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PROCEEDINGS OF THE NUTRITION SOCIETY

ABSTRACTS OF COMMUNICATIONS

The Four Hundred and Thirty-eighth Meeting of the Nutrition Society (One Hundred and Seventy-third of the Scottish Group) was held in the Kelvin Conference Centre, University of Glasgow, Glasgow on Tuesday and Wednesday, 7/8 *April* 1987, *when the following papers were read:*

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Increased dietary carbohydrate and endurance during single-leg cycling.

By A. E. HARDMAN and C. WILLIAMS, *Department of Physical Education and Sports Science, University of Technology, Loughborough, Leicestershire LE11 3TU*

The influence of high-carbohydrate diets on endurance performance has been attributed to supercompensation of muscle glycogen but liver glycogen is also elevated by such diets (Hultman & Nilsson, 1971). The purpose of the present experiment was to explore the possibility that increased availability of blood-borne glucose might contribute to improved endurance after carbohydrate loading. A single-leg exercise model was employed, utilizing the observation that supercompensation of muscle glycogen takes place only in a previously exercised limb (Hultman & Bergstrom, 1967).

Endurance time to exhaustion at 70% of single-leg maximum oxygen uptake (Test 1) was determined for eleven males and three females who were then allocated to either a control group (C) or a high-carbohydrate group (CHO). For the 3 d following Test 1, the C group maintained their normal diet whilst the CHO group increased the proportion of energy derived from carbohydrate. The endurance test was then repeated (Test 2) by all subjects using the leg that was inactive during Test 1. Energy intake was similar before each test (C, 12·2 (SD 2·8) MJ *v.* 11·6 (SD 2·1) MJ; CHO, 10·4 (SD 2·5) MJ *v.* 11·7 (SD 3·7) MJ, both not significant) but the CHO group obtained an increased proportion of energy from carbohydrate before Test 2 (C, 48 (SD 7) % *v.* 49 (SD 8) %, not significant; CHO, 44 (SD 2) % *v.* 62 (SD 4) %, $P<0.01$). Endurance time and the 30 min values for respiratory exchange ratio (R) and capillary lactate and glucose concentrations are shown in the Table.

	Endurance time (min)		R		Lactate (mmol/l)		Glucose (mmol/l)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD
C: Test 1	107·5	9·1	0·88	0·06	4·01	1·19	4·06	0·53
Test 2	101·8	21·7	0·88	0·04	4·32	2·05	3·87	0·43
CHO: Test 1	98·5	21·9	0·90	0·05	3·75	1·62	4·10	0·70
Test 2	123·7	43·2	0·92	0·03	4·11	1·44	3·91	0·38

Despite the slightly longer endurance time of the CHO group on Test 2 (not significant, 2-tailed test) there was no indication of increased carbohydrate utilization from R values or blood metabolites (Table). This study suggests that elevation of liver glycogen has little influence on endurance performance during high intensity cycling exercise.

Hultman, E. & Bergstrom, J. (1967). *Acta Medica Scandinavica* **182**, 109–117.
Hultman, E. & Nilsson, L. H. (1971). *Advances in Experimental Medicine and Biology* **11**, 143–151.

Towards NACNE: practical nutrition education in a high-risk area. By A. S. ANDERSON, M. E. J. LEAN and H. COUBROUGH, *Department of Dietetics, Aberdeen Royal Infirmary, Foresterhill, Aberdeen AB9 1GS*

There is now a reasonable concensus of scientific opinion that adoption of the nutritional principles outlined in the reports of the National Advisory Committee on Nutrition Education (NACNE) (1983) and the Department of Health and Social Security (1984) (COMA) would improve health in the general population (Acheson, 1986). Scepticism persists, however, about the feasibility of making the required changes in eating habits for the population at risk. For the present study a low-cost nutrition education programme was designed and run by a part-time dietitian in Aberdeen Royal Infirmary with the aim of improving the nutrition of staff. Its effectiveness was evaluated by assessment of habitual dietary intakes of staff, assessed using a previously validated food frequency questionnaire method (Yarnell *et al.* 1983), based on food composition tables using standard portion sizes (W. Doyle, personal communication). This was administered to random samples of 300 staff before and 12 months after the intervention programme.

