populations may reflect the selective survival of infants genetically susceptible to insulin resistance and subsequently to developing non-insulin dependent diabetes.

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Incidence and recognition of malnutrition in hospital

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Abstract

***Objectives*—To determine incidence of malnutrition among patients on admission to hospital, to monitor their changes in nutritional status during stay, and to determine awareness of nutrition in different clinical units.**

***Design*—Prospective study of consecutive admissions.**

***Setting*—Acute teaching hospital.**

***Subjects*—500 patients admitted to hospital: 100 each from general surgery, general medicine, respiratory medicine, orthopaedic surgery, and medicine for the elderly.**

***Main outcome measures*—Nutritional status of patients on admission and reassessment on discharge, review of case notes for information about nutritional status.**

***Results*—On admission, 200 of the 500 patients were undernourished (body mass index less than 20) and 34% were overweight (body mass index >25). The 112 patients reassessed on discharge had mean weight loss of 5·4%, with greatest weight loss in those initially most undernourished. But the 10 patients referred for nutritional support showed mean weight gain of 7·9%. Review of case notes revealed that, of the 200 undernourished patients, only 96 had any nutritional information documented.**

***Conclusion*—Malnutrition remains a largely unrecognised problem in hospital and highlights the need for education on clinical nutrition.**

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Introduction

More than 15 years have passed since the high incidence of protein energy malnutrition in medical and surgical patients was first shown,[1-3] and adverse changes in nutritional status during hospitalisation have also been reported.[4] Nutritional status has been shown to have important effects on health in recovery from illness or injury. Experimental semistarvation of normal volunteers that caused a 25% loss of body weight (to a body mass index of 17·5) was associated with apathy, depression, fatigue, and loss of will to recover.[5] Consequent loss of muscle power affects respiratory function, increasing susceptibility to chest infection,[6] and reduces cardiac function.[7] Impaired immune function increases the risk of infection.[8] Inevitably, such complications result in increased morbidity and mortality and lengthened stay in hospital,[9] at substantial extra cost in health care.[10]

Despite such findings, we believe that the problem of malnutrition in hospital remains largely unrecognised. The nutritional screening of patients at risk of depletion is not routine in many areas. In this study we sought to determine the incidence of nutritional depletion in patients admitted to hospital, to monitor changes in nutritional status during hospitalisation, to determine awareness of nutrition in different clinical units, and to assess the effect of nutritional intervention in relation to nutritional parameters.

Patients and methods

One of us (JPM) assessed the nutritional status of 500 patients on their admission to Dundee Teaching Hospitals Unit: 100 consecutive admissions from each of five disciplines—general surgery, general medicine, respiratory medicine, orthopaedic surgery, and medicine for the elderly. Patients admitted as day cases were not included in the study. Table I shows details of the

TABLE I—*Details of 500 patients admitted to hospital in five specialties. Values are numbers*

Condition	Elective procedures	Non-elective procedures	Total
General surgery:	53	47	100
Major abdominal surgery	14	11	25
Oesophageal surgery	4	2	6
Minor surgical procedures	10	7	17
Other major surgery	16	2	18
Vascular surgery	8	6	14
Surgical emphysema	0	1	1
Renal colic	0	2	2
Pancreatic disease	0	4	4
Abdominal pain	1	12	13
General medicine:	47	53	100
Ischaemic heart disease	8	21	29
Malignant disease	11	2	13
Neurological disorders	3	9	12
Inflammatory bowel disease	9	4	13
Other gastrointestinal disorders	7	4	11
Diabetes mellitus	0	3	3
Vascular disease	5	5	10
Protein energy malnutrition	1	2	3
Investigation of weight loss	2	0	2
Renal failure	1	3	4
Respiratory medicine:	38	62	100
Chronic obstructive pulmonary disease	6	32	38
Asthma	7	11	18
Malignant disease	12	0	12
Tuberculosis	3	0	3
Trauma	0	3	3
Other respiratory disease	10	16	26
Orthopaedic surgery:	43	57	100
Metastatic bone disease	6	0	6
Trauma fractures	0	47	47
Joint replacements	19	0	19
Minor surgical procedures	18	10	28
Medicine for the elderly:	18	82	100
Respite care	18	0	18
Neurological disorders	0	15	15
Respiratory symptoms	0	14	14
Malignant disease	0	4	4
Gastrointestinal disorders	0	5	5
Renal disease	0	2	2
Investigation of weight loss	0	1	1
Ischaemic heart disease	0	15	15
Other acute illness	0	26	26

patients studied. This study was approved by Tayside Health Board ethics committee.

