}	107^{ab}	118^{a}	114^{ab}	104^{b}	6.3
Growth rate (g/d)	27^{c}	36^{bc}	50^{ab}	59^{a}	50^{ab}	7.8
AME intake (kJ/d)	1023^{c}	1235^{ab}	1377^{a}	1360^{a}	1190^{b}	75.3
Heat production (kJ/d)	798^{b}	892^{a}	946^{a}	923^{a}	884^{a}	41.6
Energy retention (kJ/d)	225^{b}	343^{ab}	431^{a}	437^{a}	307^{b}	58.5
Apparent metabolizability	0.72^{a}	0.69^{b}	0.69^{b}	0.72^{a}	0.64^{c}	0.01

^{abc} Mean values within a row not sharing a common superscript were significantly different, $P< 0.05$.

Wetting and grinding the diet led to increased food consumption, growth rate and energy retention (Table). Elevated NaCl content increased the metabolizability of the diet compared with the corresponding diet 3. High protein content (diet 5) produced a similar weight gain to the lower-protein diet 3, but with decreased energy retention. Heat production increased significantly with increased food intake and growth rate on the "processed" diets. The birds were, therefore, shown to have been able to increase food intake, growth rate and heat production when their diet was treated appropriately. The results were, accordingly, consistent with the explanation that gut function and not heat production places a limit on food consumption at 30°.

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Clinical practices that undermine the effectiveness of growth monitoring in primary health care.

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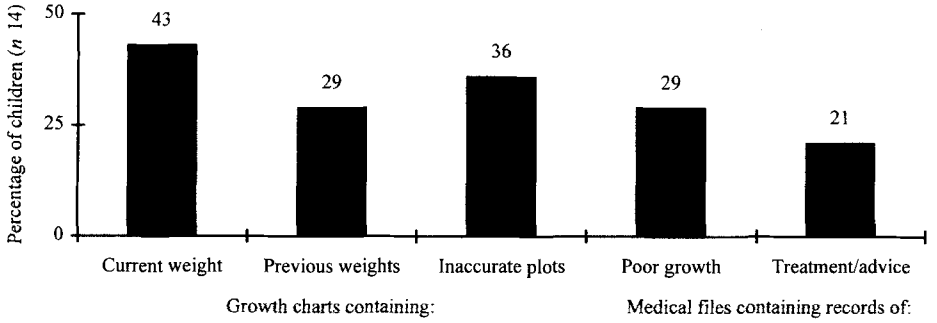
Growth monitoring is a cornerstone of current primary health care initiatives which aim to eradicate infant mortality in less developed countries (Morley 1994). However, in established urban communities of rapidly industrialising countries, such as South Africa, primary health care is increasingly provided by facilities with access to expert medical care (Coetzee & Ferrinho 1994). Under these circumstances, it remains unclear whether growth monitoring is being used as an important diagnostic tool to identify children who require medical attention for growth faltering (Morley 1994).

To assess the importance of growth monitoring in a semi-formal urban community in South Africa we examined the growth charts contained within the Road to Health (RTH) cards of seventy-nine consecutive patients who attended the paediatric clinic at Alexandra Health Centre in Johannesburg (Coetzee & Ferrinho 1994). Any child whose growth chart indicated a period of static or negative weight gain during the past 12 months, or whose weight had fallen below the 3rd National Center for Health Statistics percentile, was considered to have experienced growth faltering. The RTH cards and medical files of these patients were examined in detail to evaluate the accuracy of the growth chart and to assess what remedial advice or treatment had been given.