129 responses were analysed in 1985 and 108 in 1986: distributions of age, sex and social class were similar to those of the entire health board staff. Mean energy intakes were unchanged.

Although little weight can be placed on absolute nutrient intakes of individuals assessed by this questionnaire method, analysis of the pre- and post-intervention surveys indicated significant changes towards lower fat and higher carbohydrate intakes ($P<0.05$). Mean fat intakes of staff fell from 37·7 (SE 0·7) to 35·0 (SE 0·6)% of total energy ($P<0.01$). Current long-term nutritional goals (NACNE, 1983) were achieved by 6% of staff before the intervention programme and by 13% afterwards ($P<0.05$). Improvements appeared to occur throughout all age, sex and socio-economic groups. Examples set in the staff dining rooms, by introducing new or modified recipes and promoting low-fat/high-carbohydrate dishes and snacks, were well received and did not increase catering costs. These improvements in nutrient intakes did not appear to be paralleled by any similar changes in food purchases in the general population over the same period (January 1985–January 1986) (D. Buss, personal communication): they may thus be attributed to the programme. The reduction in dietary fat would be expected to produce a 2% drop in blood cholesterol and a 4% fall in the incidence of heart disease (Stamler, 1983). The employment of an enthusiastic part-time dietitian with this specific remit might well be justifiable purely on local financial considerations.

Acheson, E. D. (1986). *Proceedings of the Nutrition Society* **45**, 131–138.

Department of Health and Social Security (1984). *Diet and Cardiovascular Disease. Committee on Medical Aspects of Food Policy. Report of the Panel on Diet in Relation to Cardiovascular Disease.* London: H.M. Stationery Office.

National Advisory Committee on Nutrition Education (1983). *A Discussion Paper on Proposals for Nutritional Guidelines for Health Education in Britain.* London: Health Education Council.

Stamler, J. (1983). *Progress in Biochemistry and Pharmacology* **19**, 245–308.

Yarnell, J. W. G., Fehily, A. M., Milbank, J. E., Sweetnam, P. M. & Walker, C. L. (1983). *Human Nutrition: Applied Nutrition* **37A**, 103–112.

Activity pattern of rural women from Rajasthan, India. By M. CHOUDHRY, K. KAUR and S. CHOUDHRY (introduced by J. V. G. A. DURNIN), *Department of Foods & Nutrition, Sukhadia University, Udaipur, India*

In India, rural women have an important role in agriculture as well as their usual household tasks. The present study was conducted on forty rural farm women, forty rural housewives and forty urban housewives to quantify their activity pattern. Urban housewives were from Udaipur (Rajasthan) and rural housewives and farm women were from Nai Village, which is about 15 km from the city. These married women were between 15 and 40 years of age and were non-pregnant and non-lactating at the time of the study. The women were visited by the investigator on two consecutive days and were asked to recall the time spent in various activities on the previous day. The energy cost of individual activities was estimated as a multiple of basal metabolic rate (BMR) using values in the recent Food and Agriculture Organization/World Health Organization/United Nations University (FAO/WHO/UNU) (1985) report. Mean time spent on six categories of expenditure was calculated (Table) and, as recommended by the FAO/WHO/UNU (1985), the overall ratio of total energy expenditure (TEE):BMR was also calculated.

