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## **PROCEEDINGS OF THE NUTRITION SOCIETY**

### **ABSTRACTS OF COMMUNICATIONS**

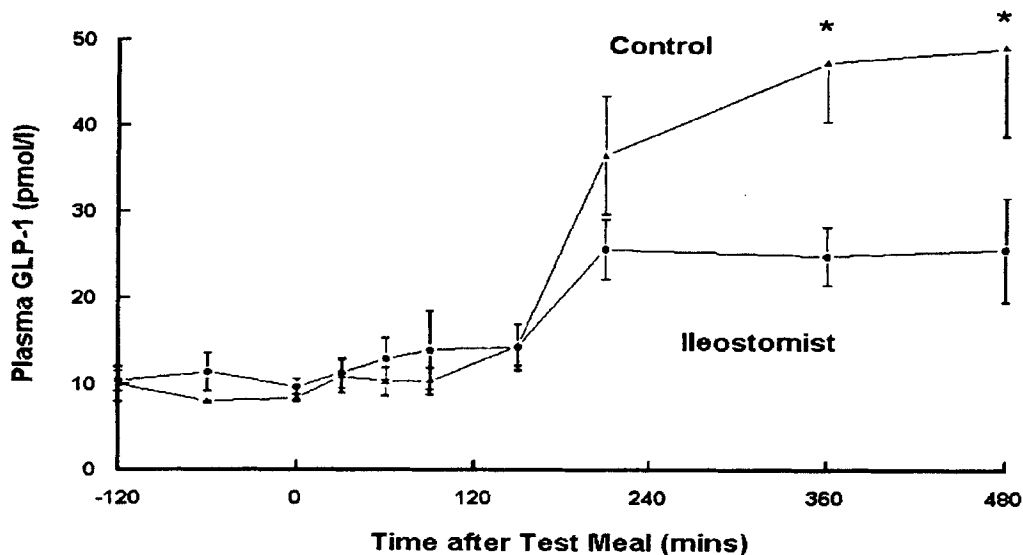
*A Scientific Meeting was held at the University of Dundee, on Tuesday–Wednesday, 2/3 April 1996, when the following papers were presented.*

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

**Importance of the colon as a source of circulating glucagon-like peptide 1.** By M. DENISE ROBERTSON<sup>1</sup>, G. LIVESEY<sup>2</sup>, LINDA M. MORGAN<sup>3</sup>, SHELAGH HAMPTON<sup>3</sup> and J.C. MATHERS<sup>1</sup>, <sup>1</sup>Human Nutrition Research Centre, Department of Biological and Nutritional Sciences, University of Newcastle upon Tyne NE1 7RU, <sup>2</sup>Institute of Food Research, Norwich Laboratory, Norwich Research Park, Colney, Norwich NR4 7UA and <sup>3</sup>School of Biological Sciences, University of Surrey, Guildford GU2 5XH.

Glucagon-like peptide 1 (GLP-1) produced from proglucagon in the distal intestine enhances postprandial insulin secretion and may inhibit gastric acid secretion. Since human colonic tissue is capable of synthesizing fully processed, biologically active GLP-1 (Deacon *et al.* 1995), the absence of a functioning colon in those with ileostomies may result in altered gluco-regulatory responses to meals.

This hypothesis was tested by comparing postprandial plasma concentrations of GLP-1 in six healthy male ileostomists and six control male subjects each of whom consumed a test meal containing 50 g peas (*Pisum sativum*) after an overnight fast. Two further carbohydrate-free meals were provided 2 and 6 h later.



Fasting plasma GLP-1 concentrations were similar in both groups of subjects. There was no detectable GLP-1 response until 200 min after the test meal when there was an approximately 5-fold increase in the controls but only a 2.5-fold increase in the ileostomists. Plasma GLP-1 concentrations remained elevated until the end of the measurement period (8 h after the test meal).

These results suggest that the colon is a major source of circulating GLP-1 and indicate that caution should be observed when using ileostomists to investigate postprandial glucoregulatory responses.

M.D.R. holds a BBSRC CASE studentship in collaboration with the Institute of Food Research, Norwich Laboratory

Deacon, F.F., Johnsen, A.H. & Holst, J.J. (1995). *FEBS Letters* 372, 269-272.

**The effect of volume and glucose concentration on the gastric emptying rate of glucose solutions in man.** By J.B. LEIPER<sup>1</sup>, J. DAVIDSON<sup>2</sup> and R.J. MAUGHAN<sup>1</sup>, *Department of Environmental and Occupational Medicine, and* <sup>3</sup>*Department of Nuclear Medicine, Foresterhill, Aberdeen AB9 2ZD*

Many factors affect the rate of gastric emptying of liquids in man; while increasing the gastric volume stimulates a faster rate of emptying (Noakes *et al.* 1991), increasing the glucose concentration slows gastric emptying (Vist & Maughan, 1995). The interaction of these two opposing factors in regulating the rate of delivery of fluid and energy to the small intestine is still controversial. Using a scintigraphic technique, we have investigated the relative importance of volume and glucose concentration on the rate of gastric emptying. With approval from the local ethics committee, the rate of emptying of three glucose solutions was measured in six healthy male volunteers at rest. Subjects consumed on trial A: 200 ml of a 200 g glucose/l solution, on trial B: 400 ml of a 100 g glucose/l solution and on trial C: 800 ml of a 50 g glucose/l solution; therefore the amount of glucose ingested on each trial was the same but the volume in which it was dissolved differed. The treatment order was randomized using a Latin-squared order design, with each trial being separated by between 5 and 7 d. Each test drink contained 2MBq of <sup>99m</sup>Tc diethylene triamine penta-acetic acid as the non-absorbable, water-soluble  $\gamma$ -emitting tracer. Fasted volunteers rapidly ( $\sim 120$  s) drank the solution while standing facing a  $\gamma$  camera. Anterior and posterior abdominal scans were alternately recorded over 60 s for a total of 1 hour. Arithmetic mean counts of anterior and posterior counts were used to construct the gastric emptying curve for each solution, and the volume and energy delivered to the duodenum were calculated.

The mean rate of gastric emptying (ml/min) of solution A (2.6 (SD 0.4)) was slower ( $P = 0.03$ ) than that of solution B (5.7 (SD 0.8)), which was slower ( $P = 0.03$ ) than that of solution C (11.1 (SD 1.6)). However, when the rate of emptying was expressed as a percentage of the volume ingested there was no difference between the trials ( $P = 0.74$ ). As each solution contained the same amount of glucose, the rate of energy delivery on all three trials was essentially the same and approximated on trial A to 8.64 (SD 3.65) kJ/min, on trial B to 9.29 (SD 3.54) kJ/min and on trial C to 8.87 (SD 3.57) kJ/min. The mean rate of gastric emptying of solution A was faster ( $P = 0.018$ ) during the first 30 min following ingestion (2.81 (SD 0.47) ml/min) than during the second 30 min period (2.21 (SD 0.21) ml/min). Similarly, solution B was emptied at a faster rate ( $P = 0.001$ ) during the first half of the study period (6.58 (SD 0.54) ml/min) than during the second half (4.20 (SD 0.83) ml/min). There was a slower rate of gastric emptying of solution C over the initial 10 min following ingestion (5.18 (SD 2.21) ml/min) than over the rest of the study period ( $P = 0.001$ ). The rate of gastric emptying of solution C was faster between 10 and 30 min following ingestion (14.2 (SD 2.73) ml/min) than over the remaining 30 min (9.44 (SD 1.77) ml/min;  $P = 0.001$ ). Therefore the calculated rate of energy delivery to the duodenum did not follow a constant linear pattern.

The regulation of gastric emptying of different volumes of beverages which contain the same total amount of glucose appears to be such that the same fraction of each solution, and hence the same amount of glucose, is emptied over similar periods of time. This suggests that the total glucose content of a solution has a greater effect than the volume in determining the rate of gastric emptying.

Noakes, T.D., Reher, N.J. & Maughan, R.J. (1991). *Medicine and Science in Sports and Exercise* 23, 307-313.

Vist, G.E. & Maughan, R.J. (1995). *Journal of Physiology* 486, 523-531.

**The effects of alterations in dietary carbohydrate intake on the performance of prolonged high intensity exercise in well-trained individuals.** By Y.P. PITSILADIS and R.J. MAUGHAN, *Department of Environmental and Occupational Medicine, University Medical School, Aberdeen AB9 2ZD*

While it is well recognized that the capacity to perform prolonged exercise is strongly influenced by the dietary carbohydrate (CHO) intake in the days preceding exercise, the effects of changes in the composition of the diet on high-intensity exercise have not been extensively studied. Therefore the aim of the present study was to examine the effects of alterations in dietary CHO intake, while continuing normal training, on performance of prolonged high intensity exercise. Seven well-trained individuals with a maximum O<sub>2</sub> uptake (VO<sub>2</sub> max) of 69 (SD 6) ml/kg per min exercised to volitional exhaustion on a cycle ergometer at 80 (SD 3) % of VO<sub>2</sub> max on four occasions. The first two exercise tests were familiarization trials and were carried out following the subjects' normal diet which comprised 15.7 (SD 3.3) MJ, of which 55 (SD 7) % of energy intake was in the form of CHO. Training during this period comprised running (median) 16 (range 15-80) km/week, cycling (mean) 78 (SD 36) km/week and swimming 4 (SD 3) km/week and was standardized during the periods of dietary control. The following two exercise tests were performed 2 weeks apart after 7 d of dietary manipulation. The experimental diets consisted of a 70% and 40% CHO diet, isoenergetic with each subject's normal diet and administered in randomized order. Blood samples were obtained from a superficial forearm vein at rest, after 5, 10, 20 min of exercise and at exhaustion. Respiratory gas measurements were obtained during the 7th and 15th min of exercise and VO<sub>2</sub> and respiratory exchange ratio (R) were determined. Heart rate (HR) and rating of perceived exertion (RPE) were obtained at intervals of 5 min and at exhaustion. Statistical analysis of the data was carried out using two-factor ANOVA for repeated measures followed by Student's *t* test for paired data, where appropriate. Time to exhaustion following the high-CHO (26.9 (SD 7.4) min) and low-CHO (26.5 (SD 6.5) min) diets was not different (*P*=0.90). No differences in resting blood metabolites were found apart from a lower β-hydroxybutyrate concentration following the high-CHO diet. During exercise, blood lactate was higher (5 and 10 min time points) and β-hydroxybutyrate was lower (5 min time point) following the high-CHO diet. No differences between conditions were found in blood glucose or plasma glycerol and free fatty acids. The R was higher during exercise following the high-CHO diet. A significant difference was found at the 15 min time point. No differences in VO<sub>2</sub>, HR or RPE were found between conditions at any of the measured time points. The results of this study indicate that moderate changes in diet composition during training do not affect performance of prolonged high-intensity exercise in well-trained individuals when the total energy intake is moderately high.

