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PROCEEDINGS OF THE NUTRITION SOCIETY

ABSTRACTS OF COMMUNICATIONS

The Three Hundred and Seventy-first Meeting of the Nutrition Society was held at Ranmoor House, University of Sheffield on Tuesday and Wednesday, 20/21 April 1982 when the following papers were read:

The period required for a weighed dietary survey of hospitalized patients. By G. C. PEARSON, D. B. MORGAN and R. HULLIN, *Department of Chemical Pathology, Leeds University*

There have been several studies of the nutritional intake of hospitalized patients, based on the weights of food eaten. The duration of these studies has varied from 1 to 8 d and there is some uncertainty about the time required to obtain a reasonable estimate of normal food intake.

The food intake of thirty-four elderly women on a long-stay ward was weighed for a period of 22 d. Daily intakes and the 22 d mean intakes of protein, energy, iron and vitamin C were calculated from McCance and Widdowson's Food Composition Tables (Paul & Southgate, 1979). The energy intake varied least, Fe and vitamin C intakes varied considerably from day to day.

In order to obtain a value so that the average intake of the group was within $\pm 10\%$ of the 22 d mean, intakes had to be measured over 1 d for energy, 3 d for Fe and protein, and 4 d for vitamin C. If individual intakes are being investigated, the number of patients whose intake would be within $\pm 10\%$ of the 22 d mean for weighed intakes measured over 7 d or less are shown in the Table.

Nutrient	Patients with intakes within $\pm 10\%$ of 22 d mean (%)		
	7 d weighed intake	4 d weighed intake	1 d weighed intake
Energy	95	60	24
Protein	80	30	3
Vitamin C	75	10	3
Fe	60	15	3

In order that the intakes of 95% of the patients were within $\pm 10\%$ of their 22 d mean the intake had to be measured for 7 d for energy, 10 d for protein and 12 d for Fe and vitamin C.

These results indicate that the necessary duration of a weighed dietary survey depends on the nutrient under investigation, the accuracy demanded and whether the information is required for a group or an individual.

Paul, A. A. & Southgate, D. A. T. (1979). *McCance and Widdowson's The Composition of Foods*, 4th ed. London: HM Stationery Office.

A comparison of analysed and calculated values for intakes of trace metals. By MARGARET S. LAWSON, VALDA W. BUNKER, H. TREVOR DELVES and BARBARA E. CLAYTON, *Chemical Pathology and Human Metabolism, Medical Faculty of the University of Southampton, Southampton General Hospital, Southampton SO9 4XY*

Comparisons of six weighed dietary intakes assessed by calculations from food tables with those obtained by analysis of duplicate diets are reported for intakes of energy, nitrogen, iron, copper, zinc and manganese.

Published data in food tables (Paul & Southgate, 1978) and from Wenlock & Buss (1979) were used to calculate intakes from weighed diets. The analysed intakes of trace metals were obtained by analysis of the diets by atomic absorption spectrophotometry.

The analysed intakes of N ranged from 265 to 710 mmol daily; energy intakes ranged from 4.46 to 7.07 MJ daily. The agreement between our analysed and calculated intakes was similar to the data published by Stock & Wheeler (1972), with five out of six analysed values agreeing within $\pm 20\%$ of the calculated values.

Statistical analysis of the elemental data is summarized in the Table. In spite of good correlation coefficients, the percentage errors for some of the calculated intakes are large, although in this small sample our results for Fe appear to give a better correlation than that found by Stock & Wheeler (1972). However, for all four elements there are variations between the values for different subjects, and it is not possible to predict what the error is likely to be when intakes are calculated.

	N (mmol)	Zn (μ mol)	Cu (μ mol)	Fe (μ mol)	Mn (μ mol)
Analysed intakes daily	266-710	54-210	6-24	65-290	110-490
B	1.053	0.7	1.134	1.207	0.995
A	183.0	12.61	-0.336	-18.48	-0.268
r	0.936	0.731	0.926	0.984	0.858
Percentage error					
i	+21.4	-45.0	-4.2	+20.0	+10.7
ii	+12.6	+1.6	+37.3	+13.0	-24.0
iii	+17.0	0	+17.3	-10.6	-55.0
iv	-10.5	-43.0	-0.8	+13.2	+14.7
v	-8.0	+2.0	-3.1	-7.0	-29.0
vi	+0.3	-7.4	+43.5	+21.5	-52.0

In the regression equation for calculated *v.* analysed intakes: B, slope of regression line; A, intercept of regression line; r, correlation coefficient; percentage error

$$= \frac{\text{analysed} - \text{calculated}}{\text{analysed}} \times 100.$$

These observations suggest that for individual dietary assessments, the trace metal values quoted in the food tables may greatly over or underestimate the true dietary intake.

Financial assistance from Roussel Laboratories and Wessex Regional Health Authority is gratefully acknowledged.

Paul, A. A. & Southgate, D. A. T. (1978). *The Composition of Foods*. 4th ed. *Spec. Rep. Ser. med. Res. Coun.* No. 297.

Stock, A. L. & Wheeler, E. F. (1972). *Br. J. Nutr.* 27, 439.

Wenlock, R. W. & Buss, D. H. (1979). *Br. J. Nutr.* 41, 253.

The use of a dietary diary plus interview to measure the dietary habits of schoolchildren. By A. F. HACKETT, J. PEARCE, A. TWIST, A. J. RUGG-GUNN and J. E. ESTOE, *Department of Oral Biology, The Dental School, Newcastle upon Tyne NE2 4BW*

A study of dental caries increment and dietary habits measured over a 2 year period in 11–13-year-old children is nearing completion. The children were dentally examined and had their height and weight measured in October 1979, 1980 and 1981. Each child also recorded, in dietary diaries, all food and drink consumed on 3 consecutive days on five separate occasions between September 1979 and July 1981. On completing each diary the children were individually interviewed on the fourth day to ensure a quantitative estimate of intake. There were 466 volunteers (59.3% of 11-year-old children in seven schools in South-Northumberland). Forty-five children left the area or had incomplete records, only two asked to leave the study but five were rejected as being unreliable. A total of 2269 diary/interviews were collected over the 2 year period by a single dietitian. 196 male and 218 females (2065 diary/interviews) completed the study.

Two studies have been undertaken to assess the accuracy and validity of the diary/interview. The first compared the description of a school meal obtained by the diary/interview from twenty-eight of the children, with weighed records of those same meals. Mean diary estimates were consistently lower than weighed estimates but differences were small for many items, e.g. energy (kJ) weighed (W) 2330 diary (D) 2222 ($r +0.4$, $P < 0.05$), carbohydrate (g) W 65, D 63 ($r +0.5$, $P < 0.01$), pies (g) W 66, D 58 ($r +0.8$, $P < 0.01$) and potatoes (g) W 89, D 92 ($r +0.3$, $P > 0.05$). It is concluded that the diary/interview method gives a good estimate of a group's intake but not for individuals. The diary/interview occasionally gave more information than weighing. The second study correlated the mean protein intake of 30 adults from the diary/interview to their 24 h excretion of urea and ammonia. A correlation coefficient of $+0.4$ ($P < 0.05$) was found. The mean protein intake from the diary/interview was found to be $88 \text{ g} \pm 3.5$ ($\pm \text{SEM}$) and the protein intake estimated from the urea/ammonia excretion with suitable additions for other nitrogen losses was $87 \text{ g} \pm 3.1$. It is concluded that a valid estimate of the protein intake of a group of intelligent adults was made. The 3 d diary/interview method is an efficient and acceptable means of recording the dietary habits of schoolchildren. It has been demonstrated that under certain conditions accurate and valid quantitative data can be obtained.

Comparison of delayed hypersensitivity with biochemical and anthropometric measurements during nutritional support. By R. CRAWFORD, A. D. S. SMITH, P. STROMBERG, A. SHENKIN and A. J. W. SIM, *Surgical Nutritional Advisory Group, Departments of Biochemistry and Surgery, Glasgow Royal Infirmary*

Delayed hypersensitivity skin test response may correlate with nutritional status in seriously ill surgical patients. There remains doubt whether improving nutritional status leads to conversion of an anergic to a positive response. We have studied 125 patients with surgical conditions requiring nutritional support. Initial biochemical and anthropometric measurements are summarized in the Table. The anergic group were older (64.6 ± 14.3 years) than the positive group (53.8 ± 14.7 years) and had a higher mortality. Thirty-three patients who were initially anergic were subsequently retested, and 18 converted to a positive response. Results before and after conversion are shown in the Table.

(Initial biochemical and anthropometric measurements of all patients)

Skin test response	Serum values (mean \pm SD)				Anthropometry (mean \pm SD)	
	Albumin (g/l)	Transferrin (g/l)	Zinc (μ mol/l)	Vitamin A (μ mol/l)	Triceps skinfold (mm)	Muscle circumference (mm)
Positive (n 57)	32.9 ± 5.3	2.1 ± 0.6	13.2 ± 3.0	1.7 ± 0.8	10.2 ± 4.1	216 ± 34
Anergic (n 68)	28.2 ± 5.9	1.9 ± 0.8	11.6 ± 3.4	1.4 ± 0.8	10.3 ± 5.1	201 ± 32
P	<0.001	NS	<0.01	<0.05	NS	<0.05

(Biochemical (n 18) and anthropometric (n 15) measurements of patients originally anergic who converted to positive)

Anergic	27.9 ± 6.4	1.8 ± 0.8	11.4 ± 2.8	1.4 ± 0.8	9.5 ± 4.4	197 ± 25
Positive	30.4 ± 4.0	1.9 ± 0.9	12.6 ± 3.4	1.9 ± 0.9	9.4 ± 5.0	201 ± 39

P, statistical significance of difference; NS, not significant.

There were no significant differences between results in the anergic state and following conversion nor did results in converters differ from consistently anergic patients. The consistently anergic group were older (71.8 ± 8.5 years) than the converters (58.6 ± 13.8 years) but there was no difference in mortality.

On initial skin testing, patients who were anergic had increased mortality and had poorer nutritional status on biochemical and anthropometric grounds, than those who were skin test positive. Repeat skin testing is, however of doubtful value in the assessment of nutritional progress of surgical patients.

Some preliminary observations on the relationship between pre-conceptional diet and nausea and vomiting in early pregnancy. By BARBARA M. PICKARD (introduced by D. W. PICKARD), *Department of Animal Physiology and Nutrition, The University, Leeds LS2 9JT*

It has long been suspected that diets high in protein and low in carbohydrate are likely to predispose women to severe nausea and vomiting in pregnancy (Titus & Dodds, 1928). More recently, vitamin B6 deficiency has been implicated (Reinken & Gant, 1974). This preliminary study set out to investigate the preconceptional dietary habits of women who experienced varying degrees of sickness or no symptoms in early pregnancy. Detailed questionnaires were completed retrospectively by self-selected volunteers. Dietary analyses of 257 records with sufficiently detailed information were carried out independently by a dietitian, using a computer program linked to McCance and Widdowson's Food Composition Tables (Paul & Southgate, 1978).