Each patient's nutritional status was determined from anthropometric data—body mass index, triceps skinfold thickness, mid-arm circumference, mid-arm muscle circumference, and weight loss before illness. Body mass index by itself is not a sensitive indicator of protein energy malnutrition as it does not distinguish between depletion of fat or muscle. Low body mass index measurements will also include some patients who normally weigh less than is usual for their height. It is therefore useful to include other measurements of fat and muscle stores. Measurement of triceps skinfold thickness provides an estimate of body fat reserves. Mid-arm muscle circumference is a useful measure of muscle protein stores. Unintentional weight loss before illness was a dynamic measure of nutritional status to identify patients at risk of complications as a result of getting thinner. (It is important, however, to treat data from patient recall with caution.) To determine changes in nutritional status during hospital stay, patients who were hospitalised for more than one week were reassessed on discharge.

Height was recorded from case notes where available or measured with a Harpenden pocket stadiometer. When height was difficult to measure (for example, in elderly patients) stature was calculated from knee height. Weight was measured with either mechanical chair scales or Seca bathroom scales. Height and weight were used to determine body mass index (weight (kg)/(height (m))^2). Mid-arm circumference (cm) was measured with a tape measure, and triceps skinfold thickness (mm) was measured by the accepted method with Harpenden skinfold callipers; these were used to calculate mid-arm muscle circumference (mid-arm muscle circumference (cm) = mid-arm circumference − triceps skinfold thickness × 0·314). Values were compared with those in tables of normal values for triceps skinfold thickness and mid-arm muscle circumference measurements standardised for sex and age (for ages of 16 to 64 years), drawn from published data on the population of the United States.[11 12] Tables drawn from data on the elderly population in the United Kingdom were also used. The study data for body mass index and mid-arm circumference were also compared with data for these parameters in the British population that have been published.[13] Weight loss before illness was determined either by recalled weight or from earlier weights recorded at outpatient visits. Functional status was measured with a Harpenden hand grip dynamometer: patients were asked to grip the dynamometer three times with their non-dominant hand, and the highest reading was recorded. These values were compared with tables standardised for age and sex.[14]

Patients were considered to be mildly undernourished if their body mass index was less than 20 and if their triceps skinfold thickness or mid-arm muscle circumference was below the 15th centile. A body mass index of less than 18 and a triceps skinfold thickness or mid-arm muscle circumference below the fifth centile were evidence of moderate undernutrition, and a body mass index of less than 16 and a triceps skinfold thickness or mid-arm muscle circumference below the fifth centile were evidence of severe undernutrition. Unintentional weight loss before illness of more than 10% in the six months before admission was considered as additional evidence of undernutrition. Values for grip strength below 85% of standard may be evidence of protein depletion but in this study were not used in determining malnutrition. Patients were classified as overweight if they had a body mass index of more than 25 on admission.[15]

Case notes were reviewed for any information relating to nutritional status at the outpatient visit before admission and on admission to hospital. A checklist of expected references to nutrition was used for data collection, and any other nutritional information was also noted. This information revealed the attitudes of medical staff to nutrition and whether nutritional intervention may have been indicated before elective admission to hospital.

All data were entered into the computer system (Clinical Retrieval and Follow up Template) that was adapted for this study.[16] Statistical analysis was carried out with the SPSS package: Wilcoxon's paired t test was used to analyse weight changes in matched pairs; Fisher's test of exact probability was used to analyse associations between patients losing weight and those gaining weight; and χ^2 was used to analyse differences between the study data for body mass index and mid-arm circumference and data for the general population.

Results

MEASUREMENTS ON ADMISSION

Of the 500 patients, 67 (13%) had a body mass index of 18-20, 73 (14%) had a body mass index of 16-18, and 47 (9%) had a body mass index below 16. Table II shows that, of the patients aged between 16 and 64,

TABLE II—*Distribution of body mass index in people aged 16-64: 225 patients admitted to hospital and representative sample of British population. Values are numbers (percentages)*

	Men		Women	
Body mass index (kg/m^2)	Patients (n=134)	General population (n=1156)*	Patients (n=91)	General population (n=1159)*
<20	31 (23)	69 (6)	26 (29)	139 (12)
20·1-25	50 (37)	567 (49)	30 (33)	603 (52)
25·1-30	45 (34)	428 (37)	16 (18)	278 (24)
>30	8 (6)	92 (8)	19 (21)	139 (12)

*Data from Gregory *et al.*[13]

TABLE III—*Distribution of mid-arm circumference in people aged 16-64: 224 patients admitted to hospital and representative sample of British population. Values are numbers (percentages)*

Mid-arm circumference (cm)	Men		Women	
	Patients (n=134)	General population (n=1191)*	Patients (n=90)	General population (n=1187)*
<25	29 (22)	36 (3)	28 (31)	167 (14)
25·1-27·5	35 (26)	167 (14)	17 (19)	320 (27)
27·6-30	19 (14)	333 (28)	17 (19)	320 (27)
30·1-32·5	27 (20)	369 (31)	8 (9)	202 (17)
>32·5	24 (18)	286 (24)	20 (22)	178 (15)