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**Peptide breakdown by rumen microorganisms is sensitive to inhibition by 1,10-phenanthroline.**  
By R. J. WALLACE and N. MCKAIN, *Rowett Research Institute, Bucksburn, Aberdeen AB2 9SB*

Excessive protein breakdown and NH<sub>3</sub> production in the rumen often lead to inefficient N utilization in ruminants (Leng & Nolan, 1984). Peptides are intermediates formed when proteolytic rumen microbes break down protein. Dipeptidase activity of one of the principal species of bacteria involved in protein and peptide metabolism, *Prevotella ruminicola*, was found to be highly sensitive to the metal-ion chelator, 1,10-phenanthroline (Wallace *et al.* 1995). The present study was undertaken to investigate the effects of 1,10-phenanthroline on peptide breakdown by other bacteria and mixed rumen microorganisms.

Pure cultures of rumen bacteria were grown, washed in anaerobic buffer and incubated with 0.75 mM-1,10-phenanthroline and 1 mM-L-alanyl-L-alanine (Ala<sub>2</sub>) in a similar incubation to that described before (Wallace *et al.* 1995). Six adult sheep, fitted with permanent rumen cannulas, received a maintenance diet of hay, barley, molasses, fish meal and a vitamin-mineral mix (500, 299.5, 100, 91 and 9.5 g/kg DM respectively). Meals (500 g), given at 08.00 and 16.00 hours, and samples of rumen fluid were removed between 1.5 and 2.5 h after the morning feeding. Mixed rumen bacteria and washed protozoa were prepared by differential centrifugation and filtration by the methods outlined by Williams & Coleman (1992). Incubations were done in a similar way to pure bacterial cultures, except that the final 1,10-phenanthroline concentration was 1.5 mM. Bacterial dipeptidase, both in mixed bacteria and in pure cultures of the main dipeptidase-producing species, was highly sensitive to inhibition by 1,10-phenanthroline. Protozoa had a much higher specific activity, which was affected less by 1,10-phenanthroline, which caused only 55% inhibition of Ala<sub>2</sub> breakdown.

Table. *Influence of 1,10-phenanthroline on dipeptidase activity of rumen micro-organisms*

	Dipeptidase activity (nmol Ala <sub>2</sub> removed/min per mg protein)			
	Control	SE	1,10-Phenanthroline	SE
<i>Fibrobacter succinogenes</i> BL2	3.09	0.22	-0.02	0.15
<i>Lachnospira multipara</i> D15d	1.38	0.30	0.05	0.03
<i>Megasphaera elsdenii</i> J1	5.29	0.32	0.18	0.12
<i>Prevotella ruminicola</i> M384	6.42	0.90	0.31	0.22
Mixed rumen bacteria	1.37	0.27	0.28	0.16
Washed ciliate protozoa	11.15	2.96	5.07	2.93

Incubations were also carried out with mixed rumen micro-organisms and 0.5 g/L Trypsinase, a pancreatic hydrolysate of casein, and the effects of 1,10-phenanthroline on the production of ammonia and amino groups were determined. 1,10-Phenanthroline inhibited the formation of breakdown products from Trypsinase by 71% after 2 h in the mixed population, indicating that the breakdown of mixed peptides is also sensitive to chelation by 1,10-phenanthroline, and that there may be a role for chelators in controlling excessive peptide breakdown in the rumen.

This work was supported by Royal Gist-brocades nv, Delft, The Netherlands, and the Scottish Office Agriculture and Fisheries Department.

Leng, R.A. & Nolan, J.V. (1984). *Journal of Dairy Science* 67, 1072-1089.

Wallace, R.J., Kopecny, J., Broderick, G.A., Walker, N.D., Sichao, L., Newbold, C.J. & McKain, N. (1995). *Anaerobe* 1, 335-343.

Williams, A.G. & Coleman, G.S. (1992). *The Rumen Protozoa*. New York: Springer-Verlag.

**Comparison of two algal polysaccharides with guar gum and cellulose on bowel habit in healthy human volunteers.** By CLIVE S. ROPER, WENDY BAL and JOHN C. MATHERS, *Human Nutrition Research Centre, Department of Biological and Nutritional Sciences, University of Newcastle upon Tyne, Newcastle upon Tyne NE1 7RU*

The aim of the present study was to investigate the effects of four NSP sources viz. cellulose (CE), guar gum (GG; Guarem, Rybar Laboratories, Andover, UK) and two NSP-enriched fractions from seaweed, *Eucheuma cottonii* (EC; carrageenan) and *Palmaria palmata* (PP; xylan) on bowel habit in healthy human volunteers.

Twelve healthy human volunteers (six male) consumed their normal diet plus a supplement of 10 g NSP/ d for 3 weeks using a crossover design with a 3-week washout period between each intervention period. Subjective assessments of bowel habit were obtained daily throughout the study using a diary in which volunteers recorded stool frequency, perceived amount of faeces (large, medium or small), consistency of faeces (hard, soft or loose), time spent on toilet and any discomfort experienced during evacuation. Perceived stool volume (large = 3, medium = 2 and small = 1) was multiplied by the number of stools to give units of faecal volume per day. Responses to the interventions were examined using orthogonal contrasts within ANOVA where contrast C1 = CE v. other polysaccharides, C2 = GG v. seaweed products, C3 = EC v. PP. The Table gives data for the 3-week period.

	NSP supplement				SEM	P value		
	CE	GG	EC	PP		C1	C2	C3
Bowel frequency (movements)	28	30	36	33	1.6	0.002	0.002	0.720
Time spent on toilet (min)	98	118	142	130	5.3	0.031	0.000	0.249
Faeces volume (units)	53	55	71	59	2.8	0.002	0.001	0.001
Discomfort (% of movements)	6	7	3	4	1.2	0.045	0.001	0.683
Consistency (% of movements)								
Hard	17	23	24	16	4.3	0.594	0.423	0.060
Soft	76	62	73	75	4.7	0.387	0.033	0.350
Loose	7	16	3	9	2.7	0.512	0.008	0.152

Forty-five of the forty-eight potential treatment periods produced complete data. Food energy intake (assessed by a 7 d food diary) and body mass were unaffected by treatment. Both seaweed products increased bowel frequency and time spent on the toilet compared with the CE and GG supplements. CE, GG and PP resulted in similar daily faecal volumes but EC increased this by 28%. Reported episodes of discomfort were reduced by about 50% with the seaweed products compared with the CE and GG supplements. Consistency of movement was similar during the PP and CE supplements periods. Compared with GG, the EC and PP supplements reduced the proportion of loose stools with no change in the proportion of hard movements.

Neither seaweed ingredient produced adverse effects on bowel habit. EC resulted in an increase in bowel frequency and stool volume and reduced the looseness of the faeces suggesting a possible application in improving laxation.

We thank Dr John Cummings (Gastroenterology Department, Addenbrookes Hospital, Cambridge) for advice on assessment of bowel habit.

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***In vitro* fermentation of carbohydrate by faecal bacteria of young children in Glasgow and young urban black children in Johannesburg.** By C.A. EDWARDS<sup>1</sup>, K.A. MCLAUGHLIN<sup>1</sup>, H. HASSAN<sup>2</sup>, I. SEGAL<sup>2</sup>, E. VORSTER<sup>3</sup>, H.S. KRUGER<sup>3</sup> and A.R.P. WALKER<sup>4</sup>, <sup>1</sup>University of Glasgow, Department of Human Nutrition, Yorkhill Hospitals, Glasgow G3 8SJ, <sup>2</sup>University of Witwatersrand, Department of Medicine, Baragwanath Hospital, Johannesburg, <sup>3</sup>Department of Nutrition and Family Ecology, Potchefstroom University, Potchefstroom, South Africa, <sup>4</sup>South African Institute for Medical Research, Johannesburg, South Africa

The incidence of colonic cancer is extremely low in rural blacks in South Africa when compared with rates in industrialized populations. This was thought to be due to their high intake of dietary fibre and low intake of fat. In recent years, there has been a large migration of rural blacks to the cities and nutritional transition to a diet similar to that of industrialized populations. However, although obesity and hypertension have increased in these urban populations, the incidence of colonic cancer has remained surprisingly low (Walker, 1982). It is difficult to study the causes of this in the adult populations due to the variable time in the urban areas and ongoing nutritional transition. The colonic microflora is likely to play a key role in promoting or inhibiting the development of colonic cancer and this flora is established as a stable ecosystem during weaning and early childhood. Therefore, we have compared fermentation characteristics of eighteen young urban black children (age 8-41 months) in Johannesburg (SA) with those of eighteen children of a similar age (5-37 months) in Glasgow (G).