A total of fourteen (17.7%) children had RTH cards that contained periods of growth faltering during the previous year. A quarter of these children (24%) were less than 1 year old and there was no significant difference between the age distribution of children with or without growth faltering (Mann-Witney U test, U=541, $P>0.2$). Using duplicate records of weight measurements contained within their medical files it was possible to identify which growth charts contained incomplete and/or inaccurately plotted weight data (see Fig.). More than half (57%) of the charts did not contain the child's current weight and most (71%) did not contain all their previous weight measurements. Likewise, over a third (36%) of the charts contained data that had been inaccurately plotted. When the growth charts were accurately redrawn, using all available weight measurements, there remained evidence of growth faltering for all fourteen children, and eight displayed even worse periods of growth than those originally plotted. Nevertheless, most of the children (71%) had medical files that contained no reference to their poor growth and most (79%) had no records of any advice or treatment for poor growth.



These results suggest that the growth charts examined in the present study were able to identify children who display growth faltering even though the charts were often incomplete and incorrectly plotted. Nevertheless, improvements in plotting technique and a more consistent approach to recording each child's current weight would help improve the accuracy and consistency of these charts. Clinical assessments could then rely on growth monitoring when recording the health and treatment of children who exhibit growth faltering. Certainly, when growth monitoring is inconsistent and inaccurate, it is not clear that children with poor growth are identified and receive appropriate care.

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The effect of weaning on fermentation capacity in formula-fed infants. By A. M. PARRETT and C. A. EDWARDS, *Department of Human Nutrition, Glasgow University, Yorkhill Hospitals, Glasgow G3 8SJ*

The colonic microflora of the breast-fed (BF) infant is dominated by bifidobacteria and lactobacilli whereas the flora of the formula-fed (FF) infant is closer to that of the adult, dominated by enterobacteria and *Bacteroides* spp (Balmer & Wharton, 1989). These differences are reflected in the profile of faecal short-chain fatty acids (SCFA), products of carbohydrate fermentation in the colon (Edwards *et al.* 1994). We previously showed that the development of ability of the microflora of BF infants to ferment complex carbohydrates *in vitro* was slow, increasing significantly only during late weaning (Parrett *et al.* 1996).

Before weaning, FF infants have a flora more like that of adults, so it might be expected that their ability to ferment carbohydrates will develop more quickly than that of BF infants. In the present cross-sectional study, an *in vitro* faecal incubation system was used to assess the ability of FF infants to ferment simple and complex carbohydrate. Fresh faecal samples were obtained from ten exclusively FF infants (unweaned), ten FF infants taking liquidized food (early weaning) and ten FF infants taking chopped food (late weaning). Samples were processed within 1 h of passage. Cultures containing 32 g faeces/l and 1 g carbohydrate/l (glucose, raftilose or soyabean polysaccharide) in a tryptone basic salts medium (Adiotomre *et al.* 1990) were anaerobically incubated at 37°. A control culture with no carbohydrate was also incubated. After 24 h, pH was measured and SCFA and lactic acid in culture supernatant fractions were analysed by GLC. Results were compared by Mann-Whitney U tests after subtraction of values from the control culture.

Total SCFA + Lactic acid concentration (μmol/ml)

	Unweaned *n* 12		Early weaned *n* 7		Late weaned *n* 8		Adults *n* 6	
	Median	Range	Median	Range	Median	Range	Median	Range
BREAST-FED								
Glucose	82.3	20.7 -103.0	99.6*	82.0 -120.5	83.4	58.5 - 129.9	47.4	4.4 - 93.7
Raftilose	41.3	3.6 - 56.1	62.8†	2.5 - 90.2	76.0†††	54.8 - 113.4	60.3	40.1 -113.5
Soyabean polysaccharide	11.6	8.1 - 40.2	7.0‡‡	4.4 - 23.9	34.8††	23.2 - 78.4	46.2	9.8 - 88.5
	Unweaned *n* 10		Early weaned *n* 10		Late weaned *n* 10			
	Median	Range	Median	Range	Median	Range		
FORMULA-FED								
Glucose	56.3	15.8 -107.2	67.7	23.9 -101.3	68.5	10.9 - 155.7		
Raftilose	45.7	17.9 -149.6	61.4	25.0 -111.4	64.5	14.0 - 150.6		
Soyabean polysaccharide	14.1	11.5 - 27.2	18.5	3.1 -100.8	26.2	2.2 - 69.4		

Significantly different from adult: * $P< 0.05$.
Significantly different from unweaned infant: † $P< 0.05$, †† $P< 0.01$, ††† $P< 0.001$.
Significantly different from late weaned infant: ‡‡ $P< 0.01$.
All comparisons by Mann-Whitney U test.