The women were grouped according to sickness. I, no sickness; II, mild nausea; III, moderate nausea and/or vomiting; IV, severe nausea and/or vomiting. The results for certain dietary variables are shown in the Table together with the statistical significance as determined by Kendall's ranked correlation coefficient analysis.

Group	Protein (g)		Protein (%*)		Vitamin B6 (mg/d)		mg Vitamin B6 (mg/100 g protein)		Sugar (%*)	
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
I (n 32)	87.5	21.5	15.5	2.1	1.59	0.41	1.83	0.23	14.0	4.2
II (n 45)	91.8	28.3	16.4	2.7	1.70	0.51	1.88	0.30	13.4	5.2
III (n 91)	87.4	19.9	15.9	2.3	1.65	0.43	1.90	0.34	13.4	5.3
IV (n 89)	94.9	21.9	16.9	2.9	1.65	0.40	1.76	0.28	12.3	4.9
P	<0.02		<0.009		NS		<0.003		<0.01	

*Expressed as percentage of total energy intake.
P, statistical significance of difference; NS, not significant.

The results are consistent with the proposal that dietary habits prior to pregnancy may be related to the severe sickness subsequently experienced by certain women. The sickness characteristic of the first trimester may possibly be exacerbated if the demand for glucose cannot be readily met from the diet or if the liver glycogen-glucose turnover is inadequate or both.

I am very grateful to Miss Lynn Malkin for her skilled technical assistance with the dietary analyses.

Paul, A. A. & Southgate, D. A. T. (1978). *McCance and Widdowson's The Composition of Foods*. London: HM Stationery Office.
Reinken, L. & Gant, H. (1974). *Clin Chim Acta* 55, 101.
Titus, P. & Dodds, P. (1928). *Am. J. Obst. Gynec.* 16, 90.

Mammary and uterine transfer of immune tolerance to dietary antigens in weanling rabbits. By M. J. GIBNEY, *Department of Nutrition* and P. J. GALLAGHER, *Department of Pathology, Faculty of Medicine, University of Southampton*

It is now well established that dietary protein can traverse the gut intact and stimulate the production of circulating and secretory antigen-specific antibodies. We have previously reported that this capacity to generate antibodies to a particular dietary protein is greatly reduced in weanling rabbits if the maternal diet also contained that protein (Pathirana *et al.* 1981). This induction of tolerance could occur *in utero* by the transfer of maternal antibodies across the yolk-sac. However, it could also be induced by antigen exposure during the post-natal period (15–20 d) of immunological immaturity, either by nibbling their mother's diet or by transfer of the antigen via the milk. The experiment described here set out to investigate these possibilities.

Two groups of three female New Zealand white rabbits were given either control diets (soya isolate, 100 g/kg) or an experimental 'egg' diet (hen egg albumen, 100 g/kg). At 6 months of age they were mated in pairs of control and egg-fed dams and within 6–12 hours of parturition half of one litter in each pair was exchanged with half of the other litter. Two weeks after parturition the dams were switched to a fish-meal based stock diet to prevent the possibility of the young nibbling the mothers' diet. All rabbits were weaned onto the egg diet at 6 weeks of age and anti-egg antibodies were assayed by the enzyme-linked immunosorbent assay (ELISA). Results are expressed as optical density units, 450 nm, 1:1000 dilution of serum.

High levels of circulating anti-egg antibodies (1 g G) were found in the three egg-fed dams at 10 weeks of age while control-fed dams showed no such response. There was an increase in the level of circulating anti-egg antibody (1 g G) in all rabbits weaned onto the egg diet. By 4 weeks of age, there were significant differences between treatments. Rabbits of control dams, which remained with their dams during lactation, had significantly ($P < 0.01$) higher levels of anti-egg 1 g G than their littermates, fostered to egg-fed dams for lactation (1.211, n 8 *v.* 0.672, n 7; SEM \pm 0.116). This shows that suckling egg-fed dams was sufficient to induce tolerance. Rabbits of egg-fed dams showed similar anti-egg 1 g G levels at 4 weeks after weaning irrespective of whether they remained with their dam or were fostered to control dams for lactation (respectively 0.581, n 7 *v.* 0.763, n 8; SEM \pm 0.175).

These results support our previous findings and show that tolerance can be induced by both the uterine and mammary routes, possibly by very different mechanisms.

Pathirana, C., Goulding, N. J., Gibney, M. J., Pitts, J. M., Gallagher, P. J. & Taylor, T. G. (1981). *Int. Archs. Allergy appl. Immun.* **66**, 114.

Dietary intake of advanced cancer patients. By T. D. WALSH,^{1,2} G. P. JACKSON³ and K. BOWMAN¹ (introduced by I. MACDONALD), ¹*St. Christopher's Hospice, Sydenham, London SE26 6DZ*, ²*Department of Clinical Pharmacology, Guy's Hospital Medical School, London SE1*, ³*Department of Dietetics and Nutrition, St. Thomas' Hospital, London SE1 7EH*

A National Health Service registered dietitian assessed the voluntary dietary intake of thirteen advanced cancer patients—eleven female, two male; median age 74 years (range 56–83)—on one ward of St. Christopher's Hospice for five consecutive days including a weekend. Four patients were excluded; one discharged on the first day, one with intractable vomiting throughout and two with motor neurone disease. Two patients died during the course of the study (on the fourth day).

A semi-weighed technique was used. Standard portions of food (served from a bulk trolley in the ward kitchen) were weighed. Plate waste (by weight) was subtracted from food served to give estimated individual intake. Intake was not directly observed to avoid anxiety or influence consumption. Non-hospice food was not included. Energy, protein, fat, carbohydrate, iron, calcium and dietary fibre content were calculated using standard food composition tables (Paul & Southgate, 1978).

Mean individual daily intakes (estimated) had a median energy value of 5760 kJ (1376 kcal)/d, range 938–8945 kJ (224–2137 kcal)/d; protein content was 44 g (range 11–86)/d, fat 52 g (9–93)/d, carbohydrate 169 g (21–194)/d, calcium 748 mg (268–1457)/d, iron 4.8 mg (0.5–13.0)/d and dietary fibre 5.0 g (0.5–21.0)/d.

Estimated results suggest a low energy, Fe and dietary fibre intake; Ca intake was high. Low Fe and high Ca intake may be significant as Fe-deficiency anaemia and hypercalcaemia are common. Most hospice patients receive polypharmacy which may affect appetite and taste sensation. Opiates cause anorexia and constipation. Constipation is a serious problem eased by increased dietary fibre intake.

68.52% of hospice admissions in 1980 (*n* 676) complained of anorexia on admission. Nutritional status may affect prognosis or subjective well-being or both in advanced cancer. Diets should be tailored to individual preferences in food, taste and texture. The value of nutritional supplementation and the role of appetite stimulants in improving nutritional status needs investigation.

T.D.W. and K.B. each were supported by Department of Health and Social Security Grant No. OCS(A)3.

Paul, A. A. & Southgate, D. A. T. (1978). *McCance and Widdowson's The Composition of Foods*, 4th ed. London: HM Stationery Office.

Nutritional status in head and neck cancer. By GERALD B. BROOKES
(introduced by M. I. GURR), *The London Hospital, London*

Patients with head and neck malignancies may often present with concurrent nutritional deficiencies caused predominantly by local effects of the tumour. A prospective study into the nutritional status of eighty-seven patients (sixty-four male, twenty-three female) with primary squamous cell carcinoma of the head and neck was undertaken to determine the prevalence and degree of nutritional deficit, and to evaluate the relative importance of the possible causative factors. The patient population was characterized by both advanced disease and advanced age. In 60% the tumours were staged as T₃ or T₄, whilst 47% were over 65 years of age.

Nutritional status was assessed by weight loss relative to the pre-morbid weight (P%) and relative to the 'ideal' weight (I%) (Jelliffe, 1966); arm muscle circumference was derived from anthropometric indices and the difference from the normal value (Jelliffe, 1966) expressed as a percentage (A%); creatinine height index estimation; serum albumen and transferrin assays; and nitrogen balance studies. Evaluation of these factors showed that creatinine height index and N balance studies were unreliable. The relatively 'static' factors of weight loss and anthropometric indices gave consistent and reproducible data, and were averaged to provide a general nutritional status (GNS) score.

$$\text{GNS score} = \frac{P + I + A}{3} \%$$

This nutritional index correlated fairly well with serum albumin values, but poorly with the more 'dynamic' serum transferrin biochemical factor. The data obtained in a control population of 334 subjects supports the validity of defining a GNS score of <-10% as indicative of a significant nutritional deficit. It is suggested that this GNS index provides a simple, easily obtainable and clinically useful nutritional assessment guide.

Thirty-three of the eighty-seven patients (37.9%) were found to be suffering from concurrent undernutrition (GNS score <-10%) at presentation. Nearly 15% of the group were suffering from malnutrition, defined as a GNS score >-20%. Dysphagia was the most important predisposing factor and present in 82%, indicating that the major cause of nutritional deficit in this disease groups is 'starvation'. Anorexia (60%) and alcohol abuse (42%) were also relevant factors.

The preliminary disease free survival rates of the thirty-three undernourished patients suggest that nutritional deficit as an important adverse prognostic factor in head and neck cancer and probably exerts its effect in these cases by causing secondary immuno-incompetence, as suggested previously (Brookes & Clifford, 1981).

Brookes, G. B. & Clifford, P. (1981). *J. Roy. Soc. Med.* **74**, 132.

Jelliffe, D. B. (1966). *The Assessment of the Nutritional Status of the Community*, WHO monograph no. 53. Geneva: WHO.

Riboflavin, vitamin A and zinc deficiencies: studies on risk factors associated with oesophageal cancer in China. By D. I. THURNHAM¹, PRAMPIMPORN RATHAKETTE¹ and K. M. HAMBIDGE², ¹*Department of Human Nutrition, London School of Hygiene and Tropical Medicine, Keppel Street WC1E 7HT*, ²*University of Colorado Health Sciences Center, 4200 East-Ninth Street, Denver, 80262, USA*

Intimate contact between carcinogenic agents and the oesophageal wall is probably a major determinant in increasing susceptibility of the tissue to develop cancer. Deficiencies of riboflavin (Wynder & Klein, 1965), vitamin A (De Luca *et al.* 1972) and zinc (Gerson & Meyers, 1977) have each been shown to affect the integrity of epithelial tissue with particular effect on the oesophagus. Northern China is one of those areas of the world where the incidence of oesophageal cancer is very high (200/100 000; Cook-Mozaffari, 1979).