One faecal sample was collected from each child and processed within 1 h of passage by the same investigator at both sites. *In vitro* cultures (9 ml) containing minerals, salts and tryptone with 100 mg glucose, lactose, starch, pectin or no carbohydrate (Adiotomre *et al.* 1990) were inoculated with 1 ml of a 320 g/l faecal slurry and incubated under anaerobic conditions for 24 h at 37°. Short-chain fatty acid (SCFA) concentration was measured in culture fluid and original faecal samples by GLC. Results were compared by Mann-Whitney U test.

There was no difference in median total faecal SCFA concentrations (median (range)): (G 381.5 (112.2 - 549)  $\mu\text{mol/g}$  dry weight, SA 345.9 (84.4 - 688.2)), but faeces of SA children had a higher molar proportion of propionic acid (191 (77-330)) and a lower molar proportion of acetic acid (584 (359-720)) than faeces of G children (propionic 138 (24-260)  $P < 0.05$ , acetic 683 (462-819)  $P < 0.01$ ).

Compared with those of G children, cultures of faeces from SA children produced more total SCFA from glucose (median (range)): (SA 95.7 (68.2-105.7)  $\mu\text{mol/ml}$ ; G 64.2 (46.9- 102.3)  $P < 0.001$ ), lactose (SA 86.5 (71.3-102.9); G 72.3 (44.3-101.9)  $P < 0.05$ ) and pectin (SA 85.8 (57.0 -119.5); G 75.0 (55.5-105.4)  $P < 0.05$ ) but not from the no carbohydrate and starch cultures. The pattern of SCFA reflected those of faeces with a lower proportion of acetic acid and a higher proportion of propionic acid in the no carbohydrate (acetic: SA 430 (367-575); G 611 (250 -714)  $P < 0.001$ , propionic SA 209 (151- 275); G 149 (326-243)  $P < 0.001$ ); glucose (acetic: SA 488 (356 -699); G 611 (315-963)  $P < 0.01$ , propionic SA 283 (125- 472); G 143 (236-366)  $P < 0.001$ ). and lactose (acetic: SA 507 (354-714); G 610 (348-966)  $P < 0.01$ , propionic SA 203 (75.8-348); G 124 (19-263)  $P < 0.05$ ), cultures, although there was no difference in molar proportions for the complex carbohydrate cultures. The complex carbohydrates were less well fermented by both groups of children. There was no difference in the molar proportion of either faecal or culture fluid butyrate between the two groups of children but cultures of faeces from G children had lower butyrate concentration in cultures containing lactose (median (range)): (SA 18.7 (12.2-34.9); G 10.9 (0.3-36.6)  $\mu\text{mol/ml}$   $P < 0.05$ ) and pectin (SA 12.4 (7.5-22.7); G 9.4 (3.3-20.7)  $P < 0.05$ ). Butyrate is believed to be important for colonic mucosal health.

In conclusion, the fermentation characteristics of faecal bacteria of young children from Glasgow and urban black children from South Africa differ significantly and may be related to the higher starch intake of the South African children. Early differences in colonic microflora may affect bacterial activity in later life but the significance of these findings in relation to incidence of colonic cancer has yet to be established.



**Movement towards a healthier diet in Tayside between 1984 and 1994.** By C. BOLTON-SMITH<sup>1</sup>, L. MCKAY<sup>1</sup> and S. OGSTON<sup>2</sup>, <sup>1</sup>*Cardiovascular Epidemiology Unit and* <sup>2</sup>*Department of Epidemiology and Public Health, University of Dundee, Ninewells Hospital and Medical School, Dundee DD1 9SY.*

The 10-year nutritional follow-up study to the baseline Scottish Heart Health Study (Tunstall-Pedoe *et al.* 1989) was carried out in 1994-5. Men and women (n 4587), now aged 50-69 y were randomly selected from the original study population (contactable number 9009) and sent a repeat questionnaire which included a slightly modified food frequency questionnaire (FFQ) fully comparable with that used 10 years earlier (Bolton-Smith *et al.* 1991). An additional food health questionnaire was also included, which asked subjectively about dietary change covering fifteen food categories (breads, cooking fats, cheese, potatoes, green vegetables, alcoholic drinks, red meat, fish, milk, spreading fats, fruit, soft drinks, poultry, cakes and sweets and "other foods").

Results are reported here for the 318 subjects in Tayside who correctly completed and returned the questionnaires. Of these, 23 % reported making no conscious effort to change their diet and a mean of 39 (SD 11) % of subjects reported attempting to change diet in each food category. Regardless of reported attempts to change specific components of diet, significant differences in the frequency of consumption of different food groups was detected in 1994 compared with 1984 by paired t testing. These were positive changes (i.e. an increase in 1994 compared with 1984) for breads, breakfast cereals, rice and pasta, fish, root vegetables and fresh fruit (all  $P < 0.001$ ), and negative changes for red meat ( $P < 0.001$ ) and meat products ( $P = 0.02$ ). When the 10-year differences in frequency of consumption of food groups were compared for those who reported (subjectively) a change in that food group and those who did not, significant changes in bread (white bread decreased and wholemeal bread increased,  $P < 0.001$ ), red meat (beef and tinned meat decreased,  $P < 0.009$ ), fish (white fish increased,  $P = 0.042$ ), milk (low-fat types increased,  $P < 0.001$ ), fresh fruit (total increased,  $P < 0.001$ ), poultry (increased,  $P = 0.042$ ) and type of spreading fat (low-fat types increased,  $P = 0.048$ ) were detected using the Wilcoxon test.

The underlying changes in diet which were recorded using the FFQ may have come about due to the ageing of the population, changes in smoking habit, changes in the food products available over the 10 years, and to the publicising of food-health issues in general. However, these data also indicate that between 40 and 50 % of 50-69-year-olds in Tayside have actively tried, and achieved, a change in their diet which is in line with current healthy eating recommendations. The main exception is in green vegetable consumption: although 38 % subjectively reported to have made a change, the FFQ detected no significant change in actual frequency of consumption. These Tayside data will be compared with those from other Scottish Health Boards in due course, and will provide a national view of dietary change (and motivational factors) in Scotland for this age group over this time period.

Funding from the Scottish Office Home and Health Department is acknowledged.

Bolton-Smith, C., Smith, W.C.S., Woodward, M. & Tunstall-Pedoe, H. (1991) *British Journal of Nutrition* **65**, 321-335.

Tunstall-Pedoe, H., Smith, W.C.S., Crombie, I.K. & Tavendale, R. (1989) *Scottish Medical Journal* **34**, 556-561.



**Confectionery, biscuits, cakes and desserts v. fresh fruit: influence of body mass index.** By W.L. WRIEDEN<sup>1</sup>, M.K. McCLUSKEY<sup>2</sup> and C. BOLTON-SMITH<sup>2</sup>, <sup>1</sup>*School of Food and Accommodation Management, University of Dundee, DD1 4HT* and <sup>2</sup>*Cardiovascular Epidemiology Unit, Ninewells Hospital and Medical School, Dundee, DD1 9SY*

It has been reported that there is no association between a high frequency of consumption of sweet biscuits and confectionery (sweets and chocolates), and BMI in Scottish women, although total energy intake was greater in the high frequency group ( $\geq 7$  / week) (New & Grubb 1996). It would seem that some people are able to eat confectionery and other sweetened foods without compromising their weight. However it could be argued that consumption of confectionery might lower the intake of foods such as fruit.

As part of the 1992 WHO MONICA study in north Glasgow the dietary habits of over 2000 men and women aged 25-74 years were surveyed using a standard food frequency questionnaire (FFQ) (Bolton-Smith *et al.* 1991). The FFQ included questions on the weekly frequency of consumption of all the major types of foods. Using these data the relationship between fresh fruit consumption and confectionery, and fresh fruit consumption and the sum of all sweetened foods in the diet (sweets, chocolates, biscuits, cakes and desserts) was studied for men and women of different BMI.

	Median weekly number of total fruit items consumed							
	Men				Women			
	BMI 17-24.9		BMI $\geq 25$		BMI 17-24.9		BMI $\geq 25$	
	<i>n</i>		<i>n</i>	<i>n</i>		<i>n</i>		<i>n</i>
<b>Confectionery:</b>								
<once a week	3	150	5	196	6	129	6	162
1-3 times a week	4	110	5	177	7	166	7	213
4-7 times a week	5	72	4	84	7	124	7	98
ANOVA	*		NS		NS		NS	
<b>Sum of sweetened foods:</b>								
< once a day	2	109	4	141	4	98	5	116
1-2 times day	4	114	6	175	6	143	7	180
> twice a day	6	85	5	113	9	154	8	140
ANOVA	***		*		***		**	

Difference in means between frequency groups by ANOVA on transformed (square root) data \* $P < 0.05$ , \*\* $P < 0.01$ , \*\*\* $P < 0.001$ .