Percentage of a day spent at various levels of energy expenditure

Energy cost (multiple of BMR)	Farm women	Rural housewives	Urban housewives
up to 1	37	38	35
1·1–2·9	39	50	56
⩾3	24	12	9
TEE:BMR	2·0	1·7	1·6

There were large differences in activity pattern. Farm women spent 24% of their time on the activities requiring ⩾3 × BMR, while the rural housewives and urban housewives spent only 12% and 9% of their time in this way. The ratio of TEE:BMR was very high, i.e. 2·0 for farm women (FAO/WHO/UNU (1985) suggested 1·82 for hard-working women) as this was the peak period of farming and women were engaged in grass cutting, digging, collecting manure, etc. If we calculate the BMR of these women using the equations suggested by the FAO/WHO/UNU (1985), and allowing a reduction of 10% for Indians, then the BMR of farm women, rural housewives and urban housewives would be 4·4, 4·4 and 4·8 MJ/d respectively, and estimated energy expenditure would be 9·0, 7·5 and 7·5 MJ/d respectively. This suggests that during the peak season the energy requirement of farm women is high but the results, based upon a recall method, need confirmation using more precise methods.

Food and Agriculture Organization/World Health Organization/United Nations University (1985). *Energy and Protein Requirements. Technical Report Series* no. 724. Geneva: WHO.

Energy intake, expenditure and balance of the transglobe expedition Antarctic crossing party. By RODERICK DUNCAN (introduced by I. T. CAMPBELL), *British Antarctic Survey, Madingley Road, Cambridge CB1 0ET*

What study there has been of energy balance in drivers of skidoos has been of short journeys (Campbell, 1975; Duncan, 1983). Campbell's (1981) longitudinal study of intake in men man-hauling on a polar expedition suggests that the energy balance of men on long journeys might be different from those on short journeys.

The transglobe expedition party comprised three men, who travelled 3540 km in 74 d. They recorded the number of fixed-weight ration packages they used, as well as any additional items and discards, the results being totalled for the party. The energy values of foodstuffs were determined using the tables of McCance & Widdowson (1972). Energy expenditure was determined using the diary card method (Acheson *et al.* 1980). Subjects were weighed before and after the journey. The rations provided 19·3 MJ/man per d. The energy intake of the party was 17·8 MJ/man per d. The overall average energy expenditure of the party was 18·6 MJ/man per d. No travelling took place on 37 out of the 74 d, either because of bad weather or because of scientific work. On travelling days, energy expenditure was 21·8 MJ/man per d, and on non-travelling days 15·4 MJ/man per d. Two of the subjects lost weight during the trip, and one gained weight. The average weight loss was 2·7 kg. The subjects were also weighed 4 d after the end of the trip, and the average weight loss calculated from these figures was less, at 1·6 kg.

The members of the party were in energy balance, the intake and expenditure values being within each other's experimental error. This contrasts with the values found on short skidoo journeys by Duncan (1983) and Campbell (1975), where subjects were in negative energy balance. The weight loss of the transglobe party, while large in absolute terms, amounted to only 0·04 kg/man per d, whereas on short skidoo journeys Duncan (1983) found much larger weight losses, averaging 0·17 kg/man per d. These values tend to confirm the view that, while men on short sledging journeys may be in negative energy balance, the energy balance of men on longer journeys is likely to approach neutral.

The transglobe party comprised Sir Ranulph Fiennes, Oliver Shepard and Charles Burton, to whom thanks are due for collecting the data.

Acheson, K. J., Campbell, I. T., Edholm, O. G., Miller, D. S. & Stock, J. M. (1980). *American Journal of Clinical Nutrition* **33**, 1155–1164.

Campbell, I. T. (1975). The determination of energy balance in man. M.D. Thesis, University of London.

Campbell, I. T. (1981). *British Journal of Nutrition* **45**, 89–94.

Duncan, R. (1983). Energy balance and cold stress in polar travellers. M.D. Thesis, University of Aberdeen.

McCance, R. A. & Widdowson, E. M. (1972). *The Composition of Foods*. London: H.M. Stationery Office.

Energy balance in dog sledgers and skidoo drivers in Antarctica: a comparison. By RODERICK DUNCAN (introduced by I. T. CAMPBELL), *British Antarctic Survey, Madingley Road, Cambridge CB1 0ET*

During the last 10 years, motorized sledges (skidoos) have taken over from dogs as the main method of overland travel in polar regions. The present study compares the energy balance of skidoo drivers with that of dog sledgers.