*Data from Gregory *et al.*[13]

TABLE IV—*Nutritional status of 500 patients at time of admission to one of five hospital specialties. Values are numbers*

	Hospital specialty				
	General surgery (n=100)	General medicine (n=100)	Respiratory medicine (n=100)	Orthopaedic surgery (n=100)	Medicine for elderly (n=100)
Undernourished	27	46	45	39	43
Normal	25	30	17	30	27
Overweight	48	24	38	31	30

TABLE V—*Prevalence of protein energy malnutrition among 500 patients admitted to five hospital specialties. Values are numbers*

	Hospital specialty				
Malnutrition	General surgery (n=100)	General medicine (n=100)	Respiratory medicine (n=100)	Orthopaedic surgery (n=100)	Medicine for elderly (n=100)
Mild	10	11	13	28	4
Moderate	16	27	19	5	20
Severe	1	8	13	6	19

TABLE VI—*Changes in weight during hospitalisation among 112 patients who were reassessed on discharge. Values are numbers unless stated otherwise*

	Patient's status on admission				
			Undernourished		
Weight change	Overweight (n=29)	Normal (n=28)	Mild (n=19)	Moderate (n=19)	Severe (n=17)
None	7	11	0	0	0
Weight loss:	20	11	17	13	11
Mean weight loss (%)	5·4	5·3	5·3	9·7	6·4
Weight gain:	2	6	2	6	6
Mean weight gain (%)	2·3	3·4	3·4	4·4	8·1

23% of the men and 28% of the women had a body mass index below 20, significantly different from the 6% of men and 12% of women in the general population ($P<0·001$). Within the same age group, 22% of the men and 31% of the women in the study group had a mid-arm circumference of less than 25 cm, significantly higher than the 3% and 14% of men and women respectively in the general population ($P<0·001$) (table III).

Altogether, 140 (28%) of the 500 patients had a triceps skinfold thickness between the fifth and 15th centile, and 88 (18%) had a triceps skinfold thickness below the fifth centile. Two hundred (40%) of the patients had a mid-arm muscle circumference value between the fifth and 15th centile and 177 (35%) had a mid-arm muscle circumference below the fifth centile. A weight loss of more than 10% in the six months before admission to hospital was recorded for 66 (13%) of the patients.

The grip strength of 420 patients was measured (36 patients were too ill or confused to perform the test). Values of below 85% of standard were recorded for 283 patients, of whom 134 (47%) were undernourished, while 137 patients had grip strengths of 85% or more of standard, of whom 19 (14%) were undernourished.

NUTRITIONAL STATUS ON ADMISSION

Table IV shows that 129 of the 500 patients were normally nourished on admission to hospital, 171 were overweight, and 200 were undernourished. Undernutrition was evident in 27 of the general surgery patients, 46 of the general medical patients, 45 of the patients in respiratory medicine, 39 of the orthopaedic surgery patients, and 43 of the patients in the assessment units for medicine for the elderly. Of those 200 undernourished patients, 66 were considered to have mild protein energy depletion, 87 were moderately depleted, and 47 were severely depleted. Table V shows the prevalence of protein energy malnutrition in the different groups of patients.

CHANGES IN NUTRITIONAL STATUS DURING HOSPITALISATION

Altogether, 112 patients were reassessed on discharge. Table VI shows that weight loss had occurred in 20 (69%) of the 29 overweight patients, 11 (39%) of the 28 normally nourished patients, and 41 (75%) of the 55 undernourished patients. Weight gain was observed in two of the overweight patients, six of the normally nourished patients, two mildly undernourished patients, six moderately undernourished patients, and six severely undernourished patients.

Weight loss during hospitalisation resulted in patients' nutritional status being recategorised: two (7%) of the overweight patients lost weight to within the normal weight range, while another two became moderately undernourished; five (26%) of the mildly undernourished patients became moderately undernourished; and seven (37%) of the moderately undernourished patients became severely undernourished. No patient moved from the undernourished groups to the normal or overweight groups. All the patient groups showed a greater weight loss than weight gain except for the severely undernourished group. Weight loss was accompanied by corresponding changes in triceps skinfold thickness and mid-arm muscle circumference.

REFERRAL FOR NUTRITIONAL SUPPORT

Of the 55 undernourished patients reassessed on discharge, 10 had been referred for nutritional support (three for parenteral feeding and seven for enteral tube feeding). Seven of these patients gained weight compared with five of the 45 patients not referred for nutritional support ($P<0·001$), and only one of those referred lost weight compared with 36 of those not referred ($P<0·001$). The mean weight gain in the referred group was 7·9% (range 2·4-22·2%, $P<0·001$), while the mean weight loss in the group not referred was 7·2% (range 1·9-15·2%, $P<0·001$).