A survey was done in May, 1980 when blood was obtained from 111 of 527 participants (fifty-eight male, fifty-three female) in Linxian County, Henan Province most of whom underwent endoscopy to obtain information on oesophagitis. The latter is believed to be a premalignant stage of oesophageal cancer (Crespi *et al.* 1979). Of the total sample, 24% reported intermittent dysphagia, 86% had oesophagitis, 6% angular stomatitis and 1% night blindness (Muñoz *et al.* 1982). Yearly food consumption values suggest that recommended daily allowances for riboflavin were only 70% sufficient while for vitamin A were >200% but obtained almost entirely from vegetable sources (Su-Fang Zheng and Xin-Fu Liu, unpublished results).

Measurements of riboflavin status showed that 97% of the subjects had an activation coefficient (AC) >1.3, while for vitamin A status, 6% had a plasma retinol <100 µg/l and for plasma Zn, twelve subjects (14%) were <600 µg/l. Carotene concentrations were adequate in all but one subject. When the degree of riboflavin deficiency is related to the lesions seen in the oesophagus, a slightly higher prevalence of chronic oesophagitis was observed in subjects with AC >1.80 than in those with moderate riboflavin deficiency (1.30–1.79). No such association was observed with either vitamin A or Zn.

We are grateful for financial support from Department of Health and Social Security and the International Agency for Research on Cancer, Lyon, France.

Cook-Mozaffari, P. (1979). *Nutrition and Cancer*, 1, 51.

Crespi, M., Muñoz, N., Grassi, A., Aramesh, B., Amiri, G., Mojtabai, A. & Casale, V. (1979). *Lancet* ii, 217.

De Luca, L., Little, E. P. & Wolf, G. (1969). *J. biol. Chem.* 244, 701.

Gerson, S. J. & Meyers, J. (1977). *J. Nutr.* 107, 724.

Muñoz, N., Crespi, M., Grassi, A., Chu Chuan Yen & Li Ping (1982). *Lancet* (In the Press).

Wynder, E. L. & Klein, U. E. (1965). *Cancer* 18, 167.

Measurement of mid-arm circumference: its value in the assessment of nutritional status in Crohn's disease. By A. D. HARRIES, L. A. JONES, R. V. HEATLEY and J. RHODES (introduced by M. I. GURR), *University Hospital of Wales, Heath Park, Cardiff*

Chronic malnutrition is common in inflammatory bowel disease, particularly Crohn's disease. We have examined anthropometric measurements to identify which patients with Crohn's disease are at risk and to follow their response to enteral nutritional therapy. A study was performed on 106 patients with Crohn's disease who were unselected and attending a gastrointestinal clinic. Measurements included weight, height, mid-arm circumference (MAC) and skinfold thickness, and results were expressed as a percentage of ideal standards (Jelliffe, 1966). Similar measurements were performed on 106 patients with ulcerative colitis and 106 healthy controls who were age and sex matched with Crohn's patients. Serum albumin, pre-albumin and creatinine height index were simultaneously measured in certain patients. Eighty-four sets of anthropometric measurements were also performed at monthly intervals on twenty-four patients with Crohn's disease receiving enteral supplementation.

Patients with Crohn's disease had significant reduction in all anthropometric measurements ($P < 0.01$) compared with controls and patients with ulcerative colitis—who did not differ statistically. In patients with Crohn's disease a strong correlation was found between weight and MAC ($R\ 0.872$, $P < 0.001$). All thirty-nine Crohn's patients with an MAC less than 90% of the ideal standard (Group 1) were below ideal weight, and twenty-one were more than 10% below ideal weight. Sixteen Crohn's patients with an MAC greater than 90% of ideal standard (Group 2) were also below ideal weight, although none were more than 10% below the ideal standard. Biochemical measurements (mean \pm SD) were significantly reduced in Group 1 compared with Group 2. Serum albumin: Group 1 36.8 ± 6.0 g/l ($n\ 27$), Group 2 42.9 ± 3.7 g/l ($n\ 28$, $P < 0.001$). Serum pre-albumin: Group 1 223 ± 73 mg/l ($n\ 27$), Group 2 295 ± 63 mg/l ($n\ 28$, $P < 0.001$). Creatinine height index: Group 1 0.71 ± 0.17 ($n\ 20$), Group 2 0.91 ± 0.19 ($n\ 9$, $P < 0.02$). Measurements in Group 2 approached those obtained in control and ulcerative colitis Groups. In Crohn's patients undergoing enteral supplementation change in weight correlated most strongly with change in MAC ($R\ 0.819$, $P < 0.001$).

Measurements of mid-arm circumference is easy to perform. We have shown that in patients with Crohn's disease it reliably identifies those who are at particular risk of under nourishment (i.e. those with MAC values less than 264 mm in males and 257 mm in females). Moreover, repeat measurements of MAC are a simple and accurate method of assessing nutritional changes in Crohn's disease.

Jelliffe (1966). *The Assessment of the Nutritional Status of the Community*. WHO monograph no. 53. Geneva: WHO.

Retinol deficiency in severe Crohn's disease—clinical manifestations and assessment of retinol therapy during nutritional support. By A. N. H. MAIN, P. R. MILLS, J. BRONTE-STEWART, A. SHENKIN and R. I. RUSSELL, *Gastroenterology Unit and Department of Biochemistry, Royal Infirmary, Glasgow and Tennent Institute of Ophthalmology, University of Glasgow*

The finding of severe night-blindness in two patients with extensive Crohn's disease has prompted us to examine retinol status in our Crohn's patients in hospital and in those requiring nutritional support (NS) intravenously (IVN) or externally (EN).

Of twenty-two patients studied, seventeen required one or more periods of NS. Eleven weighed <80% of their ideal weight. Serum albumin was <30 g/l in ten and serum transferrin (TF) <1.5 g/l in four (normal 2–4 g/l). Ten of the twenty-two patients had low levels of retinol in plasma (in comparison with a population of hospitalized patients without systemic disease). Two with severe fat malabsorption, complained of night-blindness and were demonstrated to have severe impairment of dark adaptation. Low plasma retinol levels had been present for several months with concurrently low serum levels of albumin, TF, retinol-binding protein (RBP) and prealbumin. Their symptoms and dark adaptation improved markedly with oral retinol therapy (1500 µg/d) in one, and in the other (see Table) with IVN including 750 µg retinol/d. This was associated with a rapid rise in plasma retinol, RBP and other serum proteins. The remaining eight patients with low retinol levels had no visual symptoms, and five had normal serum albumin and TF levels.

Plasma/serum	Months prior to night-blindness			Days after start of IVN		Reference ranges
	7	2	0	7	14	
Retinol (µmol/l)	0.7	0.6	0.6	1.4	2.0	1.9–5.2
RBP (mg/l)	—	10	13	20	36	32–91
Prealbumin (mg/l)	—	110	100	105	205	215–400
Transferrin (g/l)	1.6	0.8	0.7	1.1	2.1	2.0–4.0
Albumin (g/l)	29	24	23	31	31	35–51

There were eighteen periods of IVN of mean duration 5 weeks. Retinol (750 µg/d) was supplied intravenously. Plasma retinol fell during two IVN periods and remained low at the end of a further five periods despite an increase in weight and increased serum TF. Nine patients were tube-fed (EN) for a mean duration of 5 weeks. Retinol levels were low after four of the periods despite enteral supplementation in the commercial feeds of over 1680 µg daily.

The occurrence of persistently low retinol levels together with visceral protein depletion and fat malabsorption should alert the clinician to the possibility of visual impairment due to retinol deficiency. NS resulting in improvement of visceral protein levels without a rise in plasma retinol might indicate inadequate retinol supply. Dark adaptation testing provides a useful means of identifying these patients and of assessing the adequacy of retinol therapy.

Prevalence of nutritional disturbance and diagnostic value of nutritional assessment in chronic gastrointestinal disorders. By D. P. MAUDGAL, LIZA ANG, S. M. VARAMBHIA, M. BLAND and J. D. MAXWELL (introduced by O. G. BROOKE), *Departments of Medicine and Social Medicine, St. George's Hospital Medical School, London SW17*

Protein-energy malnutrition is common among hospital inpatients, institutionalized subjects and patients suffering from active gastrointestinal (GI) disorders. The nutritional status of patients seen in gastroenterology clinics with chronic GI symptoms, many of whom do not show any demonstrable organic lesion despite time consuming and expensive investigations, is not well documented. We speculated that the presence of nutritional disturbance might help us to distinguish between patients with organic and functional GI disorders. The aims of the present study were to assess the nutritional status of patients with chronic GI disorders using anthropometric measurements (height, weight, triceps, biceps and subscapular skinfolds, mid-arm and arm muscle circumference) together with protein markers (albumin, retinol-binding-protein RBP, and thyroxine-binding-prealbumin TBPA), and to determine whether these measurements can be used to separate organic from functional bowel disease.

We studied seventy-five control subjects (twenty-five medical and nursing staff, eighteen medical students and thirty-two selected patients) and 150 patients with chronic GI disorders (thirty-two irritable bowel syndrome IBS, fifty-two inflammatory bowel disease IBD, thirty peptic ulcer PU, sixteen malabsorption syndrome M, and twenty patients with intra-abdominal malignancy C).

Significant impairment of two or more anthropometric and protein markers was found in all organic disease categories ($P < 0.05$ to < 0.001). RBP and TBPA were significantly lower in IBS ($P < 0.01$) than controls. Anthropometric and protein measurements did not correlate very well. However, stepwise discriminant analysis of anthropometric or protein data correctly allocated 70.2% and 70.3% patients respectively to disease or control groups. Correct classification improved to 80.3% on combined measurements. Combination of three-six selected indices with high discriminating value correctly diagnosed 71% IBS, 65% IBD, 65% PU, 65% M and 88% C.

In conclusion anthropometric and protein markers of nutrition were frequently abnormal in patients with chronic GI symptoms due to organic disease. Surprisingly, RBP and TBPA were abnormal even in IBS. However, discriminant analysis on combinations of these simple and inexpensive measurements may assist in diagnosis of patients with chronic GI disorders.

Assessment of the dietary adequacy of zinc, copper, iron and manganese in the elderly. By VALDA W. BUNKER, MARGARET S. LAWSON, H. TREVOR DELVES and BARBARA E. CLAYTON, *Department of Chemical Pathology and Human Metabolism, Medical Faculty of the University of Southampton, Southampton General Hospital, Southampton SO9 4XY*

The adequacy of the intake of the essential trace elements zinc, copper, manganese and iron in self-selected diets of ten elderly volunteers has been assessed. The total dietary intakes, faecal and urinary excretions of Zn, Cu, Mn and Fe were measured over a 5 d period for five men (mean age 78.4 years) and five women (mean age 75.5 years) using previously published techniques involving duplicate diets and faecal markers.

All diets were nutritionally adequate (see Table) as indicated by the mean energy and protein intakes. The balance studies showed that all subjects were in equilibrium for N and within experimental errors of $\pm 5-10\%$, nine out of ten were in equilibrium for the four trace elements. The mean plasma concentrations of Zn, Cu, Fe, Mn and ferritin were within the expected reference ranges.