In subjects who were not overweight (BMI 17-24.9 kg/m<sup>2</sup>), those who ate the most sweetened foods consumed significantly more fruit weekly. A similar pattern was seen for men, but not women, by frequency of confectionery consumption. For overweight (BMI  $\geq 25$  kg/m<sup>2</sup>) men the highest fruit consumption occurred in the group who ate sweetened foods 1-2 times daily but for overweight women fruit consumption again was significantly increased in those who ate the most sweetened foods, but was similar across the confectionery frequency groups. Whilst in overweight men (BMI  $\geq 25$  kg/m<sup>2</sup>) general consumption of sweetened foods may be contributing to relatively low fruit intake, other factors such as taste preferences, and, particularly in the elderly, dentition, will also be influencing patterns of fresh fruit intake.

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New, S.A. Grubb, D.A. (1996). *Proceedings of the Nutrition Society* (In the Press)

Bolton-Smith, C., Smith, W.C.S., Woodward, M. & Tunstall-Pedoe, H. (1991). *British Journal of Nutrition* **65**, 321-335.

**A preliminary comparison of the frequency of sugar intake by 8-14 year old children in Tristan da Cunha and a region of Scotland.** By W. L. WRIEDEN<sup>1</sup>, P. LONGBOTTOM<sup>1</sup>, C. SOUTHWICK and T. MCKEAN<sup>2</sup>, <sup>1</sup>*School of Food and Accommodation Management, University of Dundee, DD1 4HT and* <sup>2</sup>*Department of Dental Health, University of Dundee, DD1 4HR*

There is evidence to suggest that the amount and frequency of sugar consumption is an important factor in the development of dental caries (Rugg-Gunn, 1993). In 1932 there was a very low incidence of dental caries on Tristan da Cunha (an island in the South Atlantic) but, since that date, the oral health of the population has deteriorated as sugar consumption has increased (Holloway *et al.* 1963; Fisher, 1968).

As part of a dental expedition to Tristan da Cunha in August 1995, 3-d unweighed food diaries were obtained from all the families represented at the island's school. From these families the weekday diaries for the twenty-two children aged 8-14 years were compared with those from eighty-seven children of similar age range from four schools (one secondary school in a small town, two rural primaries and one urban primary) in Tayside, Scotland, collected over the period 1992-5. The number of occasions, in one day, when sugared foods and drinks were eaten (NSEO) was noted for each child. The mean decayed, missing or filled teeth (DMFT) value for the twelve Tristan da Cunha children aged 12-14 years was also noted and compared with the average of that recently recorded for Tayside 12-year and 14-year-old children (Scottish Health Boards Dental Epidemiological Programme 1992-3 and 1994-5).

Age range (years)	School	Mean NSEO	SD	Mean DMFT	SD
12-14 (n 12)	Tristan-da Cunha	2.50	0.879	0.92	2.02
13-14 (n 26)	Tayside secondary	2.65	1.018	2.6*	-

\* Average of mean DMFT (1.9) for 1992-3 survey of 12-year-old children and mean DMFT (3.25) for 1994-5 survey of 14-year-old children

There was no significant difference between the mean NSEO for the Tristan da Cunha 12-14-year-olds and that from a random sample of 13-14-year-olds from a Tayside secondary school (comparison of means using Student's *t* test) but the Tayside mean DMFT in 12-14-year-old children was over double that for Tristan da Cunha. The mean NSEO for 8-11-year-olds was 2.55 (SD 0.96, *n* 10) for Tristan da Cunha compared with 2.16 (SD 1.19, *n* 38) for 10-11-year olds at the two rural Tayside schools, and 3.22 (SD 1.54, *n* 23) for 9-year-olds at a Dundee school situated in a relatively deprived area. It is inappropriate to use mean DMFT for this age range but three out of the ten Tristan da Cunha children had no caries. Information from the Community Dental Service in Tayside showed that 30% of 8-year-olds in the rural primary schools but only 17% of 8-year-olds in the Dundee school had no caries. Due to the nature of the data collected in this present study, the conclusions that can be drawn are limited. However it would appear that the frequency of eating sugar is only one of the factors involved in the prevalence of tooth decay. The lower mean DMFT in the Tristan da Cunha 12-14-year olds compared with the Tayside children, despite a similar frequency of eating sugared items, is most likely to be due to the administration by the school of daily fluoride tablets in Tristan da Cunha. A suitably designed study to compare the nutrition with respect to dental health of children in Tristan da Cunha and an area of Scotland should be planned.

C.S and T.M. acknowledge funding from the Northern Ireland Centre for Health Care, Co-operation and Development. Dr C. Longbottom, Dr P. Mossey, Professor D.R. Stirrups and David Martin are also acknowledged as well as the children and staff of the Tristan da Cunha and Tayside schools.

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**Preferences for approaches to 'healthy eating' health education among South Asian family members in Scotland.** By J.P.LANDMAN<sup>1</sup> and S. WYKE<sup>2</sup>, <sup>1</sup>*Department of Dietetics and Nutrition and Centre for Food Research, Queen Margaret College, Edinburgh EH12 8TS and* <sup>2</sup>*Department of General Practice, University of Edinburgh, EH8 9DX*

In order to inform the design of appropriate and relevant health education programmes in Scotland, a three stage qualitative study investigated the preferences for ways of receiving health education about 'healthy eating' among family members of South Asian origin. 'South Asian' describes people born in the Indian subcontinent or their descendants.

Three multilingual researchers recruited quotas of mothers (M), fathers (F) and young people (YP), to include varied religious and social backgrounds, some of whom belonged to existing community groups. Between July and October 1994, there were six focus group discussions (FGD, M, 4; YP, 2); and forty-five individual semi-structured interviews (SSI) with a total of ninety-three participants, in Edinburgh, Glasgow and Stirling. FGD and individual SSI were conducted in the participants' choice of language; literally translated as necessary, and fully transcribed. Thirty participants were 11-19 years old and forty-eight were 20-39 years old. Forty-seven participants said they spoke English best and thirty-nine said they spoke Punjabi or Urdu best. Participants spoke about ways to educate other people as well as themselves. Analyses concentrated on views about settings, materials and media for 'healthy eating' education; and on comparisons among M, F and YP in the context of participants' perceptions of their lives.

The community was the most popular setting for health education in three M FGD, and twenty-two SSI. Participants liked the idea of personal, face-to-face contact in which they could exchange information and gain mutual support. Participants also said they would like practical help with skills to cook 'healthily'. Leaflets and other print materials dominated discussion about materials in five FGD and twenty-eight SSI. M especially wanted clinics to make available more leaflets with more practical, relevant information to help them to practice 'healthy eating' in South Asian culinary style. Participants in four FGD and twenty-nine SSI said that television was the best mass medium. M singled out practical positive information about South Asian cuisine, for their own benefit and that of the general population.

M expressed more interest in 'healthy eating' education than F and YP, in keeping with their roles as the main nurturers (Backett & Davison, 1995). Adults and YP expressed a common understanding of, and value for, participatory community-based approaches. This is evidence of support for a population-based strategy for 'healthy eating' education. Further research should investigate whether South Asian people of different regional origins have specific information needs.

We acknowledge funds from the Health Education Board for Scotland.

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**Daily and seasonal variation in phylloquinone (vitamin K<sub>1</sub>) intake in Scotland.** By R. PRICE<sup>1</sup>, S. FENTON<sup>1</sup>, M.J. SHEARER<sup>2</sup> and C. BOLTON-SMITH<sup>1</sup>. <sup>1</sup>*Cardiovascular Epidemiology, University of Dundee, Ninewells Hospital and Medical School, Dundee DD1 9SY*, <sup>2</sup>*Haematology Research Laboratory, The Rayne Institute, St Thomas' Hospital, London SE1 7EH*.

Assessment of dietary vitamin K intake in the UK has not been possible without the vitamin K food compositional data. This database is now relatively complete (R. Price, C. Bolton-Smith, M. Shearer, unpublished results) and has been used to determine the usual intakes of vitamin K in 65 volunteers (thirty-four women and thirty-one men) aged 22 to 54 years. Subjects recorded a 7-d weighed food record during spring, summer, autumn and winter months, consecutively but with different first season. Healthy non-slimmers, half of whom smoked, were initially recruited. Body weight was recorded at the start and end of each recording week, and subjects' diaries were scrutinized for possible omissions and lack of detail middle and end of the week. Data are presented from the sixty-four people who completed 4 seasons and the one person who completed three seasons.

	Dietary phylloquinone intake									
	Spring		Summer		Autumn		Winter		Whole Year*	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Men µg/d	71	57	69	35	79	48	86	88	72	65
Men µg/5MJ	35	26	34	17	40	27	42	40	34	30
Women µg/d	67	33	73	38	68	33	72	44	64	33
Women µg/5MJ	42	19	46	25	43	19	48	31	41	22

\* No significant seasonal differences by repeat-measures ANOVA on the log-transformed data.

In spite of the care taken, and apparent compliance of the subjects, seventy-two out of the 259 individual 7-d records provided an energy intake (EI):calculated BMR ratio of <1.2, and eighteen subjects provided records which gave an EI:BMR <1.2 for two or more of the four recording weeks. The EI:BMR was above 1.55 for one-hundred and twelve individual 7-d records. Reported dietary vitamin K intake did not differ significantly between subjects grouped by either the EI:BMR cut-off of 1.2 or 1.55.

No significant sex or seasonal variation was found, probably due to the extremely high daily variation in vitamin K intake (intra-individual coefficient of variation 103 %). Although the mean daily vitamin K intakes over the year are approximately in line with the Committee of Medical Aspects of Food Policy (Department of Health 1991) guidelines of 1 µg/d per kg body weight, these values may not adequately take into account vitamin K loss due to u.v. light exposure or differential absorption of vitamin K from foods.