Energy balance was recorded during thirteen journeys, six by skidoo and seven by dog sledge. The journeys averaged 11 d in length. Eleven of the parties were of two men, one was of three men and one of four men. A two-man skidoo trip, 56 d in length, was also studied. Energy intake was determined by recording the number of fixed-weight ration packs eaten, and recording discards and additional items. Energy expenditure was determined using the diary card method (Acheson *et al.* 1980). Body composition was determined using the method of Durnin & Womersley (1974).

Dog sledgers expended an average of 22·3 MJ/d, while consuming 13·8 MJ/d. Skidoo drivers expended 15·1 MJ/d, while consuming 10·5 MJ/d. Weight losses (kg/man per d) averaged 0·28 on dog journeys and 0·17 on skidoo journeys. Respective fat losses (kg/man per d) were 0·14 and 0·09. Using unpaired t tests, these differences yielded P values of $<0{\cdot}001$, $<0{\cdot}01$, $<0{\cdot}05$ and $<0{\cdot}05$ respectively. On the long skidoo journey, energy intake was 16·0 MJ/d and energy expenditure 16·4 MJ/d, with a weight loss of 0·03 kg/man per d.

The results confirmed an expected difference between the energy balance of dog sledgers and that of skidoo drivers. It was notable that energy intakes on all the short journeys were below the 15·8 MJ/d supplied by the basic sledging ration, and were generally well below the expected intake at base of 14·5–15 MJ/d (Campbell, 1981*b*), despite substantially negative energy balance. This suggests that food intake was inhibited. Although unaccustomed hard work might explain this on dog journeys, there was no ready explanation for low intakes on skidoo journeys. The difference in energy balance between the short skidoo journeys and the long one suggests that energy intake gradually rises on skidoo journeys, as Campbell (1981*a*) found on a man-haul trip.

Acheson, K. J., Campbell, I. T., Edholm, O. G., Miller, D. S. & Stock, M. J. (1980). *American Journal of Clinical Nutrition* **33**, 1155–1164.
Campbell, I. T. (1981*a*). *Proceedings of the Nutrition Society* **40**, 28A.
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Duncan, R. (1983). Energy balance and cold stress in polar travellers. M.D. Thesis, University of Aberdeen.
Durnin, J. V. G. A. & Womersley, J. (1974). *British Journal of Nutrition* **32**, 77–97.

Energy utilization and physical activity in intubated and self-fed male domestic fowl. By M. G. MACLEOD, T. R. JEWITT and JULIE E. M. ANDERSON, *AFRC Institute for Grassland and Animal Production, Poultry Division, Roslin, Midlothian EH25 9PS*

Feeding by crop intubation is used routinely to determine the true metabolizable energy (TME) of poultry feedingstuffs (Sibbald, 1982). It has the advantages of precision in measurement of intake, of allowing the feeding of unpalatable substances and of allowing the time of ingestion to be accurately known. These advantages seem equally applicable to measurement of the efficiency of utilization of TME (k), but a likely disadvantage is that the circumvention of feeding activity and feeding-related stimuli may influence the bird's thermic response to feeding. This was examined in ten Isa-Brown cockerels (3·0–3·5 kg) by measuring the increase in heat production (H) over 48 h following two daily 50 g meals of a compound mash feed given either by intubation or by self-feeding. 72 h of fasting before and 24 h after the feeding period were used to provide baseline H values. Droppings were collected daily for bomb calorimetry; the collections during the final 24 h of the initial fasting period were used to give a measure of endogenous losses. All ten cockerels were fed by both methods, in systematic order, with an interval of 9 d between the two measurement periods. Physical activity was measured by a Doppler-radar technique.