Element (daily intake)	Intake		
	This study	Norden <i>et al.</i> (1979)	RDA/SAI*
Zn (μmol)	135	126	229
Cu (μmol)	19.5	20	31-47
Fe (μmol)	156	238	179
Mn (μmol)	98	—	45-90
			DHSS† 1979
Protein (g) ♂	69.6	55.7	54
♀	61.6	47.4	42
Energy (MJ) ♂	8.70	8.57	9.0
♀	6.69	6.72	7.0

*American Recommended Dietary Allowance/Safe and Adequate Intake.

†Department of Health and Social Security (1979) Recommended Dietary Allowance.

The mean dietary intakes of Zn, Cu and Fe (see Table) were all lower than the published RDA/SAI for the over 50 year old age group (Food and Nutrition Board (US), 1980) but similar to those obtained by Norden *et al.* (1979) who also analysed duplicate diets. The mean dietary intake of Mn exceeded the RDA/SAI value: this may have resulted from drinking large volumes of tea.

Our data suggest that although the dietary intakes of Zn, Cu and Fe were lower than the RDA/SAI values they were adequate for these healthy elderly subjects.

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The verification of dietary intake using 24 h urine samples. By B. MARY CAMPBELL-BROWN, FRANK D. JOHNSTONE, DORIS M. CAMPBELL, LATA JANDIAL and IAN MACGILLIVRAY, *Department of Obstetrics and Gynaecology, University of Aberdeen*

In planning a trial designed to examine the diet of primigravidae known to be at risk for a low birth weight baby (LBW), where dietary intake was to be measured using a 7 d weighed record of food intake, it was of importance to find a means of verifying the dietary assessments. This was because many of these subjects were to be chosen from the least affluent group of the population, who had been shown (Thomson, 1958) to have difficulty in completing accurate dietary records. Previous studies of nitrogen metabolism had shown with primigravidae in this population the close correlation between N in the diet with urinary N excretion and the capacity of this relationship to confirm the dietary N intake even when the subjects were outpatients (Johnstone *et al.* 1981).

In a pilot study with subjects (outpatients) similar to those to be chosen for the main LBW study, the relationship of the urinary N constituents with N intake are shown in the Table, with those of the study undertaken in the metabolic ward and those of the main LBW study.

Source	Gestational age (weeks)	n	Energy intake MJ (kcal)		Nitrogen intake (g/d)		Urinary nitrogen (g/d)		Correlation between nitrogen intake and urinary nitrogen (r)	Urea:creatinine		Correlation between nitrogen intake and urea:creatinine (r)	Birth weight (g)
			Mean	SD	Mean	SD	Mean	SD		Mean	SD		
Metabolic study	30-34	21	10.08 (2409)	0.88 (211)	12.5	1.26	10.2	1.15	0.792**	—	—	—	3324
L.BW pilot study	29-35	11	8.38 (2002)	1.25 (299)	10.2	3.05	7.7	2.44	0.870**	6.6	1.86	0.748*	3022
L.BW study	25-33	140	8.63 (2062)	1.53 (366)	11.2	2.50	7.5	1.89	0.399**	6.2	1.48	0.358**	3014

* $P < 0.01$, ** $P < 0.001$.

The correlations in the main LBW study of N intake with energy intake is $r = 0.697$ ($P < 0.001$), of 24 h urinary N with energy intake is $r = 0.194$ ($P < 0.05$) and of the ratio urea:creatinine with energy intake is $r = 0.168$ ($P < 0.05$).

In the pilot study the correlation coefficient for urinary N with N intake is very similar to that of the metabolic study. In the main LBW study which was conducted over a longer period (4 years) with many more subjects the correlations of the urinary N constituents although less than those of the pilot study are still highly significant and confirm the N content of the dietary assessments.

These lower correlation coefficients found in the main study indicate the difficulties in obtaining reliable dietary assessments for epidemiological studies where all cases are to be included over a considerable period of time, although using methods which when used in a metabolic ward or with a small number of highly motivated patients have a high degree of precision.

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An index of lean body mass from 24 h urinary creatinine excretion. By L.

FULLER and A. J. RICH (introduced by I. D. A. JOHNSTONE), *Department of Surgery, Royal Victoria Infirmary, Newcastle upon Tyne NE1 4LP*

A retrospective analysis was carried out from the records of seventeen patients to investigate the relationship between lean body mass (LBM) and 24 h urinary creatinine (CR) excretion. The group, comprised of nine males and eight females, aged between 15 and 76 years (mean age 48 years) had all been assessed by the Nutritional Care Team. Total body potassium had been estimated by ^{40}K counting using a whole body monitor. Seven subjects had two estimations made within 24 h, in which case values were averaged. On the assumption that the most appropriate K:LBM value was 68.1 mmol/kg lean body (Forbes & Hursh, 1963), LBM was calculated for each patient. A mean of at least two consecutive 24 h CR measurements was matched with the appropriate LBM.

By least squares regression analysis, the relationship was derived: $\text{LBM (kg)} = 14.1 + 21.4 \text{ CR (g)}$. The correlation coefficient (r) was 0.917 ($P < 0.001$) and the coefficient of determination (r^2) was 0.84, implying that differences in CR accounted for 84% of the variability in LBM. The standard error of the estimate using this equation is ± 2.93 . If single CR values were used, considerable individual daily variation was noted and if the data was calculated on this basis the correlation coefficient fell to 0.828 and the coefficient of determination to 0.69. Forbes & Bruining (1976) used an average of three or more consecutive 24 h CR measurements from normal subjects with a corresponding average of 2–3 total body K assays to obtain a correlation coefficient of 0.9878 and coefficient of determination of 0.976. It is probable that at least three consecutive 24 h CR measurements are required to obtain an accurate index of LBM.

Whilst measurement of total body K using a whole body counter provides a fairly accurate value for lean body mass, this technique is not widely available as the machinery is very expensive, heavy and cumbersome. An index of LBM and its subsequent variations would be useful for patients where measurement of body-weight is insensitive due to changes in hydration or adipose tissue stores. 24 h Cr excretion can be used to obtain an index of LBM, providing three or more 24 h urine collections are taken with as much accuracy as possible.

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A longitudinal study of nutritional status and its influence on birth weight in primigravid Caucasian, Asian and West Indian women in London.

By D. I. THURNHAM¹, JAYSHREE DATTANI¹, JOAN M. L. STEPHEN¹ and JILL EVERETT², ¹Department of Human Nutrition, ²Ross Institute of Tropical Hygiene, London School of Hygiene & Tropical Medicine, Keppel Street WC1E 7HT

The women were randomly selected at approximately 20 weeks pregnancy in the ante-natal clinic at a South London Hospital. Attempts were made to obtain thirty subjects in each group. Blood was taken at approximately 20 weeks, 33 weeks and from the cords at birth. Indices of anaemia and vitamins B₁, B₂, C and D status in addition to urinary urea, creatinine, plasma albumin and total protein were measured. The Table shows a selection of the biochemical results which illustrated interesting relationships. Three of the measurements were correlated with birth weight: urea ($r = 0.39$, $P < 0.01$, $n = 44$), alkaline phosphatase (AP, $r = -0.38$, $P < 0.01$, $n = 45$) and plasma ascorbic acid (PAA, $r = 0.29$, $P < 0.05$, $n = 48$).

	Blood sample (weeks)	Caucasian		Asian		West Indian				
		Mean	SE	Mean	SE	Mean	SE			
Urea (mM)	20	1.71	0.18	(24)	1.28 ^a	0.17	(23)	2.29 ^b	0.24	(10)
AP (K.A. units)	33	8.8	0.56	(24)	9.2	0.71	(14)	7.5	0.9	(9)
25-OHD (nM)	20	31.5 ^b	2.0	(25)	14.75 ^a	1.63	(21)	28.5 ^b	7.03	(9)
25-OHD (nM)	33	24.5 ^b	2.25	(26)	14.25 ^a	2.5	(17)	25.8	7.38	(8)
25-OHD (nM)	Cord	14.5	2.65	(14)	8.5	2.25	(8)	15.0	5.15	(6)
PAA (μM)	33	45.5	5.1	(27)	43.2	5.1	(18)	34.0	9.0	(9)
Birth weight (kg)	—	3.39	0.09	(14)	3.17	0.14	(14)	3.41	0.12	(10)

Means that do not share a common superscript letter are significantly different ($P < 0.05$). Number of subjects shown in parentheses.

Urinary urea is a measure of protein intake and breakdown (Sauberlich *et al.* 1974). The association between urea and birth weight is probably due to the fact that the smaller body size of Asian women will tend to produce smaller birth weights (Hyttén & Leitch, 1964) and be associated with a smaller appetite hence lower protein intake. AP is an indirect measure of vitamin D status. There was no correlation between AP and 25-hydroxycholecalciferol (25-OHD) and 25-OHD was not correlated with birth weight but mean AP activity tended to be higher (NS) and 25-OHD lower ($T = 2.8$, $P < 0.01$) in the Asians than the rest. 25-OHD was the only measurement in the mothers' blood at 33 weeks which was found to be correlated with concentration in the cord blood ($r = 0.64$, $P < 0.001$, $n = 24$). The results suggested that high AP activity was associated with low birth weight and that this might be associated with vitamin D status which was poor in the Asian women.

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Intracellular and extracellular components of man derived from nuclear based determinations of protein, water and fat. By H. M. JAMES, D. R. CHETTLE, P. J. FABRICIUS, P. W. DYKES, J. G. FLETCHER and M. C. SCOTT (introduced by A. B. McALLAN), *The General Hospital, Birmingham and Departments of Physics and Experimental Pathology, Birmingham University*

We used neutron activation *in vivo* to measure whole body nitrogen (Vartsky *et al.* 1979), whole body counting of naturally occurring ^{40}K to measure whole body potassium (Hughes & Williams, 1967), β counting of tritium in plasma to determine total body water (Blahd, 1971), X-ray fluorescence of stable bromide in plasma to determine extracellular water (Price *et al.* 1975) and fat-folds to determine total body fat (Fletcher, 1962). Whole body protein was determined from whole body N and its cellular component was estimated using 0.33 whole body K. Cell mass was 8.3 whole body K (Moore *et al.* 1963). Thus we were able to estimate lean body mass and its components: cellular fluid and protein, extracellular fluid and protein with bone mineral a small remainder. Our subjects were ten underweight patients with severe intestinal disease, twelve overhydrated patients, five obese patients and five normals.

The wasted patients were 23% below their ideal weight and they had a reduction of 20% in lean body mass which consisted of a 40% reduction in the cellular component with little or no change in the extracellular component. The overhydrated were 22% above their ideal weight and they had an increase of 10% in lean body mass which consisted of a 20% reduction of the cellular component with a 50% increase of the extracellular component.

Determination of the cellular component revealed wasting most clearly, it showed that lean tissue wasting was largely confined to the cellular component, and it was not complicated by the larger proportion of extracellular fluid in the wasted lean body. This approach is more effective in the classification of wasting than routine clinical methods (lean body mass, history of weight loss, or comparison of weight with ideal weight).