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**Variability in intake of fats and antioxidant vitamins assessed by multiple 7-day weighed dietary records.** By J. A. PAYNE, A. D. L. MACVEAN and R. A. RIEMERSMA, *Cardiovascular Research Unit, University of Edinburgh, George Square, Edinburgh EH8 9XF.*

Our understanding of the role of dietary fats and antioxidant vitamins in the pathology of disease depends on research relating nutrient intake to nutritional status and morbidity. A carefully conducted 7-d weighed record may provide the best representative measure of habitual nutrient intake, although 7 days are insufficient for the assessment of micronutrient intake (Bingham, 1987). However, it is very rare for a weighed dietary survey to extend beyond 7 d. The 7-d weighed record has recently attracted negative criticism as comparison of recorded energy intake with energy expenditure suggests that many subjects under-report energy intake, and hence nutrient intake (Livingstone, 1995). While assessment of energy expenditure is now regarded as the most accurate measure of energy requirement, the 7-d weighed record remains our most sophisticated tool for the assessment of actual intake of nutrients. The present research addresses the question: How good is the 7-d weighed record for the assessment of intake of fats and antioxidant vitamins?

Forty-four volunteers (twenty-two men and twenty-two women living as couples), aged 27 - 74 years were recruited into the study during 1994 by advertising in a local newspaper (80% socioeconomic group I or II). They were provided with electronic scales weighing in 1 g units and instructed to complete 7-d dietary records bi-monthly for 14 months. Food packaging was retained to assist dietary analysis by Comp-Eat 4 (Nutrition Systems, London). Over 1000 foods from recipes, direct analysis and manufacturers' data were added to the database and values for carotenoids in commonly consumed vegetables and fruits updated (Scott & Hart, 1994). Sixteen couples completed seven 7-d records, four couples completed six, and two achieved four records. Mean intake of nutrients and the mean within-person CV for intake of energy, fat and antioxidant vitamins are shown below. Energy intake represents 97% RNI for men and 95% RNI for women.

	Women (n 22)				Men (n 22)					
	Intake		RNI*	within-person CV		Intake		RNI*	within-person CV	
Mean	SD	Mean		%	range	Mean	SD		Mean	%
Energy (MJ)	8.03	1.40	8.45	9	4 - 16	10.38	1.58	10.7	10	5 - 22
Energy (kcal)	1910	335	2014	9	4 - 16	2470	375	2539	10	5 - 22
Fat (g)	78	18		13	6 - 22	101	20		13	6 - 32
% energy as fat	36	5		7	5 - 11	37	5		8	3 - 19
SFA (g)	29	9		17	7 - 31	38	10		17	8 - 35
MUFA (g)	25	6		5	6 - 31	33	6		16	7 - 41
PUFA (g)	15	5		22	9 - 48	19	5		23	9 - 41
Vitamin C (mg)	106	44	40	30	8 - 55	105	50	40	28	9 - 57
Vitamin E (mg)	9	4		23	7 - 50	11	4		24	9 - 43
Carotene(µg) equivalents	3327	1776		39	16 - 67	3647	1906		40	14 - 86

\* energy RNI based on an individual's body mass and occupation/recreational activities.

SFA, saturated fatty acids; MUFA, monounsaturated fatty acids; PUFA, polyunsaturated fatty acids.

These results suggest that a 7-d record can provide reproducible information on energy and total fat intake. However there is considerable within-person variation in intake of fatty acids and antioxidant vitamins, suggesting that a single 7-d record, however carefully recorded, incurs a mean error of 15 - 25% in the estimation of habitual fatty acid intake, and 20 - 40% in the estimation of habitual antioxidant vitamin intake.

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**Oxidized lipids in food.** By R. WILSON<sup>1</sup>, J. A. PAYNE<sup>1</sup>, R. SMITH,<sup>2</sup> P. WILSON,<sup>2</sup> M.J. SHEPHERD,<sup>2</sup> and R. A. RIEMERSMA<sup>1</sup>. <sup>1</sup>*Cardiovascular Research Unit, University of Edinburgh, George Square, Edinburgh EH8 9XF.* <sup>2</sup>*Food Science Laboratory, Norwich NR4 7UQ*

Oxidized lipids have been implicated in the aetiology of coronary heart disease (Witztum, 1994). The difficulty in testing this hypothesis is the lack of reliable methods to measure oxidized fatty acids (FA) *in vivo*. We have developed a novel method to quantify oxidized C18 FA (C18 hydroxy) from oleic acid, linoleic acid and linolenic acid by gas chromatography mass spectroscopy (GCMS). As little information on the levels of C18 hydroxy in food is available, we examined the levels in some foods.

Eight vegetarian and ten meat or fish-based recipes were selected from a collection of recipes derived from a recent population-based study. Each recipe was replicated in the laboratory and immediately homogenised under argon to prevent oxidation. Lipid was extracted from 3 gram homogenate by solvent (Folch et al., 1957) and analysed for C18 hydroxy by GCMS. Three identical vegetable stir-fry recipes, prepared with different oils, were also analysed. A description of each recipe, method of cooking, levels of total fat and oxidized lipid are shown in the table below.

Description	Cooking method (including added oil)	Fat (g/kg)	C18 hydroxy (mg/kg)	%18:2 (% total FA)	C18 hydroxy (% total fat)
Mushroom/cheese bake	Bake	0.420	1.409	7.5	0.33
Roast mixed vegetables	Bake (olive/walnut oil)	0.158	0.247	21.3	0.16
Borsch (beetroot soup)	Boil (olive oil)	0.171	0.086	9.3	0.05
Broccoli in cheese sauce	Boil	0.527	0.964	5.5	0.18
Courgette in tomato sauce	Microwave (olive oil)	0.285	0.703	14.4	0.25
Haricot bean with onion	Stir-fry (sunflower oil)	1.069	3.495	62.1	0.33
Ratatouille	Brown/boil (olive oil)	0.135	0.234	11.2	0.17
Courgette in cheese sauce	Boil/bake	0.700	2.480	18.1	0.35
Veal stew	Boil/simmer	0.189	0.234	12.8	0.12
Lamb casserole	Brown/bake (olive oil)	0.611	0.297	6.7	0.05
Sweet n' sour chicken	Boil/simmer (Stork)	0.505	1.578	13.8	0.31
Pork casserole	Brown/bake (rapeseed)	0.579	0.578	21.8	0.10
Haddock chowder	Brown/boil (butter)	0.270	0.445	5.4	0.16
Beef chilli con carne	Microwave	0.493	0.558	4.7	0.11
Prawn and vegetables	Stir fry (sunflower oil)	0.520	0.729	62.8	0.14
Liver and bacon casserole	Brown/bake (Stork)	0.735	0.158	11.8	0.02
Tuna and cheese sauce	Boil	1.262	3.033	6.0	0.24
Chicken with tomato sauce	Roast/boil (olive oil)	0.303	0.152	12.3	0.05
Mixed vegetables*	Stir fry (olive oil)	11.54	2.100	8.2	0.18
Mixed vegetables*	Stir fry (sunflower oil)	11.42	5.650	66.2	0.50
Mixed vegetables*	Stir fry (walnut oil)	11.67	1.570	59.2	0.13

\* identical mix and weight of vegetables and amount of oil, and cooked for the same length of time

There was no simple relationship between percentage linoleate and the levels of total C18 hydroxy. However, analysis found levels of total C18 hydroxy to be proportional to levels of total fat in the recipes ( $r = 0.75$ ,  $P < 0.001$ ) but more importantly to the level of total unsaturated fat in the recipes ( $r = 0.69$ ,  $P < 0.001$ ). The data demonstrate that C18 hydroxy is present in food. Absorption of C18 hydroxy from food needs to be considered before C18 hydroxy levels in plasma could be considered to indicate oxidative stress *in vivo*.

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**The effect of feeding and weaning practice on growth and nutritional status of Glasgow boys and girls in the first year of life.** By S.A.H. SAVAGE, J.J. REILLY and J.V.G.A. DURNIN, *University of Glasgow, Department of Human Nutrition, Yorkhill Hospitals, Glasgow G3 8SJ*

A longitudinal study was undertaken in Glasgow to assess growth and nutritional status of healthy infants from birth until 2 years. A representative sample of 127 infants was recruited, measured monthly until 6 months then at 9, 12, 18 and 24 months. Anthropometric measurements made were weight; length; triceps and subscapular skinfolds; head, mid-upper arm, calf and thigh circumferences. The main aims were to assess growth and nutritional status in Glasgow infants and the factors which affect this; and to compare data with other reference values. Breastfeeding rate was 42% at the end of the first week, 39% at 2 months, and the median age at which solid food was introduced was 11 weeks, range 4-35 weeks (Savage *et al.* 1994).

It has previously been reported that feeding method and age at weaning influence the growth and nutritional status of infants. This abstract concentrates on weight, length, head circumference and BMI of boys and girls in the first year of life. The effects of feeding method and weaning practice on these measurements were assessed using two-sample *t* tests.

Direct comparisons were carried out between breast-fed (*n* 48) and formula-fed (*n* 74) infants and between infants weaned before 12 weeks (*n* 65) and at or after 12 weeks (*n* 61). At 1 year formula-fed girls had a significantly greater mean BMI than those breast-fed ( $P=0.04$ ), and breast-fed boys had a significantly greater mean head circumference than formula-fed boys ( $P=0.01$ ), but no differences were found for weight or length (Table). There was no evidence that timing of introduction of solids influenced growth or nutritional status in boys, but girls weaned before 12 weeks had significantly greater weight ( $P<0.001$ ), length ( $P<0.01$ ), head circumference ( $P<0.001$ ) and BMI ( $P<0.05$ ) at 1 year than those weaned at or after 12 weeks. However, when the 1 month measurements were examined those girls who were largest at 1 month tended to be weaned early.