In contrast to the BF infants in our previous study, there were no significant differences between any stages of weaning for any substrate with FF infants. The greater similarity of the colonic flora of FF infants to that of the adult, therefore, allows faster adaptation to the complex carbohydrates in a mixed weaning diet than the simpler flora of the BF infant. This may be related to the greater incidence of diarrhoea during weaning in breast-fed infants (Gordon, 1971).

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Associations of indices of adiposity with features related to the metabolic syndrome X. By NAVEED A. SATTAR,[1] THANG S. HAN,[2] MICHAEL E.J. LEAN,[2] JAMES SHEPHERD,[1] and CHRIS J. PACKARD,[1] *University Departments of [1]Pathological Biochemistry and [2]Human Nutrition, Glasgow Royal Infirmary, University NHS Trust, Glasgow G4 0SF*

The present study investigated the associations of indices of adiposity including waist circumference, BMI, waist to hip ratio (WHR), and waist:height ratio with features related to the metabolic syndrome X (Reaven *et al.* 1993) in ninety-three men and ninety-eight women aged 18-69 years, who were recruited by local advertisement.

Standard anthropometry (World Health Organization, 1995) and measurements of blood pressure, fasting concentrations of insulin, plasma lipids and lipoprotein subfractions, and apoproteins were made. Plasma cholesterol, triacylglycerol, HDL-cholesterol, VLDL-cholesterol and LDL-cholesterol measurements were based on the standard Lipid Research Clinics Protocol (National Institutes of Health, 1975). $VLDL_1$ mass (S_f 60-400) and plasma LDL (S_f 0-12) were prepared by a modification of the cumulative gradient centrifugation technique (Lindgren *et al.* 1972), LDL subfractions were isolated by non-equilibrium density gradient ultracentrifugation (Griffin *et al.* 1994). Men and women respectively, had mean BMI (kg/m^2) 24.8 (SD 3.0) and 24.3 (SD 3.8), mean waist circumference (cm) 85.8 (SD 9.0) and 75.3 (SD 9.6), and mean WHR 0.878 (SD 0.069) and 0.765 (SD 0.064).

Controlled for age and cigarette smoking, both waist circumference and BMI correlated with a cluster of key cardiovascular risk features of the metabolic syndrome X. Dividing waist by height did not substantially change the correlations, whilst WHR correlated with fewer risk factors (Table).

	Partial correlation coefficients (controlled for age and cigarette smoking) between indices of adiposity and key features of metabolic syndrome X							
	Men (*n* 93)				Women (*n* 98)			
	Waist	Waist: height	BMI	WHR	Waist	Waist: height	BMI	WHR
Small dense LDL	0.30**	0.30**	0.20	0.27	0.31**	0.35***	0.39***	0.23
Triacylglycerol	0.43***	0.41***	0.42***	0.29**	0.48***	0.50***	0.47***	0.39***
Apolipoprotein-B	0.32**	0.31**	0.33**	0.11	0.35***	0.40***	0.35***	0.30**
HDL cholesterol	-0.26	-0.29**	-0.32**	-0.16	-0.34***	-0.34***	-0.27**	-0.24
HDL_2	-0.30**	-0.36***	-0.25	-0.36***	-0.34***	-0.38***	-0.27	-0.28**
Apolipoprotein-AI	0.12	0.06	0.06	0.08	-0.10	-0.12	-0.06	-0.03
Insulin	0.37***	0.33**	0.42***	0.04	0.49***	0.48***	0.49***	0.31**
$VLDL_1$ mass	0.31**	0.26	0.27	0.11	0.42***	0.40***	0.38***	0.33**
Mean blood pressure	0.27**	0.26	0.31**	0.09	0.28**	0.28**	0.38***	0.19

Significance levels: $^{**}P < 0.01$, $^{***}P < 0.001$.