	Self-fed		Tube-fed	
	Mean	SEM	Mean	SEM
Gross energy (GE) intake (kJ/d)	789	68·1	850	1·8
TME intake (kJ/d)	674	54·4	722	6·1
TME/GE (kJ/kJ)	0·86	0·012	0·85	0·007
Total heat increment (kJ/d)	98·5	16·36	83·4	15·39
k (for maintenance)	0·85	0·024	0·88	0·022
Increment in activity when fed (units/d)	51 162	13 609	424	3099

Some food was refused when the birds were self-fed, giving lower intake and greater variability of GE and TME intakes. Metabolizabilities measured by the two methods were similar, with little between-bird variability. Heat increment was about 15% lower with intubation and this led to a 3% increase in k for maintenance. Activity remained at the fasting level of about 20 000 units/d when the birds were intubated but increased from 20 000 to about 70 000 units/d when the birds were self-fed. If an activity unit is conservatively assigned a cost of 0·3 J/kg body-weight$^{0.75}$ (MacLeod & Jewitt, 1984) or about 0·8 J/bird, the difference in activity is more than sufficient to account for the difference in heat increment between the two treatments.

MacLeod, M. G. & Jewitt, T. R. (1984). *Proceedings of the Nutrition Society* **44**, 34A.
Sibbald, I. R. (1982). *Canadian Journal of Animal Science* **62**, 983–1048.

Digesta flow from the ileum and transit time through the caecum of rats given diets containing graded levels of peas. By J. S. GOODLAD and J. C. MATHERS, *Department of Agricultural Biochemistry and Nutrition, The University, Newcastle upon Tyne NE1 7RU*

The microflora of the large intestine (LI) ferment exogenous and endogenous polymers to support their growth and produce volatile fatty acids (VFA) as end-products. We have shown recently that dietary alterations can produce large systematic changes in caecal VFA pattern in the rat (Key & Mathers, 1987). Quantitative interpretation of such studies is limited by lack of knowledge of the amounts of fermentable materials supplied to the LI.

Groups of six male Wistar rats (initial weight 240 g) were housed individually in metabolism cages and offered daily 20 g of semi-purified diets containing 0, 100, 200, 300, 400 and 500 g raw peas (*Pisum sativum* var. Progreta)/kg as the only source of dietary fibre (DF), and 2 g Cr_2O_3/kg as a flow marker. After 21 d, the rats were killed and digesta collected from the terminal sixth of the small intestine and the caecum. Ileal dry matter (DM) flow was calculated by the marker ratio method, DM disappearance in the LI as ileal flow minus faecal output and caecal transit time (TT) as the quantity of marker found in this organ divided by the daily intake of marker (Faichney, 1975). Mean faecal Cr recovery was 1·06 (SE 0·029) of intake.

Peas in diet (g/kg) . . .	0	100	200	300	400	500	SE of Mean
Ileal DM flow (g/d)	1·2	1·6	1·8	2·1	2·7	2·7	0·18
DM disappearance in LI (g/d)	0·5	0·8	0·8	0·9	1·4	0·9	0·18
DM digestibility	0·97	0·96	0·95	0·92	0·92	0·91	0·003
Caecal TT (d)	0·88	0·43	0·46	0·43	0·39	0·46	0·047

Inclusion of graded levels of peas in the diet produced a significant ($P<0·001$) linear increase in DM flow from the ileum. The proportion of this DM which disappeared in the LI (0·44 (SE 0·017)) was not significantly ($P>0·05$) affected by diet so that the amount of DM disappearing in this organ increased linearly ($P<0·05$). Inclusion of peas (100 g/kg) in a diet otherwise devoid of peas halved caecal TT but greater inclusion rates had no further effect. These marker techniques may be useful in further quantitative studies of LI metabolism.

J.S.G. holds a SERC CASE studentship in collaboration with Unilever Research.

Faichney, G. J. (1975). In *Digestion and Metabolism in the Ruminant*, pp. 277–291 [I. W. McDonald and A. C. I. Warner, editors]. Armidale: University of New England Publishing Unit.

Key, F. B. & Mathers, J. C. (1987). *Proceedings of the Nutrition Society* **46**, 11A.

Cholesterolaemic and intestinal responses to oat bran fractions in chicks.