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Changes in intra- and extracellular components during preoperative feeding assessed by nuclear techniques. By P. J. FABRICIUS, H. M. JAMES and P. W. DYKES (introduced by A. B. McALLAN), *The General Hospital, Birmingham*

We have measured whole body potassium (^{40}K counting) water (tritium dilution), extracellular fluid volume (bromide dilution) and fat (skinfolts) to assess the initial composition and the changes during preoperative feeding of malnourished patients with upper gastrointestinal disease.

Fourteen patients who had lost a mean weight of 15 kg (21%) have been studied. Initial measurement showed that lean body mass was 89% of the expected value. The low values of whole body K, 2.13 mmol (expected 3.10 mmol) and later 27.4 l (expected 34.0 l) with a normal extracellular fluid volume of 14.0 l, show that the major loss of lean tissue is intracellular although body fat is also reduced.

Seven of the patients were fed parenterally and seven enterally for 21 d. The mean changes with feeding are shown in the Table.

	Parenteral feeding	Enteral feeding
Weight (kg)	+7.6***	+4.2***
Nitrogen balance (g)	+139***	+66*
Whole body potassium (mmol)	+384***	+138***
Cell mass (from K^+) (kg)	+3.15	+1.1
Body water (l)	+3.5**	+1.2 NS
Extracellular fluid volume (l)	+0.7 NS	+0.6 NS
Fat (kg)	+2.9**	+1.1 NS

NS, not significant.

* $P < 0.05$, ** $P < 0.02$, *** $P < 0.01$.

Thus preoperative feeding of malnourished patients increases body N, K and intracellular water as well as fat, without changing extracellular fluid volume.

Taste changes in advanced cancer. By T. D. WALSH^{1,2}, K. BOWMAN¹ and G. P. JACKSON³ (introduced by I. MACDONALD), ¹*St. Christopher's Hospice, Sydenham, London SE26 6DZ*, ²*Department of Clinical Pharmacology, Guy's Hospital Medical School, London SE1*, ³*Department of Dietetics and Nutrition, St. Thomas' Hospital, London SE1 7EH*

Hospice inpatients were interviewed by a National Health Service registered dietitian, using a structured questionnaire, to discover the incidence of any subjective changes (since becoming ill) in weight, appetite and taste sensation/food preference.

Twenty-five patients consented to participate—fourteen males, eleven females; median age 65 years (range 49–84 years)—after selection by the ward sister as mentally and physically competent to be interviewed. There were no refusals.

Weight loss (20/25) and anorexia (17/25) were common. Thirteen patients reported taste changes in response to direct questions. Changes in taste (13/25) were mostly non-specific; all food 'tasteless' (5/13) or 'bitter' (2/13). Specific taste changes included sweet (2/13), salt (1/13), sweet and salt (1/13). Changes in food preference were most commonly sweet foods (7/13) and meat (6/13). Five patients were aware of changes in preference among a choice-list of specific foods, but did not have taste changes.

Changes in taste were not related to gastro-intestinal tract symptoms, length of illness or survival in this sample.

Anorexia and changes in taste/food preference in advanced cancer are common (De Wys, 1978; Brewin, 1980). Staff caring for such patients should be aware of individual taste and food preferences and plan diets appropriately. Further study of any relationship between taste changes and drug therapy is necessary.

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Serum ferritin in the assessment of hepatic iron storage in alcoholic liver disease. P. R. MILLS, D. WRAY, M. R. MOORE, R. N. M. MACSWEEN and R. I. RUSSELL, *Gastroenterology Unit, Royal Infirmary and Departments of Medicine and Pathology, Western Infirmary and Glasgow Dental Hospital, Glasgow*

Alcoholic liver disease is often associated with secondary hepatic iron overload which may occasionally cause difficulty in the differentiation from idiopathic haemochromatosis. Serum ferritin has been demonstrated to correlate well with total body Fe stores in patients with idiopathic haemochromatosis (Powell *et al.* 1978). A prospective study of the value of serum ferritin in the assessment of hepatic Fe storage in alcoholic liver disease was therefore undertaken.

106 British patients (seventy-four males) with clinical and biochemical evidence of alcoholic liver disease were studied. Patients with evidence of Fe deficiency were excluded. Serum ferritin was measured by radioimmunoassay (Fer-Iron, Ramco Lab) and needle liver biopsy carried out for assessment of stainable liver Fe on a scale 0-4 (Scheuer *et al.* 1962). In addition, in forty patients liver Fe concentration was measured by atomic absorption spectrophotometry and hepatic necrosis assessed histologically on an arbitrary scale 0-3. Liver Fe concentration was also measured in ten healthy controls undergoing elective duodenal ulcer surgery.

Liver histological findings were as follows: fatty liver alone (thirty-nine patients), alcoholic hepatitis (thirty-one) and alcoholic cirrhosis (thirty-six). Stainable liver Fe was demonstrated in 48% of these patients but only four (3.8%) had significant siderosis of grade 3 or 4. Liver Fe concentration was increased (range 84-1890 nmol/mg protein) above the 95% confidence interval for the controls (7-80 nmol/mg protein) in thirteen (33%) patients and there was a good correlation with serum ferritin levels ($r\ 0.84$, $P < 0.001$). Serum ferritin showed stepwise increments with stainable liver Fe grades but there was considerable overlap of ferritin results between the grades. No association was found between serum ferritin and the degree of hepatic necrosis.

Significant Fe overload has therefore been demonstrated to be uncommon in patients with alcoholic liver disease in the West of Scotland. Serum ferritin proved to be a useful non-invasive marker of liver Fe concentration but did not correlate so well with stainable liver Fe, possibly because staining estimates only that fraction of iron stored as haemosiderin.

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Preoperative parenteral nutrition in the operative management of Crohn's disease. By D. G. RICHARDS and R. G. CLARK, *University Surgical Unit, Clinical Sciences Centre, Northern General Hospital, Sheffield S5 7AU*

Malnutrition is a common complication of Crohn's disease in surgical practice. Preoperative parenteral nutrition is used to restore nutritional deficits and reduce operative morbidity. The exact place of this form of management is not yet clearly defined and this study attempts to identify what can be achieved in the seriously depleted patient awaiting extensive surgery.

Nine patients received preoperative parenteral nutrition comprising 0.23 g nitrogen and 168 kJ/kg body-weight for a total of 887 patient days and have been divided into two groups. Five patients (Group 1) were awaiting surgery once they were adjudged fit and are compared with four patients (Group 2) fed parenterally in an initial attempt to achieve resolution of the disease process, and who eventually came to operation.

	<i>n</i>	Age (years)	Initial weight (kg)	Initial albumin (g/l)	Days to optimum weight	Days to operations
Group 1	5	23.4	39.84	32.4	45.8	50.2
Group 2	4	27.8	43.0	35.0	76.5	159.0

Over the preoperative period Group 1 gained 7.24 kg in weight and an increase in serum albumin to 36.8 g/l. Group 2 gained 9.35 kg with little change in the serum albumin. Rebound hypoglycaemia was the only metabolic complication encountered in a single patient, two catheters required replacement for mechanical obstruction and septicaemia was proved once in four episodes of pyrexia. Postoperative morbidity was low. Two patients developed lobar pneumonia, one developed superficial wound sepsis and another a deep wound dehiscence.

Parenteral nutrition achieved excellent nutritional support in the management of serious undernutrition in Crohn's disease, achieving the maximum nutritional benefit within 40–60 d of feeding, but does not influence radically the course of the disease.

Anthropometric measurements in surgical patients being parenterally or enterally fed. By J. E. A. SMITH, A. J. W. SIM and A. SHENKIN, *Surgical Nutritional Advisory Group, Royal Infirmary, Glasgow*

Measurements of body-weight, triceps skinfold thickness and mid-arm muscle circumference are widely used in the assessment of nutritional status and in monitoring progress during nutritional support. In an attempt to determine the usefulness of such measurements, we have compared the anthropometric findings with serum protein concentrations and with clinical progress in postoperative patients who required nutritional support. Eleven patients (TPN group) received a standard parenteral nutrition regimen (providing 14 g N and 12.6 MJ (3000 kcal)/d) for an average of 2.7 weeks and thirteen patients (TF group) received fine bore nasogastric tube feeding with a whole protein feed (average intake 12 g N and 8.4 MJ (2000 kcal)/d) for an average of 4.1 weeks.

Results (mean \pm SD) at the beginning and end of the study period are summarized in the Table.

		Weight (kg)		Skinfold thickness (mm)		Muscle circumference (mm)		Albumin (g/l)		Transferrin (g/l)	
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Parenteral nutrition	Beginning	56.9	11.5	12.8	5.8	209	29	31.9	5.2	2.0	0.4
	End	58.4	11.1	12.6	6.0	213	31	33.3	4.8	2.3	0.2
Tube feeding	Beginning	54.2	7.1	10.7	4.9	205	26	28.8	6.2	1.8	0.6
	End	55.7	6.6	11.1	4.7	205	21	32.8	4.9	2.4	0.6

Paired statistical analysis failed to demonstrate any significant improvement in the anthropometric measurements in either group. However, in the TF group only, there was a significant increase in serum albumin ($P < 0.05$) and serum transferrin ($P \leq 0.005$). Of the TF group, four patients showed improvements in the anthropometric measurements and eleven an increase in serum proteins, whereas in the TPN group, two patients had an improvement and one a deterioration in anthropometry and two an increase in serum proteins. With the exception of one patient who remained on long-term TPN and one who continued tube feeding, all patients were discharged home on normal oral diet. This study therefore confirms that nutritional status in surgical patients can be maintained or improved by enteral or parenteral routes.

In four cases in the TPN group and one in the TF group inconsistencies between anthropometry and serum protein measurements were observed which could be interpreted in the light of changes in fluid balance or the effects of surgery. However, in general, anthropometric measurements showed the same trend as the changes in serum protein concentration. Repeated anthropometric measurements may therefore play a part in nutritional monitoring.

Can we monitor response to nutritional therapy? By J. A. R. SMITH and J. M. SIMMS (introduced by R. G. CLARK), *University Surgical Unit, Royal Hallamshire Hospital, Sheffield.*

A serious deficiency in nutritional therapy is the absence of a method of selecting patients in need of nutritional support, and of monitoring their response to therapy. More recently, the prognostic nutritional index (PNI) of Mullen *et al.* (1979) has used nutritional indices to identify patients with a poor prognosis after surgery, but serial measurements of PNI in response to nutrition before surgery have shown that not all patients improve following 7–10 d of total parenteral nutrition (TPN). Those who do improve, however, have a low risk of complications (Simms & Smith, 1981), while those who deteriorated were those who developed major complications.

The PNI is derived from serum albumin, triceps skinfold thickness (TSF), transferrin and cell mediated immunity all of which are also influenced by surgery. The value of PNI as an index of response to nutritional therapy in the postoperative period has not been assessed prior to this paper.