	Breast-fed		Formula-fed		<i>P</i> -value	Early-weaned		Late-weaned		<i>P</i> -value
	Mean	SD	Mean	SD		Mean	SD	Mean	SD	
<b>Boys</b>										
Weight(kg)	10.51	0.93	10.29	1.25	0.43	10.39	1.09	10.45	1.22	0.83
Length (mm)	766	24	755	32	0.14	762	27	759	33	0.75
Head circumference (mm)	485	13	473	12	0.01	475	11	479	15	0.15
BMI (kg/m <sup>2</sup> )	17.9	1.2	18.0	1.3	0.80	17.9	1.2	18.1	1.4	0.53
<b>Girls</b>										
Weight(kg)	9.31	1.04	9.75	1.48	0.21	10.15	1.36	9.00	0.93	0.001
Length (mm)	747	25	740	32	0.43	754	25	730	26	0.002
Head circumference (mm)	480	12	475	13	0.14	469	11	458	9	0.000
BMI (kg/m <sup>2</sup> )	16.7	1.6	17.7	1.8	0.04	17.8	1.7	16.9	1.7	0.047

A multiple regression was carried out for each measurement to assess whether these between group differences were still significant when other variables were taken into account. The explanatory variables used were age of weaning, mother smoking during pregnancy, mothers education, social class of head of household, mothers age, other children in the family, mothers and fathers height, duration of breastfeeding and 1 month measurement. With these other variables taken into account, duration of breastfeeding was a significant factor in determining head circumference in boys at 1 year. In girls at 1 year, timing of weaning was a significant factor for weight but not for the other three measurements, and duration of breastfeeding was a significant factor for BMI.

In conclusion, the differences in weight and length between breast-fed and formula-fed infants reported in other studies were not observed in the present study, although a difference was found for BMI in girls. Although timing of weaning was significantly associated with anthropometry at 1 year in girls this was partly due to the fact that girls who were larger at 1 month tended to be weaned earlier.

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**Increased fibrinogen synthesis in cancer patients: implications for nitrogen economy.**

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Our body composition studies show that skeletal muscle is the most likely source of amino acids to support the demand for acute-phase protein synthesis during wasting (Preston *et al.* 1987). We have noted that fibrinogen is the major acute phase protein associated with an inflammatory response in cancer patients with the anorexia-cachexia syndrome and have recently shown that, in pancreatic cancer patients with an acute-phase response, median fibrinogen absolute synthetic rate is increased from 28 (range 23-55) mg/kg per d in healthy controls to 88 (range 34-148) mg/kg per d in cancer patients ( $P=0.008$ ), an increase of over 3 g/d (Preston *et al.* 1995). Amino acids that have been mobilized from skeletal muscle, but are surplus to fibrinogen synthesis, due to the marked difference in amino acid composition of these proteins, would be oxidised and lost as urinary N. It has been postulated that the imbalance in amino acid composition between acute-phase and skeletal muscle protein could largely account for the negative N balance observed following uncomplicated surgery (Reeds *et al.* 1994). For the first time, we have performed a calculation to investigate the significance of ongoing elevated fibrinogen synthesis to the N economy of the cachetic cancer patient.

There are two approaches that can be used to calculate the equivalence of acute phase and skeletal muscle proteins. First, using skeletal muscle amino acids, we calculate that 7.9 g skeletal muscle protein is required to support the synthesis of 3 g fibrinogen. In this case, tryptophan (followed by serine and then tyrosine) is the most limiting amino acid. Alternatively, using amino acids exported from the leg muscle of post-absorptive weight-losing cancer patients (Bennegard *et al.* 1984), the increase in fibrinogen synthesis would equate to 7.3 g muscle protein/d. This value is similar to that given earlier, however in this case serine (followed by tryptophan and then methionine) is most limiting. Assuming that dietary intake and *de novo* synthesis are inadequate, we calculate that this is equivalent to a loss of 35 g body tissue during the first day of the acute-phase response. In terms of N economy, the amino acids mobilized from skeletal muscle and oxidized would contribute 0.9 g to urinary N. Cancer patients with inflammation can thus show a negative N balance of 16 mg/kg per d which may continue (albeit at a lower rate) if acute-phase protein breakdown and recycling of amino acids is incomplete.

Anti-inflammatory intervention may be required to moderate the acute-phase response during inflammation, but nutritional support should ensure an adequate supply of aromatic amino acids together with serine, and the metabolically-related amino acids, methionine, cysteine and glycine (Grimble, 1990), as serine, cysteine and glycine may become conditionally essential.

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**Evaluation of the use of knee-height to estimate stature in individuals aged  $\geq 75$  years living in Edinburgh: implications for the determination of body mass index.** By E. BANNERMAN<sup>1</sup>, N. CHAPMAN<sup>2</sup>, S. COWAN<sup>3</sup>, J.J. REILLY<sup>4</sup>, T. KIRK<sup>1</sup>, W.J. MACLENNAN<sup>2</sup> and F. PENDER<sup>1</sup>, <sup>1</sup>Department of Dietetics and Nutrition, Queen Margaret College, Edinburgh EH12 8TS, <sup>2</sup>The University of Edinburgh, Geriatric Medicine Unit, Royal Infirmary of Edinburgh, Edinburgh EH3 9EW, <sup>3</sup>Medical Physics, Western General Hospital, Edinburgh EH4 2XU, <sup>4</sup>Department of Human Nutrition, Yorkhill Hospitals, Glasgow G3 8SJ.

Height measurements or estimates of stature are frequently used in nutritional assessments for the calculation of BMI and the determination of under- and over-nutrition, for example. The decrease in height that is associated with ageing makes attempts to carry out the standard height measurement on elderly subjects a difficult and inaccurate exercise to perform, especially on subjects who are immobile or disabled. Demispan and knee height are two alternative methods that can be used for estimating stature. The COMA report (Department of Health, 1992) highlights the need for the validation of alternative measures of stature in elderly individuals. The aim of the present study was to evaluate the use of knee height for estimating stature in individuals aged  $\geq 75$  years living in Edinburgh and identify the implications when using this to determine BMI in nutritional assessment.

Height and knee-height were measured on thirty-four 'healthy' non-institutionalized individuals (seventeen males, seventeen females)  $\geq 75$  years old, mean age 81 (range 76-95) years, living in Edinburgh. All subjects were able to stand erect without help for the measurement of height. Knee height measurements were made on the left side. Stature was estimated from knee height using age- and sex-specific equations derived from data obtained from white Americans (Chumlea *et al.* 1985). The method described by Bland & Altman (1986) was used to compare the values of estimated stature with measured height.

For the group, there appeared to be no significant difference between measured height and estimated stature (mean difference 0.01 m and 0.00 m, for males and females respectively). The 95% limits of agreement for estimated stature were -40 mm to +80 mm and  $\pm 80$  mm for males and females respectively. These are comparable with those published in the literature. This, together with the fact that there was no significant bias in estimating stature suggest that the equations appear valid for use with other elderly populations. However, the lack of accuracy at the individual level is likely to have significant implications when BMI is calculated, as shown in the Table. For example, a difference between measured and estimated height of 0.07 m would give a difference of 3 kg/m<sup>2</sup> for BMI calculated using actual height and estimated stature.

Subject	Weight (kg)	Measured height (m)*	Estimated stature (m)*	BMI (kg/m <sup>2</sup> )*	BMI (kg/m <sup>2</sup> )*
4	75	1.53	1.60	32	29
8	56.7	1.62	1.54	22	24
34	66.2	1.72	1.64	22	25

In conclusion, this study suggests that the equations of Chumlea *et al.* (1985) can be used to estimate stature for a group of individuals. However, the potential inaccuracies in estimating stature of individuals demonstrated in the present study, could result in the inaccurate calculation of BMI. In terms of screening individuals, this could lead to inappropriate interventions or, more importantly, the failure to identify individuals who are 'at risk'.

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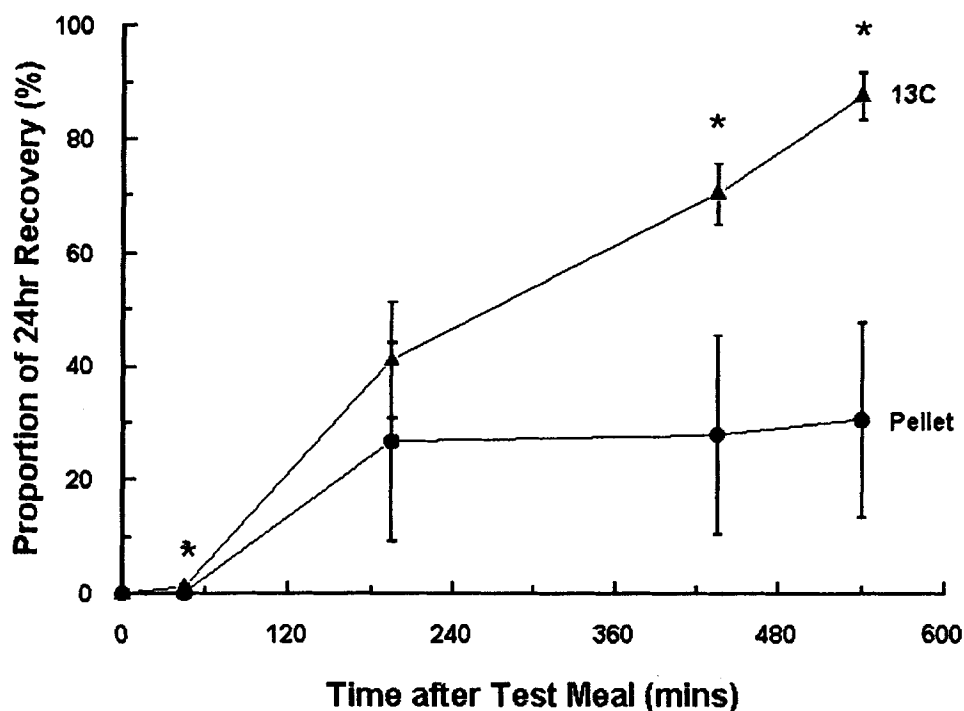
**Are radio-opaque pellets suitable markers for upper intestinal transit studies in human volunteers?** By M. DENISE ROBERTSON<sup>1</sup>, G. LIVESEY<sup>2</sup> and J.C. MATHERS<sup>1</sup>, <sup>1</sup> *Human Nutrition Research Centre, Department of Biological and Nutritional Sciences, University of Newcastle upon Tyne, NE1 7RU* and <sup>2</sup> *Institute of Food Research, Norwich Laboratory, Norwich Research Park, Colney, Norwich, NR4 7UA.*

The Present study was designed to determine the usefulness of radio-opaque pellets as markers in the determination of transit through the stomach and small bowel.