By R. W. WELCH*, D. M. PETERSON and B. SCHRAMKA, *United States Department of Agriculture, Agricultural Research Service, Cereal Crops Research Unit, 501 N. Walnut Street, Madison, WI 53705, USA*

Dietary oat bran (OB) reduces plasma and liver cholesterol (CL) in chicks and also influences gastrointestinal macromorphology, principally by increasing small intestine length (Welch *et al.* 1986). The β-glucan gum and the oil fractions have both been implicated in oat-induced hypocholesterolaemia (De Groot *et al.* 1963; Chen *et al.* 1981). The present study investigated the effects of these and other OB constituents on CL status and small intestine length in chicks.

OB was separated into five fractions; the percentage yields were insoluble (IN) 58·8, protein (PR) 15·1, soluble residue (SR) 9·9, gum (GM) 8·8, oil (OE) 7·5. The starch, crude protein (nitrogen × 6·25), β-glucan and total long chain fatty acids contents (g/kg) in each fraction were IN 600, 71, 1, 11; PR 65, 779, 12, 23; SR 18, 167, 1, 4; GM 14, 163, 595, 1; OE not determined, 34, not determined, 727. Groups (*n* 6) of 1-d-old male White Leghorn chicks (34·6 (SE 1·2) g) were fed for 19 d on a maize starch–casein–dried whole egg control (C) diet (g/kg: protein 216, oil 57, CL 2·2) or diets which incorporated, at the expense of maize starch, either native OB (NOB, 400 g/kg), remixed OB fractions (ROB, 400 g/kg) or one of the five OB fractions, *pro rata* (Table). Relative small intestine lengths (RIL) were compared using additional control-fed chicks, matched for weight (paired *t* test).

Diet (g/kg) ...	C	NOB 400	ROB 400	IN 235	PR 60	SR 41	GM 34	OE 30	SED
Body-weight (g)	102	102	107	114	111	117	77*	117	9·8
Plasma CL (mmol/l)	7·7	4·2*	4·1*	7·1	5·4*	6·5	4·2*	6·5	0·62
Liver CL (mmol/kg)	19	10*	10*	18	16	18	13*	18	2·3
RIL	100	119**	114**	104	105	106	118**	97	

Significantly different from control value: *$P<0·05$, **$P<0·001$.

Results indicate that the gum fraction was primarily responsible for both the CL reductions and the increase in small intestine length of OB-fed chicks. It appears unlikely that these effects of oat gum are directly associated with the concomitant reduction in weight gain (Welch *et al.* 1986). Protein is the only other fraction causing a significant CL reduction and this suggests that oat protein, which physico-chemically resembles legume protein, may also have a similar hypocholesterolaemic effect.

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De Groot, A. P., Luyken, R. & Pikaar, N. A. (1963). *Lancet* **ii**, 303–304.
Welch, R. W., Peterson, D. M. & Schramka, B. (1986). *Nutrition Research* **6**, 957–966.

*Present address: Biomedical Sciences Research Centre, Department of Biology, University of Ulster at Jordanstown, Newtownabbey, Co. Antrim BT37 0QB.

Fatness and fat distribution related to glucose tolerance in pregnancy. By M. E. J. LEAN, F. SUTHERLAND and H. W. SUTHERLAND, *Combined Diabetic Antenatal Clinic, Aberdeen Maternity Hospital, Foresterhill, Aberdeen AB9 1GS*

It is well established that impaired glucose tolerance in pregnancy can be dangerous to the fetus and is also an important predictor of the later development of diabetes in women (O'Sullivan, 1984). Although a relation between body-weight and the development of non-insulin-dependent diabetes is recognized, the effect of fat mass is weaker than that of fat distribution (Vague *et al.* 1985). Treharne *et al.* (1979) found a relation between 'android' fat distribution and impaired intravenous glucose tolerance in pregnancy. The present study aimed to relate in normal women three factors: oral glucose tolerance test (OGTT) in pregnancy, non-pregnant body mass index (BMI) and circumferential waist:hip ratio (WHR).