For the purpose of health promotion to prevent cardiovascular disease associated with overweight and intra-abdominal fat accumulation, the general public should be advised to be aware of the risk associated with large waist circumference.

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Separate influences on resting energy expenditure and thermogenesis in obesity. By KEVIN M. WALSH and MICHAEL E. J. LEAN, *Dept. of Human Nutrition, Univ. of Glasgow, Royal Infirmary, Alexandra Parade, Glasgow G31 2ER*

Resting energy expenditure is related to lean body mass and fat mass. The factors relating to thermogenesis are less clear. To examine the influence of body morphology on thermogenesis in obesity, resting energy expenditure was measured in twenty two obese females (age 46.2 (SD 8.5 years)), BMI 34.1 (SD 3.5) kg/m^2 over 20 min using indirect calorimetry (Deltatrac) and the mean of the readings over the final 15 min was calculated. Energy expenditure was then measured during the final 20 min of a 30 min infusion of adrenaline (25 ng/min per kg ideal body weight) (Webber *et al* 1994). The following measurements of body morphology were recorded : body weight, height, triceps skinfold thickness, waist and hip circumferences. BMI, fat-free mass and fat mass were calculated from these (Lean *et al* 1996). Ultrasound measurements were made of the intrabdominal and subcutaneous abdominal fat at standardized sites. All measurements were related to resting energy expenditure (REE) and to thermogenesis, the mean increase in energy expenditure following the catecholamine stimulus.

The mean increase in energy expenditure following adrenaline infusion was 11.8% (SD 11.3), from 6351 (SD 732) kJ/24 hrs to 7079 (SD 912) kJ /24 hrs. As expected, resting energy expenditure was predicted by body weight (r 0.56, $p < 0.05$), fat-free mass (r 0.50, $p< 0.05$) and fat mass (r 0.51, $p < 0.05$). However, these variables had little predictive value for thermogenesis (r 0.36, 0.27 and 0.36 respectively, $p>0.05$). The best predictor of thermogenesis was intra-abdominal fat measured by ultrasonography (r 0.49). This may be due to the fact that intra-abdominal fat has a higher than average density of β-adrenoreceptors, which can mediate thermogenesis.

Unlike resting energy expenditure, body morphology is not especially predictive of thermogenesis. If intra-abdominal fat is associated with a greater thermogenic response, patients with this excess central fat may benefit more from thermogenic slimming drugs.

		Thermogenesis		REE	
	n	*r*	*p*	*r*	*p*
Intra-abd fat	14	0.49	0.05<p<0.1	-0.01	>0.5
Hip	22	0.44	<0.05	0.24	0.1<p<0.5
Triceps	22	0.42	0.05<p<0.1	0.23	0.1<p<0.5
Intra-abd/Subcut	14	0.43	0.1<p<0.5	0.09	>0.5
Weight	22	0.36	0.1<p<0.5	0.56	<0.05
Fat mass	22	0.36	0.1<p<0.5	0.51	<0.05
Waist	22	0.30	0.1<p<0.5	0.42	0.05<p<0.1
BMI	22	0.29	0.1<p<0.5	0.42	0.05<p<0.1
Fat-free mass	22	0.27	0.1<p<o.5	0.50	<0.05
%body fat	22	0.25	0.1<p<0.5	0.35	0.1<p<0.5
Height	22	0.21	0.1<p<0.5	0.38	0.05<p<0.1
Subcutaneous fat	14	0.18	>0.5	-0.04	>0.5
Waist/hip ratio	22	-0.13	>0.5	0.22	0.1<p<0.5
Age	22	-0.4	>0.5	-0.04	>0.5