A total of fifty-five patients undergoing major surgical resection, largely for neoplasia, were the subjects of controlled randomized clinical trials of nutritional support postoperatively either by total or peripheral parenteral nutrition, both being compared to a control group given water and electrolytes only.

The mean results pre-operatively showed comparable PNI in all three groups, below the danger level of 60 reported by Mullen *et al.* (1979). Immediately postoperatively, all results deteriorated but none reached over 60. However, in all groups studied neither form of nutrition showed any benefit as judged by PNI compared with control groups. All groups had a mean value greater than 60 by the fifth postoperative day yet the incidence of major complications was only 5%.

Thus, the influence on the PNI of the indices used to calculate the value in the postoperative period is such that the PNI cannot be used as a monitor of response to nutritional therapy.

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Nutritional status of surgical patients in Pakistan. By PETER J. WILLIAMSON and JEREMY POWELL-TUCK (introduced by J. C. WATERLOW), *Royal Infirmary, Bristol and Charing Cross Hospital, London*

Five cross sectional prevalence studies of nutritional status were made in surgical inpatients at the Memorial Christian Hospital, Sialkot, Pakistan, over a 50 d period in early 1981. Nutritional status was assessed by measuring height, weight, arm circumference, triceps skinfold thickness, haemoglobin and serum albumin, pre-albumin and transferrin concentrations. Each subject's weight was expressed as a percentage of the age and sex related ideal given by the Metropolitan Life Insurance Data (1959). Arm muscle circumference was calculated from the triceps skinfold thickness and arm circumference measurements.

129 assessments were made in ninety-eight patients. A further forty-three assessments of forty-three subjects, either patients' relatives or non-medical hospital staff members, served as a control group. The sex ratios in the patient and control groups were the same (male-female, 3:1). The mean age, of the patients and controls (44.2 years and 43.4 years respectively) and their mean heights (1.627 and 1.619 m respectively) were not significantly different. However, the patients had significantly lower values than the controls for percentage ideal weight, haemoglobin, albumin, pre-albumin and transferrin. Mean arm muscle circumference was lower in patients than in controls but not statistically significant so ($P=0.055$). Only haemoglobin and albumin were significantly lower when the pre-operative patients were separately compared with the controls. Rank correlation showed that all the indices except pre-albumin correlated significantly with the number of days after operation.

Just over half the control groups weighed less than 85% of their ideal weight as indicated by the Metropolitan Life Insurance Data (1959). 26% of controls had arm muscle circumferences less than the 5th centile of the Ten State Nutritional Survey Data (Frisancho, 1974).

Available Western anthropometric data are shown to be probably unsuitable for use in Pakistan. However, by comparison with a control group, undernutrition is seen to be present among patients admitted to this hospital for surgical procedures, and worsens as time in hospital increases. The study emphasizes the need for an active approach to improving the nutrition of hospital patients.

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Frisancho, A. R. (1974). *Am. J. clin. Nutr.* 27, 1052.

Weight, triceps skinfold, mid-arm muscle circumference, energy and protein intake of patients at home after partial gastrectomy. By JANET P. LOWELL, *School of Nutritional Science, Robert Gordon's Institute of Technology, Queens Road, Aberdeen AB9 2PG*

Six patients (5 male and 1 female) took part in the study. Four males and the female had a Polya gastrectomy and one male had an oesophagogastrectomy. Each patient was weighed and their triceps skinfold thickness and mid-arm circumference measured on discharge from hospital and at 1 month and 7 months after discharge. Their food intakes were recorded, mostly by the weighed method, for four 3 d periods during the first month after discharge and for a 7 d period 7 months after discharge.

The mean percentage ideal body-weight remained between 86 and 88% throughout the 7 month period of study. Two patients were within 2% of their ideal body-weight throughout but four failed to attain their ideal body-weight at any time. There was little change in weight in any patient during the first month. Two patients gained and one lost weight during the following 6 months.

Mean skinfold thickness as a percentage of the standards (Jelliffe, 1966) at discharge, 1 and 7 months after discharge were (%) 59 (30-118), 58 (34-115) and 61 (36-119) respectively. Only those of the female patient were more than 100%.

Mean arm muscle circumference (arm circumference (mm)— $0.314 \times$ triceps skinfold (mm)) as a percentage of the standards were (%) 94 (86-110), 94 (85-111) and 95 (76-112) respectively.

Energy requirements were calculated on discharge as basal energy expenditure (BEE) + 50% for the four underweight patients and BEE + 20% for the two patients of ideal weight (Blackburn *et al.* 1977). During the four 3 d intake periods during the first month after discharge the mean energy intakes as a percentage of mean requirements were (%) 80 (42-104), 70 (28-114), 74 (42-104) and 83 (70-89). This increased to 110 (81-131) during the 7 d period 7 months after discharge.

Mean protein intakes, as a percentage of $1.2 \times$ actual body-weight during the four 3 d periods were (%) 70 (41-107), 62 (40-103), 63 (43-91) and 66 (44-106). This increased to 104 (62-184) 7 months after discharge.

Blackburn, G. L., Bistran, B. R., Maini, B. S., Schlamm, H. T. & Smith, M. F. (1977). *J. Parent. Ent. Nutr.* 1, 11.

Jelliffe, D. B. (1966). *The Assessment of the Nutritional Status of The Community*. WHO monograph no. 53. Geneva: WHO.

Prediction of surgical complications. By J. M. SIMMS and J. A. R. SMITH
(introduced by R. G. CLARK), *University Surgical Unit, Royal Hallamshire Hospital, Sheffield*

Malnutrition resulting in acute loss of body-weight is well recognized as a cause of increased mortality and morbidity after surgery (Studley, 1936). Attempts to produce an assessment method both to define prognosis and to select patients for nutritional support have been largely unsuccessful. Recent formulas using a mixture of anthropomorphic measurements and serum protein levels have been shown to correlate well with surgical complication rates (Mullen *et al.* 1979; Arullani *et al.* 1981; Simms *et al.* 1982).

In this study, we have attempted to simplify the situation further by analysing the individual nutritional measurements in 100 patients undergoing major surgical resections for carcinoma to see if any on its own was of adequate predictive value of postoperative complications. In our analysis, skinfold thickness and pre-albumin showed no correlation with surgical complications. Transferrin, measured as total iron binding capacity, showed a linear correlation to complications, but this was not sufficiently significant to be of predictive value. Serum albumin, though correlating poorly with minor complications, correlated well with major surgical complications and defined a high risk group well, there being only one major surgical complication in one patient with a serum albumin of greater than 36 g/l, the normal range being from 35–55 g/l. This is perhaps not totally surprising as serum albumin accounts for about 50% of the predictive score produced by the formulas mentioned above.

In this study, we have found that pre-operative serum albumin alone shows a good correlation with major postoperative complications and is as effective on its own as when it is included with other nutritional indices to produce a risk score.

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Mullen, J. L., Buzby, G. P. & Waldma, T. G. (1979). *Surg. Forum* **XXX**, 80.
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The relationship between plasma citrate concentration and skeletal muscle citrate content in man. By R. J. MAUGHAN and J. BROOM, *Department of Surgery, University of Aberdeen, Foresterhill, Aberdeen AB9 2ZD*

Nielsen has reported that the plasma citrate concentration increases during both fasting and exercise (Nielsen, 1978; Nielsen & Sorensen, 1981). He suggested that the measurement of plasma citrate concentration may be a useful indicator of metabolic events occurring within the muscle. This is true only if the plasma citrate concentration is representative of the citrate concentration within the muscle. In the present study we have measured muscle and plasma citrate levels simultaneously.

Blood and muscle (m. vastus lateralis using a percutaneous needle biopsy technique) were obtained from six healthy adult male volunteers after a period on a normal diet, after 3 d on a low carbohydrate (CHO) diet following exercise-induced substrate depletion and after a further 3 d a high CHO diet. All samples were obtained in the morning after an overnight fast. The low CHO diet resulted in a significant ($P < 0.01$) elevation of the plasma citrate concentration, which returned to control values after the high CHO diet. Mean muscle citrate content was higher after the low CHO diet than in either of the other two conditions, but this difference was not statistically significant.

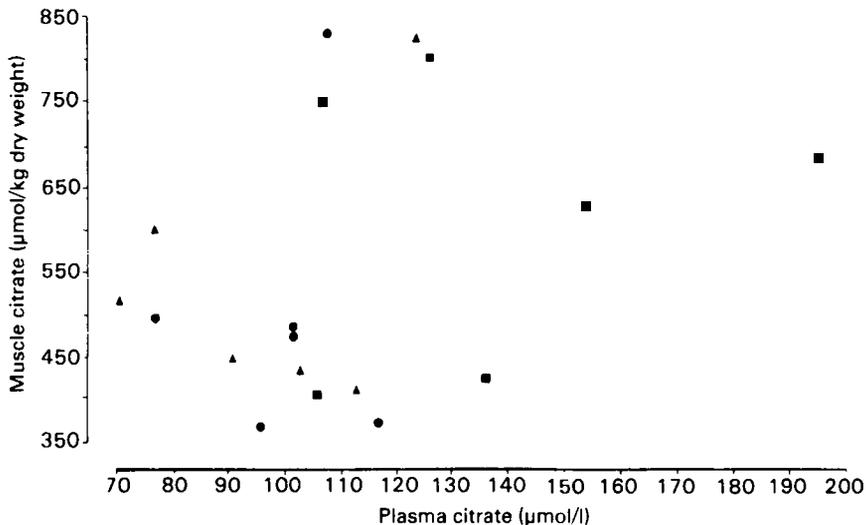


Fig. 1. Relationship between muscle citrate content and plasma citrate concentration in six subjects; measurements were made after a normal diet (●), after a low CHO diet (■) and after a high CHO diet (▲).

No correlation was observed between the muscle and plasma citrate levels (see Fig. 1). This finding suggests that measurements of plasma citrate concentration should be interpreted with caution.

This study was supported by Lipha Pharmaceuticals Limited.

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Nielsen, T. T. & Sorensen, N. S. (1981). *Scand. J. clin. Lab. Invest.* **41**, 281.

High-density-lipoprotein subfractions: The effects of a high-fibre cereal, low-fat dietary regimen. By P. M. DODSON, G. FERNS, D. J. GALTON and K. G. TAYLOR, *Department of Diabetes and Lipids, Dudley Road Hospital, Birmingham and St. Bartholomew's Hospital*

We have previously reported a significant increase in HDL-cholesterol levels in essential hypertensive patients on a high-fibre cereal, high-unrefined carbohydrate and low-fat dietary regimen (Dodson *et al.* 1981). This finding may be of importance as a negative correlation has been reported between HDL-cholesterol and the incidence of coronary heart disease.

However, recent reports have shown a stronger negative association with coronary heart disease and the HDL₂ subfraction. We now report the levels of subfractions HDL₂ and HDL₃ in nineteen essential hypertensive patients (mean age: 57±9.6 years) after 3 years on a dietary regimen of high-fibre cereal (40 g/d), high-unrefined carbohydrate (51% dietary energy) and low-fat (20% dietary energy) compared to age and sex matched healthy controls (mean age 55.3±8.8 years).