In 101 randomly selected pregnant women, aged 27 (SD 4) years, plasma glucose responses were measured to 75 g OGTT and to a standard mixed test meal (g/kg: carbohydrate 610, fat 180, protein 160, fibre 50; 1900 kJ (453 kcal)) at 26 and 27 weeks gestation respectively. Body-weight (62 (SD 11) kg), BMI (24 (SD 4) kg/m^2) and WHR (0·92 (SD 0·05); umbilicus and anterior superior iliac spine) were measured 30 (SD 5) weeks after delivery by a single observer.

Fasting plasma glucose at 26 weeks gestation correlated with body-weight (pregnant $P<0·02$; non-pregnant $P<0·014$) and with BMI ($P<0·006$ and $P<0·004$), but was not related to WHR, although WHR was itself significantly correlated with body-weight and BMI ($P<0·002$). WHR, but not body-weight or BMI, was significantly correlated ($P<0·05$) with plasma glucose at 60 min and 90 min in the OGTT and 30 min after the test meal. The relation between WHR and carbohydrate tolerance remained ($P<0·05$) as a partial correlation coefficient after correcting for any influences from maternal age, body-weight and height. WHR also correlated significantly with ($P<0·002$) gestational age at delivery but not with birth weight centile.

In conclusion, fatness (BMI) appears to determine fasting plasma glucose, but fat distribution (WHR), and not body-weight or BMI, is related to indices of glucose tolerance within the range found in normal pregnancy and also appears to bear some relation to fetal development. This correlation strengthens the view that fat distribution is a long-term predictor of glucose tolerance. WHR may be useful as a simple screening measurement for identifying pregnancies with increased risks.

O'Sullivan, J. B. (1984). In *Carbohydrate Metabolism in Pregnancy and the Newborn*, pp. 174–180 [H. W. Sutherland and J. M. Stowers, editors]. London: Churchill Livingstone.

Treharne, I. A. L., Sutherland, H. W., Stowers, J. M. & Samphier, M. (1979). In *Carbohydrate Metabolism in Pregnancy and the Newborn*, pp. 479–499 [H. W. Sutherland and J. M. Stowers, editors]. Berlin: Springer-Verlag.

Vague, P., Vallo de Castro, J. & Vague, J. (1985). In *Metabolic Complications of the Human Obesities*, pp. 77–86 [J. Vague, P. Bjorntorp, B. Guy-Grand, M. Rebusse-Scrive and P. Vague, editors]. Amsterdam: Elsevier.

The effect of copper deficiency on oxygen free radical defence mechanisms in rats fed on saturated or polyunsaturated fat. By D. G. M. CARVILLE and J. J. STRAIN, *Biomedical Sciences Research Centre, University of Ulster at Jordanstown, Newtownabbey, Co. Antrim BT37 0QB*

It is well known that copper is associated with lipid and lipoprotein metabolism (Klevay, 1973) and that dietary lipids can affect serum lipoproteins. More recently a clear-cut link between chronic inflammation and atherosclerosis has been identified (Majno *et al.* 1985). The effect of dietary Cu deficiency (Cu<0·4 mg/kg) on oxygen free radical defence mechanisms in the blood was therefore investigated in two groups (*n* 6) of individually housed, male, weanling Wistar rats fed on diets containing either 200 g maize oil/kg (M, Cu–) or 200 g coconut oil/kg (C, Cu–) for 60 d. Two other groups (*n* 6) fed on similar diets containing adequate Cu (Cu>11·0 mg/kg) served as controls (M, Cu+ and C, Cu+). Serum lipid levels were measured together with other blood indices including caeruloplasmin activity and the enzymic antioxidant defence mechanisms, superoxide dismutase (*EC* 1.15.1.1; SOD), catalase (*EC* 1.11.1.6; CAT), and glutathione peroxidase (*EC* 1.11.1.9; GSHPx), in blood cell fractions.

No significant differences were noted between the groups in food intake, weight gain or serum lipids. Those indices showing significant differences are shown in the Table.