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Energy balance during acute exacerbations in children with cystic fibrosis. By J.M. RALSTON[1], J.J. REILLY[1], J.Y. PATON[2], J. WILKINSON[3], J. EVANS[3], C.A. EDWARDS[1], and L.T. WEAVER[2], *University of Glasgow Departments of [1]Human Nutrition and [2]Child Health, and [3]CF Group, Yorkhill Hospitals, Glasgow, G3 8SJ.*

Respiratory exacerbations might have a deleterious effect on energy balance in cystic fibrosis (CF) (Reilly et al. 1997), but there are no measurements of all of the components of energy balance simultaneously in the same patient during acute respiratory episodes: intake, Ei; total energy expenditure, TEE; resting energy expenditure, REE; faecal energy losses, Ef. The aims of the present study were: to measure all components of energy balance in a group of children with CF characterised by good lung function (mean forced expiratory volume in 1 sec 76.0% of predicted), pancreatic insufficiency, and generally good clinical status and nutritional status (mean BMI SD score well -0.2, (SD 0.4); unwell 0.0, (SD 0.1)), (Freeman, JV et al, 1990); to compare changes in each component of energy balance between periods when children were 'well', and acute exacerbations, or periods of increased respiratory symptoms requiring i.v. antibiotics ('unwell').

Measurements have been completed on fifteen children when 'well' (mean age 9.9 years, (SD 2.4)), and thirteen children when unwell (mean age 9.7 years, (SD 2.5). The mean weight of the children when 'well' was 30.1kg (SD 10.4), and when 'unwell' 30.7kg, (SD 11.3). Dietary records (3 d when 'well'; 5 - 7 d when 'unwell') were used to estimate Ei, TEE was measured by doubly labelled water, and REE by ventilated hood indirect calorimetry (mean of two measurements when 'well', three - five measurements when 'unwell'). The frequency of RMR measurements during the 'unwell' episode, was greater due to the possible instability of RMR during a pulmonary exacerbation, reported by both Naon et al (1993), and Steinkamp et al (1993).

When 'well', mean TEE was 318 (SD 52) kJ/kg/d, REE 183 (SD 29) kJ/kg/d, and Ei 345 (SD 96) kJ/kg/d. When 'unwell', mean TEE was 300 (SD 81) kJ/kg/d, REE 186 (SD 35) kJ/kg/d, Ei 285 (SD 82) kJ/kg/d. Predicted REE was determined for both 'well' and 'unwell' phases, using Schofield weight, and weight height equations, (Schofield, 1985). Predicted REE values were 160 (SD 25.6) kJ/kg/d, and 150 (SD 27.4) kJ/kg/d, when 'well', and 150 (SD 27) kJ/kg/d, and 150 (SD 30) kJ/kg/d when 'unwell', respectively. Mean physical activity level (TEE / RMR), when 'well' was 1.6 (SD 0.2), and when 'unwell', 1.6 (SD 0.2). RMR was greater than predicted values in these patients, but TEE was not particularly high. Data on faecal energy losses were not available at the present time.

Negative energy balance during acute exacerbations in CF might therefore be largely due to reduced energy intake, but further work is required to confirm this. In children with mild disease who are well, intake and energy expenditure can be matched reasonably closely so that growth and nutritional status can be adequate.

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Sociodemographic differences in infant feeding practices amongst children from Johannesburg and Soweto enrolled in South Africa's Birth to Ten study. By GEORGE T.H. ELLISON[1], LUCY WAGSTAFF[2] and THEA DE WET[3], [1]*Institute of Urban Primary Health Care, Alexandra Health Centre;* [2]*Department of Paediatrics and Child Health, University of the Witwatersrand Medical School;* [3]*Birth to Ten, Urbanisation and Health Programme, Medical Research Council, South Africa*