HDL subfractions were measured in the supernatant following precipitation by heparin and manganese chloride for total HDL and then further precipitation with dextran sulphate (Ferns *et al.* 1981).

The significant reduction in blood pressure and weight of hypertensive patients after 3 months of the dietary regimen was maintained at 3 years. However, no significant changes were found in total serum cholesterol and triglyceride levels.

HDL levels were significantly elevated after 3 months and 3 years on the dietary regimen (0.95±0.18 to 1.18±0.09 and 1.19±0.12 mmol/l; *P*<0.05). As the Table shows, after 3 years, HDL₂ levels were significantly elevated and HDL₃ decreased compared to the control group. A significant increase in the HDL₂:HDL-cholesterol and HDL₂:HDL₃ values was also observed.

	Sex	Mean ideal body-weight	Total HDL-cholesterol	HDL ₂	HDL ₃	$\frac{\text{HDL}_2}{\text{Total HDL}}$	$\frac{\text{HDL}_2}{\text{HDL}_3}$
Essential							
hypertensive patients (<i>n</i> 19)	18 ♂ 1 ♀	103.8 ±11.9	1.21 ±0.54	0.61* ±0.3	0.59** ±0.26	0.50** ±0.06	1.03** ±0.25
Age and sex							
matched control group (<i>n</i> 19)	18 ♂ 1 ♀	102.9 ±12.3	1.30 ±0.2	0.43 ±0.2	0.87 ±0.08	0.32 ±0.11	0.5 ±0.24

Values are means with their standard deviations.

P*<0.05, *P*<0.001.

We conclude that the elevation of serum HDL-cholesterol at 3 months is maintained after 3 years on the dietary regimen and this may represent an increase in the HDL₂ subfraction. These results further demonstrate the possible lowering of cardiovascular risk factors by a high-fibre cereal, high-unrefined carbohydrate and low-fat dietary regimen.

Dodson, P. M., Stocks, J., Holdsworth, G. & Galton, D. J. (1981). *Br. J. Nutr.* **46**, 289.

Ferns, G., Stocks, J., Galton, D. J., Landen, J. & Williams, P. J. (1981). *Clin. Sci.* **62**, 16p.

Drug metabolism in malnourished patients assessed by antipyrine clearance—the effect of parenteral feeding. By V. SANCHEZ, D. J. NEWTON, R. G. CLARK, G. T. TUCKER and H. F. WOODS, *University Departments of Therapeutics and Surgery, Royal Hallamshire Hospital, Sheffield S10 9JF*

Malnourished patients in underdeveloped countries have been reported to have altered drug metabolism (Krishnaswamy, 1978, Buchanan *et al.* 1979). However, there is little information on the handling of drugs by malnourished surgical patients and its modification by parenteral feeding.

We have studied the kinetics of intravenous antipyrine in thirteen malnourished patients before parenteral nutrition was administered and in five patients the kinetics were re-examined after feeding. The results have been compared with a group of six non-smoking orthopaedic patients and are given in the Table.

	♂/♀	Body-weight (kg)	Age (years)	Half life (t _{1/2}) (h)	Volume of distribution (l/kg)	Clearance (ml/kg per min)
Patients	11/2	52 (32-62)	49 (19-68)	12.6 (4-27)	0.65 (0.30-1.21)	1.27 (0.30-3.60)
Controls	6/0	78 (65-87)	45 (35-59)	14.8 (10-19)	0.60 (0.58-0.65)	0.50 (0.37-0.72)
Patients prefeeding	5/0	48 (38-56)	49 (19-68)	10.9 (4-19)	0.68 (0.32-1.0)	1.27 (0.42-3.60)
Patients postfeeding	5/0	51 (45-64)	49 (19-68)	11.8 (6-16)	0.72 (0.46-1.60)	1.02 (0.36-2.16)

Values are means with their ranges.

Antipyrine in plasma was measured by a high performance liquid chromatography method with samples collected up to 24 h after a single 750 mg intravenous dose. In all cases a parenteral feeding regimen providing 0.25 g nitrogen/kg per d and 8.3-9.5 MJ/kg per d was used; the energy being provided in the form of fat and carbohydrate.

There was a wide range of results within the patient group, some having impaired clearance and others increased clearance. No statistical differences in any of the kinetic measurements were found when comparing prefeeding data in all patients against the controls or prefeeding against postfeeding data (see Table).

Antipyrine clearance while decreased in some patients was increased in others and was thus not a reliable indicator of malnutrition. Therefore the handling of drugs in malnourished patients cannot be predicted. The changes brought about by parenteral feeding were not consistent and suggest that therapy designed to correct nutritional depletion may not always restore to normal the activity of drug metabolizing enzymes.

Krishnaswamy, K. (1978). *Clin. Pharmacokinetics* 3, 216.

Buchanan, N., Davies, M. D. & Eyberg, C. (1979). *Br. J. clin. Pharmac.* 8, 451.

Biochemical indicators of nutritional status in elderly patients. By J. R. KEMM, *Department of Community Health, University of Nottingham*

Many authors (Department of Health and Social Security, 1979) have shown that low values for biochemical measures of nutritional status are not uncommon in the elderly, but the significance of these low values is uncertain. This communication reports a study of the nutritional status soon after admission of patients in two acute wards for the elderly. Measurements made included haemoglobin, albumin, retinol binding protein (RBP), plasma retinol, plasma vitamin C, erythrocyte glutathione reductase activation coefficient (EGRAC) by FAD and erythrocyte transketolase activation coefficient (ETKAC) by TPP. Weight and clinical information were also recorded.

The variables tend to fall into two groups. Retinol, RBP, albumin and haemoglobin together with weight constitute one group while plasma vitamin C, EGRAC and ETKAC constitute a second group. RBP levels were strongly correlated with plasma retinol ($r\ 0.69, n\ 113, P<0.001$) and less strongly with albumin ($r\ 0.44, n\ 119, P<0.001$) and weakly with weight. EGRAC was weakly but significantly correlated with vitamin C ($r\ 0.19, n\ 114, P<0.02$) and with ETKAC ($r\ 0.20, n\ 98, P<0.02$).

The first group of variables, but not the second tended to be lower in patients with neoplastic disease than in patients with non-neoplastic disease (see Table). The second group of variables tended to be abnormal (i.e. lower plasma vitamin C and higher EGRAC and ETKAC) in demented patients while the first group of variables did not show this tendency.

	Disease						Mental score					
	Neoplastic			Non-neoplastic			0-5			8-10		
	Mean	SD	n	Mean	SD	n	Mean	SD	n	Mean	SD	n
Albumin (g/l)	33.5	5.5	17	36.5	4.9	132	36.1	5.4	33	36.0	5.0	85
Retinol (µg/l)	392	184	10	552	184	88	557	236	24	577	288	53
Vitamin C (mg/l)	4.2	3.2	12	3.6	2.0	90	3.4	1.4	24	4.4	2.9	57

Neither group of variables showed a consistent difference between male and female patients or between old (<80 years) and very old patients (>80 years).

The association of low vitamin A levels with malignancy has been widely suspected (Atukorala *et al.* 1979). The association of dementia with indicators of poor nutritional status has also been noted by other authors (Basu *et al.* 1976) and prompts speculation as to whether the association is causal.

The financial support of Bencard Ltd for this project is gratefully acknowledged.

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The tryptophan load test for vitamin B₆ status is inappropriate for women receiving oestrogens. By DAVID A. BENDER, *Courtauld Institute of Biochemistry, The Middlesex Hospital Medical School, London W1P 7PN*

A well established test of vitamin B₆ nutritional status is the ability to metabolize a dose of between 2–5 g tryptophan. The enzyme kynureninase (L-kynurenine hydrolase, EC 3.7.1.3) in the oxidative pathway of tryptophan metabolism is vitamin B₆ dependent, and in deficiency its activity is reduced, so that a greater proportion than normal of the administered tryptophan is excreted as xanthurenic and kynurenic acids, which are normally minor metabolites of the amino acid.

There is a considerable body of research which purports to show that women receiving oestrogenic steroids are vitamin B₆ deficient. The evidence is largely of abnormal responses to the tryptophan load test. When other indices of vitamin B₆ status have been assessed they have generally been unaffected by oestrogens. However, administration of between 5–20 mg of vitamin B₆ daily has been shown to restore tryptophan metabolism to normal in women receiving steroids, and it has therefore been assumed that there is an increased requirement for the vitamin as a result of oestrogen-induced deficiency.

Enzyme kinetic and animal studies in this laboratory have suggested that oestrogens or their metabolites do not deplete body reserves of vitamin B₆, but cause apparent vitamin B₆ deficiency by direct inhibition of tryptophan metabolism. Oestrone sulphate and glucuronide inhibit kynureninase competitively with respect to the substrate and uncompetitively with respect to the vitamin B₆-derived cofactor (Bender & Wynick, 1981). The administration of oestrone sulphate to ovariectomized rats has no effect on any of the indicators of vitamin B₆ status other than to increase the excretion of xanthurenic and kynurenic acids (Bender *et al.* 1982). The results of these animal studies suggest that the inhibition of kynureninase *in vivo* is of the same type as is observed *in vitro*.

There is a 4–5 fold excess of apo-kynureninase in the liver of the rat which can be activated by supplementary vitamin B₆ (Bender *et al.* 1982); if this is also true in human liver it would explain the normalization of tryptophan metabolism by vitamin B₆ supplements in women receiving oestrogens.

It appears that the abnormalities of tryptophan metabolism that have been observed in women receiving oestrogens are not the result of vitamin B₆ deficiency, but are artefacts due to direct inhibition of tryptophan metabolism by oestrogen metabolites. It is suggested that such a direct effect of drugs must always be considered where biochemical indices of nutritional status appear to provide evidence of drug-induced vitamin deficiency or depletion.

Bender, D. A. & Wynick, D. (1981). *Br. J. Nutr.* **45**, 269.

Bender, D. A., Tagoe, C. E. & Vale, J. A. (1982). *Br. J. Nutr.* **47**, 609.

Metabolic severity of surgical procedures. By J. A. R. SMITH and J. M. SIMMS (introduced by R. G. CLARK), *University Surgical Unit, Royal Hallamshire Hospital, Sheffield*

Peripherally infused isotonic amino acids are utilized in the postoperative period provided no carbohydrate is infused and thus the high elevation of insulin levels is avoided. This avoids the antilipolytic effect of insulin, and thus endogenous fat is mobilized for energy. However, insulin levels also rise in response to the stress of certain surgical procedures, or the development of major complications.

To date, the metabolic severity of surgical procedures has been assessed by the extent of nitrogen loss postoperatively but the standard tables available are largely exaggerated and attempts to calculate nutritional needs for total parenteral nutrition (TPN) on the basis of likely nitrogen losses are of dubious benefit.