	M, Cu+		M, Cu–		C, Cu+		C, Cu–	
Diet ...	Mean	SEM	Mean	SEM	Mean	SEM	Mean	SEM
Haemoglobin (Hb, g/l)	336	13·6	239**	30·9	215	25·6	207	23·9
Caeruloplasmin (U/l)	120	10	40**	30	120	20	4**	0·9
Whole blood GSHPx (U/g Hb)	367	41·1	584	100	918	91·2	565*	118
Erythrocyte SOD (U/mg Hb)	0·98	0·102	0·43*	0·22	1·31	0·56	0·81	0·22
Macrophage CAT ($U/10^7$) $\times 10^{-3}$	1·87	0·31	0·70**	0·105	0·89	0·18	0·40*	0·094
Macrophage SOD ($U/10^7$)	2·19	0·404	0·71**	0·14	0·27	0·44	0·45	0·26
Granulocyte SOD ($U/10^7$)	2·57	0·54	2·15	0·42	2·38	0·37	1·24**	0·38

Significantly different from Cu + control: *P<0·05, **P<0·01.

Fat-dependent effects included significantly different (P<0·01) Hb concentrations, whole blood GSHPx and macrophage SOD and significantly different (P<0·05) macrophage CAT. The results lend support to the hypothesis that a mild Cu deficiency could lead to increased oxygen free radical-mediated tissue damage in atherosclerosis and that the enzymic antioxidant defence mechanisms may be influenced by dietary fat.

Klevay, L. M. (1973). *American Journal of Clinical Nutrition* **26**, 1060–1068.
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The efficacy of standard intravenous feeding regimens. By G. A. PONTING and A. J. W. SIM, *Academic Surgical Unit, St Mary's Hospital, London W2*

Standard nutritional regimens are commonly used for intravenous feeding. The present study evaluated a standard regimen, containing 4180 kJ (1000 kcal) as fat, 4180 kJ (1000 kcal) as carbohydrate (CHO) and 14 g nitrogen. Substrate oxidation, energy balance (EB) and N balance (NB) were measured in forty patients studied on fifty-eight occasions. Resting energy expenditure (REE) was measured by continuous flow indirect calorimetry and EB calculated by subtracting the non-protein energy intake (8370 kJ (2000 kcal)/d) from the REE. Urinary N (24 h) was measured by the Kjeldhal technique.

CHO oxidation and fat oxidation were calculated as described by Frayn (1983). Sepsis was defined as the presence of intra-abdominal pus.

	Positive EB				Negative EB			
	Septic (*n* 15)		Non-septic (*n* 29)		Septic (*n* 9)		Non-septic (*n* 5)	
	Mean	SE	Mean	SE	Mean	SE	Mean	SE
EB (kJ/d)	1490	290	1740	190	−1010*	270	−320	140
(kcal/d)	355	68	417	45	−242*	65	−77	33
NB (g/d)	3·6*	1·0	5·9	0·5	−2·8*	2·4	1·6	0·7
CHO oxidation								
(kJ/d)	4420*	460	5830	256	4670*	760	7000	470
(kcal/d)	1056*	109	1394	61	1116*	181	1672	113
Fat oxidation								
(kJ/d)	1390*	410	−125	226	2820*	800	300	440
(kcal/d)	332*	98	−30	54	674*	191	71	106

Significantly different from non-septic group (Mann-Whitney U test): *$P<0.05$.

Forty-four patients were in positive EB (fifteen with sepsis) and fourteen in negative EB (nine with sepsis). Patients with sepsis had reduced NB, particularly if the EB was negative, with a positive correlation between NB and EB (r 0·7).

Amongst patients with a positive EB, the septic group had increased levels of fat oxidation and decreased levels of CHO oxidation, despite having similar EB. This indicates a swing towards fat oxidation in the patients with sepsis. Conversely the patients without sepsis had minimal or negative levels of fat oxidation.

These studies demonstrate a switch towards fat oxidation in patients with sepsis, and exogenous fat storage in patients without sepsis. Non-septic patients appear not to utilize fat for the maintenance of EB.

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