Information collected during interviews with the mothers and/or principal carers of 2759 children from Soweto and Johannesburg, enrolled in South Africa's Birth to Ten study (Richter *et al.* 1995), was used to examine whether sociodemographic factors were associated with a variety of different infant feeding practices. These included the duration of breastfeeding, the age at which bottle/cup and other (solid) feeds were introduced, and the duration of exclusive breastfeeding. To ensure that the analyses included as many of the children in the Birth to Ten cohort as possible, the study concentrated on those sociodemographic variables that were available for more than 95% of the children enrolled in Birth to Ten. These included two maternal factors (age and gravidity), two paediatric characteristics (birth weight and gestational age at birth) and two sociodemographic indicators (neighbourhood of residence and use of public or private maternity clinics). The independent association between each sociodemographic variable and each of the four different infant feeding practices was assessed using analyses of covariance, the results of which are presented in the Table.

Covariates (β (SEM))	Duration of breastfeeding (weeks)[1]	Duration of exclusive breastfeeding (weeks)[1]	Timing of bottle/cup feeds (weeks)[1]	Timing of solid feeds (weeks)[1]
Maternal age (years)	-0.009 (0.095)	-0.013 (0.031)	-0.047 (0.050)	0.045 (0.028)
Gravidity (*n*)	0.023 (0.394)	0.028 (0.127)	0.052 (0.210)	-0.014 (0.117)
Birth weight (g)	0.042 (0.001)	0.038 (0.000)	0.060 (0.000)*	-0.032 (0.000)
Gestation at birth (weeks)	0.020 (0.243)	0.026 (0.079)	0.026 (0.130)	0.005 (0.072)
Factors (adjusted means)				
Infant sex:				
Male	22.08	9.50	9.92	15.21
Female	22.62	9.36	10.01	14.94
Neighbourhood:				
Township	30.50***	9.79***	10.17**	14.35*
Inner city	14.36	7.40	7.27	15.25
Suburb	22.19	11.09	12.46	15.62
Maternity clinic:				
Public	26.30***	10.05**	10.86**	14.96
Private	18.40	8.81	9.07	15.19

[1]Weeks of age standardized to a 48 week year; *$P \leq 0.05$; **$P \leq 0.01$; ***$P \leq 0.001$

Notwithstanding the limited accuracy of quantitative information on infant feeding practices (Ellison *et al.* 1997), there was no evidence of a significant association between infant feeding patterns and either maternal age or reproductive history (gravidity). There was also no association between infant sex, gestational age at birth and infant feeding patterns, although larger neonates received bottle/cup feeds later than smaller neonates. Mothers from poorer neighbourhoods (townships and inner city), and those without access to private medical facilities, displayed significantly different infant feeding patterns compared with mothers living in suburbs and those with private medical care. These differences seem to reflect the impact of socioeconomic transition and urbanization on infant nutrition (Stuart-Macadam & Dettwyler, 1995). Township mothers displayed traditional infant feeding practices with prolonged breastfeeding and the earliest introduction of solid foods. In contrast, inner city women breastfed for the shortest time and were the first to introduce bottle/cup feeds. There was a resurgence of breastfeeding among wealthier suburban mothers who also exhibited the longest duration of exclusive breastfeeding. It appears that socioeconomic status influences the impact of urbanization on the duration of breastfeeding.

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Impact of altered taste sensitivity on dietary intake of patients with advanced cancer. By R.M. PATTISON[1], R.A. RICHARDSON[1], H. DOUGAN[2] and H.I.M. DAVIDSON[1], *[1]Department of Dietetics and Nutrition, Queen Margaret College, Edinburgh EH12 8TS [2] St. Columba's Hospice, Edinburgh EH5 3RW*

Weight loss and anorexia associated with cancer cachexia have a negative impact on quality of life (Padilla *et al*, 1993) and mortality (DeWys *et al*, 1980) in patients with advanced disease. A contributing component of cancer anorexia in patients not receiving any active treatment is the presence of taste aberrations. The present study examined the relationship between dietary intake and taste perception.