In three groups of patients, the metabolic effects of isotonic amino acids alone (IAA) have been studied—namely, colectomy; total cystectomy and oesophagogastrectomy. In the latter two groups, TPN is an established part of management, i.e. these procedures are assumed to be metabolically severe.

In all three groups, insulin levels, nitrogen losses, visceral protein status and clinical outcome have been compared both in a control group and a group infused with 14 g N as IAA alone.

Following colectomy and oesophagogastrectomy mean cumulative 5 d N losses postoperatively were 36 g. Following total cystectomy this value rose to 59 g. These losses are considerably less than the quoted 100 and 250 g respectively.

In response to IAA alone, patients undergoing colectomy or oesophagogastrectomy had no elevation of insulin levels, but following total cystectomy, elevated insulin levels were found. In all three groups, IAA improved the negative N balance. There were no differences in visceral protein status or in clinical outcome between the surgical procedures or the intravenous fluids used.

N losses after major surgery are less than previously reported. The greater the N loss, the more likely the rise in insulin levels, but neither index predicted the likely benefit of nutritional support.

The postoperative nutritional status of elderly orthopaedic patients with particular reference to vitamin A and zinc. By J. W. T. DICKERSON, *Division of Nutrition and Food Science, Department of Biochemistry, University of Surrey* and M. W. J. OLDER, *Department of Orthopaedic Surgery, Royal Surrey County Hospital, Guildford*

The vitamin status of thirty patients undergoing elective total hip replacement was studied (Older, Dickerson *et al.* 1980). Fasting blood and urine samples were obtained before premedication on the day of operation and on the second, seventh and fourteenth postoperative days. None of the patients were malnourished on admission but 48 h after operation we found a statistically significant decrease in the plasma retinol and zinc levels. Our findings support the hypothesis that Zn is the key factor controlling the release of vitamin A from the liver into the bloodstream, and the possibility that the stress of operation releases ACTH and depresses the plasma Zn. A low level of vitamin A in the tissues may influence wound healing.

A comparative study was undertaken to assess the nutritional status of thirty patients having emergency surgery for femoral neck fractures (Older *et al.* 1981). Consistent preoperative data was unobtainable because of the unpredictability of admission and operation, but blood samples were taken on the second, seventh and fourteenth postoperative days as in the elective group. The plasma levels of vitamin A and RBP were significantly low at 48 h and remained below the normal range for 2 weeks. Contrary to our findings after total hip replacement, plasma Zn did not fall below the normal range.

Anthropometric measurements and hair root morphology were used respectively as in initial index and a biological marker of malnutrition but were not found to be an accurate guide in assessing change in a short-term study.

Evidence from these studies, together with our knowledge that the voluntary food intake of patients recovering from a femoral neck fracture is often inadequate (Older, Edwards *et al.* 1980), reinforces our view that long-term nutritional supplementation is important, but finding an acceptable oral supplement is proving difficult.

Older, M. W. J., Dickerson, J. W. T. & Edwards, D. (1980). *J. Bone Joint Surg.* **62B**, 533.

Older, M. W. J., Dickerson, J. W. T. & Taylor, J. (1981). *J. Bone Joint Surg.* **63B**, 641.

Older, M. W. J., Edwards, D. & Dickerson, J. W. T. (1980). *Br. J. Surg.* **69**, 884.

The stability of plasma vitamin C. By ALISON NEWILL and C. J. SCHORAH, *Department of Clinical Biochemistry, Seacroft Hospital, Leeds*

Low plasma vitamin C levels in patients in long-stay geriatric hospitals are well documented (Kataria *et al.* 1965; Schorah *et al.* 1979). Many of these hospitals have no on-site laboratory facilities, so transportation to a convenient laboratory can lead to delays. This work assesses the effect of this delay by examining the stability of vitamin C in plasma and whole blood.

Heparinized blood was obtained from elderly patients in three long-stay hospitals, and from young healthy volunteers. Portions of the blood were centrifuged immediately, and after 4 h at room temperature. Plasma proteins were precipitated with trichloroacetic acid (TCA) immediately after centrifugation. In addition, plasma which had been separated immediately was stored at room temperature for 4 h before TCA precipitation.

Supernatants after TCA precipitation from healthy volunteers were analysed by two techniques; dinitrophenyl hydrazine (DNPH), which measures total vitamin C (Roe & Kuether, 1943), and tripyridyl triazine (TPTZ) which measures only ascorbic acid (Day *et al.* 1979). Samples from the elderly were measured only by the former technique.

When stored for 4 h as whole blood (from healthy volunteers) total plasma vitamin C (DNPH) showed a 20% reduction whilst ascorbic acid (TPTZ) fell by 44%. In normal volunteers supplemented with ascorbic acid (1 g/d) for 2 weeks, the falls were 50 and 70% respectively. However, in the elderly there was little decrease in total plasma vitamin C over the same period. Losses in the young could be reduced by storing as separated plasma when 4 h decreases were 10 and 25% for DNPH and TPTZ respectively. However, with the addition of TCA to plasma before storage, losses were negligible when measured by DNPH, but remained high for TPTZ (20% in 4 h).

These results suggest that rapid loss of ascorbic acid, however the sample is stored, makes it difficult to use any technique such as TPTZ which only measures the reduced form of the vitamin.

Use of the DNPH technique allows storage of plasma or TCA precipitates, but losses are still considerable when whole blood from younger subjects is stored for 4 h, although storage for shorter periods may be possible. This will be discussed, along with reasons for the difference between whole blood storage in young and elderly, which could be due to differences in enzyme activity, white cell uptake, or initial blood vitamin C levels.

Day, B. R., Williams, D. R. & Marsh, C. A. (1979). *Clin. Biochem.* **12**, 22.

Kataria, M. S., Rao, D. B. & Curtis, R. C. (1965). *Geront. Clinica.* **7**, 189.

Roe, J. H. & Kuether, C. A. (1943). *J. biol. Chem.* **147**, 399.

Schorah, C. J., Newill, A., Scott, D. L. & Morgan, D. B. (1979). *Lancet* **i**, 403.

Vitamin C supplementation of lactating women in Keneba: a West African rural community. By C. J. BATES, A. M. PRENTICE, A. PRENTICE and R. G. WHITEHEAD, *Dunn Nutrition Laboratory, Milton Road, Cambridge and Keneba, The Gambia*

A community approach towards the determination of vitamin requirements and definition of recommended dietary allowances is the measurement of intakes needed for desirable blood levels, further justified where possible by optimization of physiological and biochemical functions.

We have shown that in lactating Gambian women, home food vitamin C levels are very low, and plasma ascorbate falls to practically undetectable levels during the rainy season (Bates *et al.* 1982). In the present study, a food supplement being given to these women was fortified with graded amounts of vitamin C during September–October 1981. The basic supplement provided, with other nutrients, 34.3 mg vitamin C/d. This was further fortified, as shown in the Table, and maternal plasma and buffy coat ascorbate levels were measured after 5 weeks.

Group	No. of subjects	Vitamin C supplement (mg/d)		Plasma ascorbate (mg/l)		Buffy coat ascorbate ($\mu\text{g}/10^8$ cells)	
		Mean	SE	Mean	SE	Mean	SE
A	19	34.3	0.6	2.6	0.3	14.7	1.2
B	21	58.3	0.9	3.9	0.4	17.5	1.0
C	22	80.7	0.8	4.8	0.6	20.8	1.2
D	17	103.1	1.2	7.1	0.7	23.2	1.1

Thus, under the conditions of physical stress and infection that occur in the rainy season in The Gambia, a supplement equal to the UK recommended dietary allowance (60 mg) for lactating women can support a plasma ascorbate of 4 mg/l in only about 50% of subjects. If the coefficient of variation of intake for a given plasma level is similar to that for plasma level for a given intake, then the 97.5% confidence (upper) limit of intake for a plasma ascorbate of 3 mg/l is 117 mg vitamin C/d; 5 mg/l requires 150 mg/d, and 7 mg/l requires 172 mg/d.

Mean breast milk ascorbate levels in groups A to D respectively were 34, 47, 54 and 56 mg/l after 2.5 weeks supplementation.

Neither plasma iron nor whole blood histamine levels showed a clear-cut, significant relation with level of supplement, although a trend towards lower histamine levels was seen as the intake of vitamin C was increased.

Bates, C. J., Prentice, A. M., Prentice, A., Paul, A. A. & Whitehead, R. G. (1982). *Trans. R. Soc. Trop. Med. Hyg.* (In the Press).

Nitrogen balance in adolescent sickle cell patients. By P. O. ODonkor and S. K. Addae, *Department of Physiology, University of Ghana Medical School, P.O. Box 4236, Accra, Ghana*

Sickle cell disease (Hb SS) patients have varying degrees of somatic growth retardation. There is little information to explain this. We have therefore studied nitrogen balance in adolescent sickle cell patients in an attempt to explain the mechanism.

Nine Hb SS patients, and five normals were investigated. All subjects were adolescent (age 14–16 years) and the Hb SS patients had been crisis-free for at least 3 months. There was no evidence of malnutrition or any other disease except the haemoglobinopathy of the Hb SS patients.

N balance was measured at three dietary protein intake levels; 90, 135 and 180 mg N/kg per d. Each protein intake level (period) lasted 11 d. Energy intake by each subject was kept constant 18.9 kJ (45 kcal)/kg per d throughout the investigation. 24 h total stool and urine were collected on each of the last 5 d of each dietary period. The stools and urines were analysed for total N, and the urines were additionally analysed for urea, ammonia, uric acid and creatinine. N balance was estimated from total N intake and total N excreted in urine and stool.

	Total nitrogen intake (mg/kg per d)	Total urinary nitrogen (mg/kg per d)		Total faecal nitrogen (mg/kg per d)		Nitrogen balance	
		Mean	SD	Mean	SD	Mean	SD
Normals	90	71.8	7.2	9.6	5.2	8.6	4.3
	135	100.7	16.3	21.0	14.9	13.3	23.5
	180	132.8	15.0	29.6	5.2	17.6	16.3
Hb SS patients	90	85.9	21.9	30.4	6.4	-26.3	20.0
	135	116.5	20.7	37.3	6.1	-18.8	20.3
	180	143.0	16.2	39.9	15.4	-2.9	8.4

Faecal N excretion was significantly greater in Hb SS patients compared with the controls ($P < 0.001$) at all three levels of N intake. Stools of Hb SS patients were bulkier than those of the normals. Urinary N excretion was greater in the Hb SS patients than in the normals ($P < 0.05$).

At the lowest N intake level of 90 mgN/kg per d, the normal controls were in positive N balance whereas even at the highest intake of 180 mg N/kg per d the Hb SS patients were still in negative balance. The predicted intake for zero balance in the controls is less than 90 mg/kg per d while that for the Hb SS patients is about 190 mg/kg per d.

It can be inferred from the results that Hb SS patients need a lot more protein for growth than their normal peers. Since these patients are usually not fed any differently from their normal peers, it can be understood why growth is retarded in Hb SS patients.