After an overnight fast, six healthy male ileostomist volunteers (aged 40-60 yrs, treated for ulcerative colitis) consumed a test meal (TM) consisting of 50 g cooked <sup>13</sup>C-enriched peas (*Pisum sativum*) together with 100 radio-opaque pellets (<1.5 mm diameter).

Two further carbohydrate-free meals were provided at 2 and 6 h after the TM and the volunteers were allowed to eat freely from 9 h post TM.

Ileal effluent was collected quantitatively at intervals up to 9 h after the TM with a final bulk collection at 24 h post TM.



By 9 h post TM, 0.84 (SE 0.17) of the NSP ingested and 0.87 (SE 0.04) of the total <sup>13</sup>C-labelled material recorded within 24 h had been collected in ileal effluent. In contrast, total recovery of radio-opaque pellets after 24 h was only 0.65 (SE 0.14) with less than one third of this collected in the first 9 h. As shown in the figure the pattern of excretion of radio-opaque pellets was very different from that of <sup>13</sup>C-labelled food residues and we conclude that, in these circumstances, radio-opaque pellets are not appropriate as markers of upper intestinal transit.

**Effects of carbonated beverages on eating behaviour over seven days.** By MARIE REID<sup>1</sup> and RICHARD HAMMERSLEY<sup>2</sup>, <sup>1</sup>*Department of Consumer Sciences, Glasgow Caledonian University, Park Campus, Park Drive, Glasgow G3 6LP*, and <sup>2</sup>*Behavioural Sciences Group, University of Glasgow, Gartnavel Royal Hospital, Glasgow, G12 0XH*.

Effects of sugar-sweetened and aspartame-sweetened drinks on mood and eating were examined over 7 d. Twenty-five healthy adults (12 male, 13 female) aged 18-35 years who habitually consumed sugar-sweetened drinks were placed on a 7 d regime receiving either sugar-sweetened drinks ( $n$  12), or aspartame-sweetened alternatives ( $n$  13). A between-subjects design was used to prevent subjects comparing the drinks, which were given blind. Using our previous methodology (Reid & Hammersley, 1994, 1995) subjects completed a prospective food diary and rated mood daily using the Profile of Mood States (McNair, Lorr & Droppleman, 1971), as well as before and after each test drink, using simple visual analogue scales. By analysis of variance there were no differences between the groups in diet over the 7 d period but post-hoc  $t$  tests showed that, on day 1 of the study only, those who received sugar-sweetened drinks had significantly more sugar episodes (where sugars, or sugar-fat, or sugar-alcohol mixtures were consumed) than did those who received aspartame-sweetened drinks ( $t(23df)=3.68$ ,  $P<0.005$ ). The sugar group had a mean of 9.5 (SD 3.9) sugar episodes compared with 4.8 (SD 2.4) for the aspartame group. Post-hoc  $t$  tests also showed that, on day 1 of the study only, those who received sugar-sweetened drinks consumed more grams of carbohydrate (CHO) in sugar episodes than did those who received aspartame-sweetened drinks ( $t(23df)=2.34$ ,  $P<0.05$ ). The sugar group consumed a mean of 116 (SD 71) g simple CHO compared with 60 (SD 45) g for the aspartame group. Using an analysis of variance the aspartame group also rated themselves as slightly less tired before the second test drink of day 1 ( $F(1,23)=5.17$ ,  $P<0.05$ ) and they felt less tired (mean 3.3, SD 1.0) than those who received sugar (mean 4.2, SD 1.3). However, overall energy intake between the two groups for the day was unaffected and the above effects were absent by day 2 of the study. Body weight was unaltered at 7 d compared with baseline. Aspartame substituted for sugar in soft drinks may temporarily reduce tiredness, while continued sugar drinks given blind may temporarily increase, or fail to reduce, appetite for CHO, but both effects disappear within 24 h. These findings suggest that the results of priming studies over less than 24 h may not generalise to the longer term.

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**Does the histamine receptor antagonist, cyproheptadine increase voluntary food intake?** By MARK G. GOODWILL<sup>1</sup>, NEIL S. JESSOP<sup>1</sup> and JOHN D. OLDHAM<sup>2</sup>, <sup>1</sup>*Institute of Ecology and Resource Management, The University of Edinburgh Edinburgh EH9 3JG* and <sup>2</sup>*Genetics and Behavioural Sciences Department The Scottish Agricultural College Edinburgh EH9 3JG*

The present study examines the effects of the H<sub>1</sub> receptor antagonist, cyproheptadine, on the voluntary food intake and corresponding weight change of both lactating and weanling Sprague-Dawley rats over a 12 day period. Mercer *et al.* (1994) suggested that suppressed voluntary food intake associated with protein-energy imbalanced diets was a result of increased plasma histidine, which is converted in the brain to histamine and this acts on the hypothalamus via H<sub>1</sub> receptors. Rats offered a low protein high energy diet mobilise relatively large quantities of body protein between days 1 and 6 of lactation, and might be expected to increase voluntary food intake when administered with an H<sub>1</sub> receptor antagonist.

Twenty-five multiparous rats (310 (SE 9.1) g) were offered *ad lib.* one of two isoenergetic, casein supplemented with methionine (99:1 w/w) diets, one of high (H; 215 g crude protein (CP)/kg dry matter (DM)) protein concentration and one low (L; 90 g CP/kg DM) protein concentration. During gestation, rats were offered diet H; litters were standardized to twelve pups at parturition (day 1 of lactation). Lactational dietary treatments were either diet L or diet H for the first 12 d of lactation. All rats received a daily injection intraperitoneally (ip) (0.5 ml total volume) of either saline (S; 150 mol/l) or cyproheptadine (D; 2.5 mg / kg body weight) dissolved in saline, just before the dark period for the first 12 d of lactation. In addition, thirty-six weanling rats (145 (SE 1) g) were offered *ad lib.* one of three isoenergetic, casein supplemented with methionine (99:1 w/w) diets (VL; 40 g/kg DM, L or H) they also received a daily ip injection (0.3 ml total volume) of either saline or cyproheptadine (2.5 mg/kg BW) for 12 d. Body weights and food intakes of all animals were weighed daily.

Control lactating rats offered diet L (LS) ate less ( $P < 0.05$ ), this resulted in a greater body weight loss ( $P < 0.05$ ) when compared with control rats offered diet H (HS) (Table 1). Food intakes and weight changes of lactating rats offered diet L and injected with cyproheptadine (LD) were comparable with rats offered diet H and significantly different from the control group LS over the first 5 d period but not over the 11 d period (Table 1). Weanling rats offered diets L and H showed no significant differences in food intake between d 1-6 or d 1-12, however rats offered diet VL had significantly reduced intakes when compared with the other groups. Cyproheptadine administered to weanling rats failed to significantly increase food intake when compared with control rats offered the same diet over either 5 or 11 d.

**Table 1** Cumulative DM intake (g) and weight change (g) for lactating rats between days 1 and 12 of lactation.

	Diet <i>n</i>	HS 5	HD 5	LS 5	LD 4	SED
DM Intake (g)	(days 1-6)	101.0 <sup>a</sup>	103.4 <sup>a</sup>	42.1 <sup>b</sup>	105.2 <sup>a</sup>	13.19
	(days 1-12)	326.0 <sup>a</sup>	319.0 <sup>a</sup>	141.0 <sup>b</sup>	173.0 <sup>b</sup>	36.30
Weight Change (g)	(days 1-6)	-20.3 <sup>a</sup>	-17.5 <sup>a</sup>	-62.8 <sup>b</sup>	-20.6 <sup>a</sup>	8.12
	(days 1-12)	-26.0 <sup>a</sup>	-29.6 <sup>a</sup>	-112.1 <sup>b</sup>	-94.4 <sup>b</sup>	9.19

Means with different superscripts within the same row differ ( $P < 0.05$ ).

The results suggest that food intake suppression shown by lactating rats offered a low protein concentration diet may be a result of increased brain histamine over the short term. However, after 11 d food intake is not increased in rats administered with the histamine receptor antagonist suggesting that another mechanism(s) is involved. Mercer *et al.* showed the drug cyproheptadine increased food intake over a 5 day period when weanling rats were offered a 4% protein diet. However, their protein source was unsupplemented casein and we wish to speculate that our 4% methionine supplemented casein diet did not evoke sufficient body protein mobilisation to significantly increase plasma histidine.