A heterogeneous group of patients with advanced cancer (*n* 42, 10M;32F; mean age 72.5 years) and age-matched controls (geriatric assessment unit, *n* 42, 13M;29F; mean age 79.7 years) were recruited. Patients receiving chemo or radiotherapy in the preceding 6 weeks and drugs containing nystatin were excluded. Taste thresholds for all primary tastes (sweet, sour, salt and bitter) were measured using the ISO 3972 method, from which taste profiles for both groups were derived. A 3d weighed food technique was used to assess the amount of food consumed in twenty-two patients with cancer and sixteen controls. Energy density of food consumed was estimated by Compeat 4 dietary analysis package (Nutrition Systems, London). In addition, patients subjectively reported any alterations in taste perception and subsequent changes in food choice.

Bitter detection threshold in cancer patients was significantly lower (more sensitive to bitter) when compared with controls (P=0.01, *t* test). Salt, sour and sweet thresholds revealed no differences between the groups. Energy intake of the cancer group was significantly lower than that of the control group (P<0.001). In the cancer group, there was no association between macronutrient intake and objectively measured taste perception. However, fifteen out of twenty-two cancer patients subjectively reported experiencing an alteration in taste perception. These patients had significantly lower mean percentage energy contribution from protein as compared with those who did not report any taste changes (14.8 (range 11.7-18.2) % *v* 17.1 (range 13.8-21.4) %, p=0.03). Moreover, an alteration in bitter taste was reflected in patients avoiding meat (18% patients), chocolate and tea (11% patients).

	Cancer Group (*n* 22)		Control Group (*n* 16)		P
	Mean (Range)	sem	Mean (Range)	sem	value*
Energy (kcals/day)	843.3 (258 - 1594)	84.7	1403.9 (621 - 2149)	92.6	0.001
Energy (kJ/day)	3528 (1079 - 6669)	354	5874 (2598 - 8991)	387	
kJ/kg weight per d	65.7 (23.8 - 119.2)	7.5	101.3 (53.6 - 162.8)	7.9	0.004
Fat (% energy)	43.7 (36.2 - 57.7)	1.1	38.1 (24.1 - 48.1)	1.4	0.004
Carbohydrate (% energy)	39.9 (24.5 - 50.9)	1.2	43.9 (38.0 - 51.1)	0.9	0.04
Protein (% energy)	16.1 (11.7 - 21.4)	0.5	17.9 (11.0 - 26.0)	1.0	NS

* Independent t-test

These findings highlight the prevalence of alterations in bitter taste sensitivity and the compromised dietary intakes in patients with advanced cancer. The presence of altered taste perception appears to have an impact on the type of food consumed. This in turn, may not only have a negative impact on quantity of food consumed but also on quality of life, an important clinical outcome in palliative care. These results may elucidate a basis for more appropriate dietary management.

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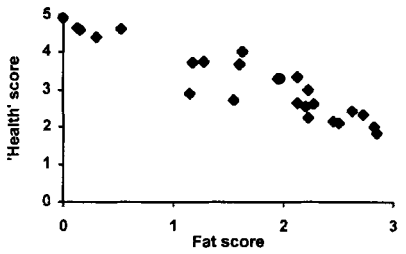
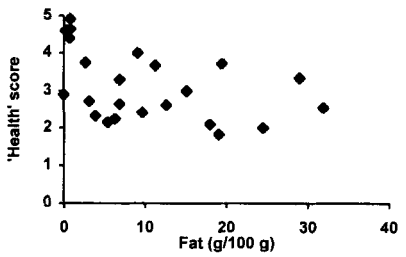
How do caterers rate 'healthy' foods? By T. GRANT, A. WISE and G. BLWYDDIN. *The Robert Gordon University, Queen's Road, Aberdeen AB15 4PH*