CASE NOTE REVIEW

Of the 200 patients undernourished on admission, 104 had no nutritional information in their case notes. At the outpatient visit preceding admission 31 patients had their height recorded and 47 had their weight documented. Comments relating to changes in appetite and weight were recorded for 11 and 20 of these patients respectively. Nutritional depletion was recorded in six cases, and referral for nutritional advice was documented in four cases. Eighteen of the undernourished patients with nutritional information in their case notes were elective admissions. These patients would be likely to have nutritional intervention at an earlier date, and three of them did receive nutritional advice when they were admitted to hospital. During admission, one patient's height was recorded, six patients' weight was recorded, 37 patients had weight change recorded, 35 patients had appetite change recorded, 13 patients had documented

evidence of depletion, and 10 patients had documented referral for nutritional advice.

Discussion

We identified the prevalence of malnutrition on admission to hospital in patients with a wide variety of disease states. The criteria we used to determine malnutrition were derived from previously published studies. Data on body mass index and mid-arm circumference were compared with data previously published for the population of the United Kingdom, and the nutritional status of the patients on admission to hospital was significantly poorer than that of the general population. The overall prevalence of undernutrition on admission to hospital was 40%.

Among the 112 patients who were reassessed on discharge, all of the nutritional status groups showed a greater weight loss than weight gain except for the severely undernourished group. The reason for this may be that this group was more likely to have been referred for nutritional support during admission. The greatest weight loss occurred in those patients who were already depleted on admission: 78% of them deteriorated nutritionally during hospitalisation. Of the undernourished patients who were reassessed, 18% had been referred for nutritional support. Seventy per cent of the patients who were referred gained weight, while 80% of the undernourished patients who were not referred for nutritional support lost weight.

We did not carry out a biochemical assessment of nutritional status because of a lack of a reliable biochemical marker of nutritional status. Albumin concentrations respond slowly to protein restriction and are more a reflection of the illness of a patient than of nutrient intake. Transferrin is more sensitive, having a shorter half life, but may be elevated during infection and stress and with concurrent iron deficiency. Thyroxin binding prealbumin and retinol binding protein both respond to nutritional intake but are also affected by disease process.

The limited amount of documented information relating to nutrition at outpatient visits and on admission to hospital highlights the continued problem of lack of awareness of nutrition. Awareness of the importance of nutritional status by general practitioners may afford intervention at an earlier stage and allow nutritional status to improve before admission to hospital.

Our study was carried out in an acute teaching hospital which has had an active nutrition advisory group since 1980. Facilities to determine and to deal with nutritional problems exist in most hospitals. Evaluation of nutritional status is important in determining patients who are at risk of developing nutrition related complications and for monitoring the efficacy of intervention. Methods of nutritional assessment need not be costly or time consuming. Anthropometric measurements are simple, cheap, and non-invasive, and technique improves with practice.

Techniques for the provision of artificial nutritional support are becoming increasingly sophisticated. However, there remains a need for improved recognition of malnutrition and an appreciation of the treatment of nutrition related complications. This suggests a need for improved undergraduate and postgraduate education about clinical nutrition.

Clinical implications

- High incidence of protein energy malnutrition in hospital patients was first shown more than 15 years ago
- Poor nutritional status adversely affects health and recovery from illness or injury
- In this study 40% of patients were undernourished on admission to hospital and two thirds of all patients lost weight during hospital stay
- Only a few patients were given nutritional support, but most of these showed improved nutritional status
- Continued lack of awareness of importance of clinical nutrition suggests need for education on this subject

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ONE HUNDRED YEARS AGO

THE SCIENTIFIC WOMAN OF TO-DAY.

There is a great change working in the French habit of thought. That unphilosophical sentence, "Cela n'entre pas dans nos habitudes," is falling into desuetude. Formerly it was a satisfactory sanction for continuing in a deplorable routine. This evolution is evident in many ways. The universal cry against the Napoleonic *régime* maintained in the French lycées, crushing out all spirit of intellectual and moral initiative; the enthusiastic adoption of antiseptic measures even to the extent of hairdressers washing combs and brushes with perchloride of mercury solution, disinfected omnibuses and railway stations and railway carriages, are all indications, without touching on politics, of a more independent form of thought, which will lead ere long to a well developed strongly rooted initiative such as forms the backbone of the Anglo-Saxon race. The tolerance, nay more, almost popularity, gained by the formerly ridiculed, if not despised, lady medical student is an interesting indication of the coming change. Mme. Stanisla Meunier, in her clever novel, *M. de Prévannes*, describes a lady American medical student. In her picturesque charming language she shows that a woman can study medicine and science and be as attractive, and even as well dressed, as the most successful drawing-room belle. This conception a few years ago could not have been arrived at, even in a novel. (*BMJ* 1894;i:1322.)