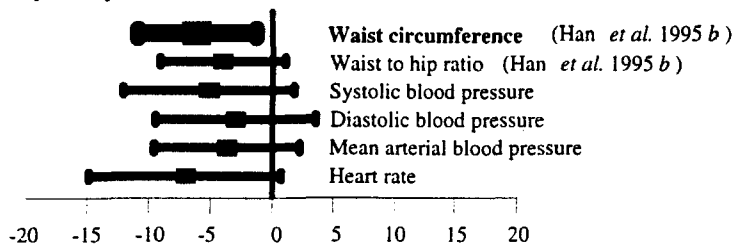
M.G.G. gratefully acknowledges receipt of a Ministry of Agriculture, Fisheries Food studentship and also the Scottish Office Agriculture and Fisheries Department who partly funded the work.

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**The relationship between women's birth weight and their current cardiovascular function.** By THANG S. HAN<sup>1</sup>\*, GERALDINE McNEILL<sup>1</sup> and DORIS M. CAMPBELL<sup>2</sup>, *Departments of <sup>1</sup>Medicine and Therapeutics and <sup>2</sup>Obstetrics and Gynaecology, Aberdeen University, Aberdeen AB9 2ZD \*Present address: Department of Human Nutrition, Royal Infirmary, Glasgow G31 2ER*

It has been suggested that fetal underdevelopment may have lasting effects on vital organs, rendering subjects at higher risk of metabolic abnormalities and associated health risks later in life (Barker, 1994). Our previous study of forty-six women born in Aberdeen, aged 18-44 y and BMI 17-38 kg/m<sup>2</sup>, supported this hypothesis, showing a significant inverse relationship between birth weight and waist circumference (Han *et al.* 1995b), indicating an association between fetal underdevelopment and increased intra-abdominal fat-mass (Han *et al.* 1995a). The present study further examined the same group of women's birth weight, 2.15-3.74 kg (gestational age >36 weeks), in relation to their current systolic, diastolic and mean arterial blood pressures (BP) and heart rate (HR), measured in duplicate (five minute interval) after 15 minute rest in supine position, to assess their cardiovascular function.

Since there was a significant relationship between the women's birth weight and their body weight ( $r$  0.39;  $P$  = 0.008), these measurements were used as independent variables in multiple regression analysis to predict BP or HR (dependent variable).



The Figure shows that the regression coefficients ( $\beta$ ) and 95% CI of birth weight for predicting systolic ( $\beta$  -5.2, 95% CI: -12.2, 1.9), diastolic ( $\beta$  -3.0, 95% CI: -9.5, 3.4), and mean arterial BP ( $\beta$  -3.7, 95% CI: -9.7, 2.2), and HR ( $\beta$  -7.1, 95% CI: -14.9, 0.7) were all negative, but not significant, indicating a tendency for an inverse relationship between low birth weight and increased BP and HR in women.

Since cardiac output (Q) is directly related to heart size as reflected by stroke volume (SV) and heart rate (HR):  $Q = SV \times HR$  (Vander *et al.* 1990), assuming women with the same body weight require the same Q; those with lower birth weight had a tendency to increase their HR, suggesting smaller SV or heart size. The tendency for elevated BP in women who were born smaller could be related to increased total peripheral resistance, which may be related to reduced size and/or number and/or elasticity of blood vessels. The number of subjects ( $n$  46) in the present study was relatively small, but the results did show some support for the 'Barker hypothesis' (Barker, 1994). Studies on vital organ size and function in relation to early growth and development deserve further investigation.

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**Staff use and quality of anthropometric measures in a children's hospital.** By M. JANE BUNTING and LAWRENCE T. WEAVER, *Department of Human Nutrition, Yorkhill Hospitals, Glasgow G3 8SJ*

Hospital patients are more vulnerable to malnutrition following trauma, major surgery and during infection. The effects of malnutrition are far-reaching, and several studies have reported a significant prevalence in children's hospitals. However, this is poorly recognized due, it has been suggested, to a lack of awareness and nutritional education of medical staff. We aimed to document the extent of staff use and the quality of anthropometric measures in the Royal Hospital for Sick Children, Glasgow. A prospective study was performed on two medical and two surgical wards and clinics during a 4-week period. The case notes of 305 children were reviewed for records of weights, heights and growth charts. A survey of the equipment present for measuring body weight and height in the hospital was undertaken, and a sample of the medical, nursing and dietetic staff on the wards were asked to answer simple questions about clinical nutrition. Of all the case notes, 83% of the nursing notes and 13% of the medical notes contained records of weights. 12% of the nursing notes and 8% of the medical notes contained records of heights. There were growth charts present in 40% of the case notes yet weights and heights were not always filled in. Children with weights and heights below the third centile were not always referred to the dietitian. As shown below, surgical ward notes more frequently had inadequate records of weights, heights and growth charts than those of medical wards.

#### Comparison between medical and surgical wards

	Medical	Surgical	Total
	n	n	n
Case notes reviewed	148	157	305
Weights in nursing notes	131	123	254
Heights in nursing notes	34	4	38
Weights in medical notes	35	4	39
Heights in medical notes	22	1	23
Growth charts present	96	27	123
Weights on growth charts	65	2	67
Heights on growth charts	37	2	39

Overall, most wards and clinics had working and accurate weighing equipment (82% were accurate within 1%) and height equipment (43% were 100% accurate). Of the height machines 57% were inaccurate by 1 cm or more. One was 4 cm out. Over 80% of ward staff had adequate knowledge of the theory behind anthropometry and recognized the value of growth charts. In this three-part study, we have shown that although most staff apparently know why anthropometry should be performed, and although there are reasonably accurate machines present for measurement in the hospital, the weights and heights of children continue to be recorded inadequately in hospital notes, and the proper recognition of childhood malnutrition is therefore not made.



**The influence of a modified diet on the activity of the delta-6-desaturase enzyme in men.** By D. M. PERKINS, R. A. RIEMERSMA, J. A. PAYNE and A. D. L. MACVEAN *Cardiovascular Research Unit, University of Edinburgh, George Square, Edinburgh EH8 9XF*

There are some observations that suggest that diets low in the essential fatty acid linoleic acid, reflected in low levels of this fatty acid in adipose tissue, may lead to the development of coronary heart disease. The essentiality of linoleic acid depends on its conversion to  $\gamma$ -linolenic and dihomo- $\gamma$ -linolenic acid. An important rate limiting step in this pathway is the desaturation of linoleic acid to  $\gamma$ -linolenic acid by delta-6-desaturase. In one study relatively low amounts of dihomo- $\gamma$ -linolenic acid rather than linoleic acid were more significantly related to the risk of coronary heart disease (Riemersma, 1992). This suggests that it might be the conversion by delta-6-desaturase rather than dietary intake that is the most important factor. This research examines the influence of an increased linoleic acid intake on blood lipids, adipose tissue fatty acids and the activity of the delta-6-desaturase enzyme.

The delta-6-desaturase activity in platelets was assayed by incubation with 0.5 mg microsomal protein and 200 nmol  $^{14}\text{C}$  linoleic acid for 20 min at 37°, followed by separation of the precursor from the products by argentation TLC and liquid scintillation counting. The coefficient of variation of this method is 5.8%.

Fifteen men aged 54 (SD  $\pm$  2) years, from a random population sample were recruited into the study and provided with digital electronic scales (accuracy  $\pm$  1 g) and instructed to record a 7-d weighed dietary record, giving baseline nutritional values. Nine men willing to change their diet for 4 months (<35% energy from fat; P:S fat ratio of 1) were given personalized dietary advice on how to achieve this. Polyunsaturated margarines and oils were provided free of charge by Unilever. Six men continued their habitual diet (controls). The change in diet was assessed by a second 7-d weighed record 1 month later and before the end of the intervention period. Blood samples (20 ml) were taken at baseline, week 5 and week 16. Adipose tissue was sampled at baseline and week 16.

	Intervention group (n - 9)				Control group (n - 6)			
	Baseline		Week 16		Baseline		Week 16	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
<b>Dietary intake:</b>								
Energy (MJ)	10.6	1.9	10.5	0.7	11.0	2.4	9.6	2.0
Energy (Kcal)	2529	456	2493	160	2616	581	2277	471
% energy as fat	35	6	37	3	36	4	37	3
P:S ratio	0.4	0.1	1.1**	0.4	0.4	0.2	0.5	0.2
<b>Serum:</b>								
Cholesterol (mmol/l)	6.34	0.82	6.18	0.98	6.61	1.60	6.05	1.05
Triglyceride (mmol/l)	1.67	0.87	1.68	1.30	3.30	2.68	2.56	1.48
HDL (mmol/l)	1.33	0.32	1.35	0.26	1.06	0.20	1.17	0.18
<b>Adipose tissue (% fatty acids):</b>								
Linoleic acid	11.09	2.09	12.1*	2.60	11.6	2.0	11.5	2.0
<b>Platelet:</b>								
delta-6 activity (nmol/min. mg protein)	0.056	0.038	0.072	0.042	0.082	0.035	0.08	0.051

\* $P < 0.05$ , \*\* $P < 0.001$ , paired t tests (with baseline values). P:S ratio, polyunsaturated fat : saturated fat ratio.

The % energy as fat increased by 2% during the study due to an excess intake of PUFA margarine.

Despite a marked increase in dietary linoleic acid intake (already seen at 4 weeks) the activity of delta-6-desaturase in platelets was unchanged, suggesting that the negative inhibition by polyunsaturated fatty acids on delta-6-desaturase activity is not seen in diets that are feasible in our Western society.

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