Kinghorn *et al.* (1996) investigated how chefs decide appropriate portion sizes and found that they included the 'nutritional content' as a factor. When asked to list Government dietary guidelines unprompted, 65% could give no answer. The extent of their knowledge and their attitudes towards 'healthy' foods were therefore studied. All forty-five caterers who participated in the previous study were contacted and forty agreed to take part in the present study; thirty-eight of these were male. The subjects were visited and shown a list of twenty-four foods that they were asked to score for seven selected nutrients: 0 'none', 1 'a little', 2 'some', 3 'a lot'. They were asked to rate each food for 'healthiness' on a scale 1-5. The mean score for each nutrient and for 'healthiness' was calculated for each food and values (per 100 g) of nutrient analysis for the same food were taken from the food tables. Correlation coefficients (Pearson's and Spearman's) were calculated to show the extent of relationship between scores for each nutrient and the correct analysis. Regression analysis was used to determine whether the score for 'healthiness' could be derived from the nutrient scores or analyses.

Nutrient	Correlation (Spearman)	r^2 as %	P
Fat	0.588 (0.645)	34.6	0.0025
Protein	0.402 (0.360)	16.1	NS
Carbohydrate	0.721 (0.770)	52.0	0.0001
Dietary fibre (as NSP)	0.681 (0.695)	46.4	0.0002
Iron	0.076 (0.151)	0.6	NS
Calcium	0.603 (0.614)	36.4	0.0018
Vitamin C	0.650 (0.781)	42.2	0.006

Chefs had some knowledge about five of the seven nutrients, but the r^2 explained less than 35% of the variance for fat, but more for carbohydrate, NSP and Ca. Regression analysis showed that none of the scores for nutrients contributed significantly to the score for 'healthiness' except for fat. The r^2 for the regression was 91.1% and when only fat was included in the regression analysis, the r^2 was still 86.0% ($P<0.0001$). Using the actual analyses, the regression r^2 for the prediction of 'healthiness' score from fat was only 22.0%. The equation was 'healthiness' score = 4.84 - (0.978 x fat score).





It was concluded that the chefs regarded fat content and 'unhealthiness' synonymously, but their actual knowledge of fat contents of foods was not as good as it could be. They apparently ignored the other nutrients in deciding how 'healthy' a food is, although they actually knew more about the analyses for some nutrients than they did for fat.

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Energy balance in pre-obese children treated for acute lymphoblastic leukaemia. By J. VENTHAM[1], J.J. REILLY[1], J.M. RALSTON[1], M. DONALDSON[2] and B.E.S. GIBSON[3], *Departments of [1]Human Nutrition, [2]Child Health and [3]Haematology, Yorkhill Hospitals, Glasgow G3 8SJ*

Children with acute lymphoblastic leukaemia (ALL) gain weight excessively during and after 2 years of maintenance chemotherapy (Odame *et al.* 1994; Sainsbury *et al.* 1985) and a high proportion of adult survivors are obese (Didi *et al.* 1995). The reason for excess weight gain is unclear, but previous studies have reported no evidence of reduced resting metabolic rate (RMR) (Reilly *et al.* 1996a) and no evidence of hyperphagia (Bond *et al.* 1992). The aim of the present study was to identify the cause of positive energy balance in ALL by measuring all the components of energy balance in eighteen patients (eight boys, ten girls, mean age 11 years) in first remission who had shown excess weight gain and eighteen healthy control children matched pairwise for age, sex, fat free mass, socio-economic status and season.

Total energy expenditure (TEE) was measured by doubly-labelled water, RMR by ventilated-hood indirect calorimetry, energy intake (Ei) by 3 d household measures record, body composition by bioimpedance (Reilly *et al.* 1996b) and energy expended on activity (PAE) calculated as TEE-RMR.

TEE was significantly higher (paired t test, $P<0.05$) in controls than patients: mean paired difference 1.5 MJ/d (95%CI +0.4 to +2.4) which was due to a mean difference in PAE of 1.1 MJ/d (95% CI +0.1 to +2.1) with a smaller mean difference in RMR of 0.4 MJ/d (95% CI +0.2 to +0.6).

Reduced physical activity might therefore predispose children with ALL to obesity, but further work is required in order to confirm this.

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