Undernutrition in hospital — causes and consequences

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Malnutrition refers to both undernutrition and obesity. Pharmacists should be aware of the high incidence of undernutrition in hospital patients and how they can contribute to detecting this problem. This article describes the relationship between undernutrition and medicines

Malnutrition is a common but frequently ignored problem in hospital patients. Symptoms of malnutrition may go unnoticed or may be mistaken for those of the patient's main illness. Furthermore, nutritional status is frequently unrecorded in the patient's medical notes. However, if a patient is malnourished and no attention is paid to nutritional intake, disease prognosis is likely to be poor, hospital stay lengthened and the patient may be less able to respond to surgical and medical procedures, including medication, thus increasing the risk of therapeutic failure and adverse effects.

In addition, hospital malnutrition costs the NHS a considerable sum of money. Of the total cost of treating malnutrition in the UK, which is in excess of £7.3 billion (and more than double the projected £3.5 billion cost of obesity), more than half arises from the treatment of malnourished patients in hospital (approximately £3.8 billion) and in long-term care facilities (approximately £2.6 billion).[1] The National Institute for Health and Clinical Excellence (NICE) and the National Collaborating Centre for Acute Care have produced a clinical guideline on treatment of malnutrition.[2] Although pharmacists are not usually involved in nutritional assessment, they should be aware of the high incidence of malnutrition in hospitals and of the contribution they can make to the detection and management of this important public health problem.

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What is malnutrition?

Malnutrition can be defined as a state of nutrition in which a deficiency or excess (or imbalance) of energy, protein, and other nutrients causes measurable adverse effects on tissue/body form and function, and clinical outcome. Malnutrition therefore refers to both obesity and undernutrition. This article focuses on undernutrition.

Practically, undernutrition is defined by a body mass index (BMI) of less than 18.5 (kg/m^2); unintentional weight loss greater than 10 per cent within the previous three to six months; or a BMI of less than 20 and unintentional weight loss greater than 5 per cent within the previous three to six months.[2]

Undernutrition in hospital

Undernutrition is a significant public health problem in both hospitals and the community. In terms of absolute numbers of patients, most undernutrition exists in the community, but the incidence is greater in hospital and nursing homes. In addition, the passage of patients through hospitals is considerable. Although only about 0.4 per cent of the UK population is in hospital at any one time, about 12 million people are admitted to hospitals in England each year, including day cases.

Studies investigating the incidence of undernutrition in patients in hospital have reported widely variable results (see Panel 1, p354). A pioneer study published in the US in 1974 found a 50 per cent incidence of malnutrition in surgical patients.[25] Two years later, the same author detected a 44 per cent malnutrition rate in both surgical and medical patients.[26] A year after that, a British study reported a 50 per cent incidence of malnutrition in surgical patients.[21] Since these early publications, a large number of clinical studies conducted in several countries have shown that the risk of undernutrition in patients in hospital ranges from 6 to 55 per cent, depending on the country, the hospital sector and the measures of undernutrition used in the study.

When BMI is used as an indicator of nutritional status, the prevalence of undernutrition in adult patients admitted to UK hospitals has been found to be between 10 and 40 per cent (undernutrition was defined in this study as BMI < 20).[22] However, use of BMI alone will lead to underestimates of undernutrition because many people who have unintentionally lost more than 10 per cent of their body weight in the preceding six months will be at risk of undernutrition even though their BMI may remain above 20. Furthermore, most undernourished patients admitted to hospital lose more weight during their stay,[22] and are at risk of worsening nutritional status.[14,19,31] They are therefore discharged back into the community in a worse nutritional state than when they were admitted.

Causes of undernutrition

Undernutrition has many causes, which are related to both physical issues and psychosocial issues such as poverty, education, social isolation etc. The main causes of undernutrition can be classified as follows:

Impaired intake Impaired intake can be caused by poor appetite, illness, pain or nausea when eating, medication, dysphagia, depression, confusion, weakness, arthritis in the hands or arms, painful mouth, poor dentition, surgery to the head, jaw or neck, lack of food, poverty, homelessness, alcohol abuse, idiosyncratic diets, inability or lack of motivation to shop and cook, poor quality diet or poor food presentation at home, in care homes or hospital.

Impaired digestion or absorption Impaired digestion and/or absorption can be caused by medical or surgical problems affecting the stomach, intestine, liver or pancreas.

Increased nutrient requirements Illness, surgery, treatment and organ dysfunction can all increase nutritional demands.

Excess nutritional losses Vomiting, diarrhoea, fistulae, stomas, skin exudates from burns and losses from nasogastric tubes and other drains can lead to excessive nutritional losses.

Undernutrition and disease

Almost any moderate or severe chronic disease or recovery from a severe acute disease increases the risk of undernutrition. Older people and those on multiple medicines or requiring prolonged hospital stay are at particular risk. Any condition causing muscle weakness (respiratory or peripheral), pain, poor co-ordination, gastrointestinal symptoms, chewing or swallowing problems and impaired appetite, taste, sight or smell can have deleterious consequences for nutrition.

Examples of diseases where undernutrition can occur include:

- Cancer
- Stroke
- Chronic neurological disease (eg, motor neurone disease, multiple sclerosis, Parkinson's disease)
- Chronic gastrointestinal disease (eg, Crohn's disease, ulcerative colitis)
- Chronic obstructive pulmonary disease
- AIDS
- Dementia
- Severe chronic arthritis
- Anorexia nervosa and bulimia nervosa

Undernutrition can also occur in pre- and post-operative patients.

Panel 1: Prevalence of undernutrition in patients in hospital

Country/region	Number of patients	Number of hospitals/ department/ward	Percentage of patients malnourished
Argentina[3]	1,000	38 hospitals	47
Australia[4]	84	Surgical	14
Australia[5]	819	Two hospitals	36
Brazil[6]	4,000	Multi-centre	48
Cuba[7]	1,905	Two hospitals	41
Denmark[8]	750	Three hospitals	22
France[9]	324	Medical	30 (men) 41 (women)
Germany[10]	803	Multiple departments	22
Iran[11]	156	Nine wards	6
Latin America[12]	9,348	Multi-centre	50
Lebanon[13]	100	Surgery	53
Netherlands[14]	155	Medical	45
New Zealand[15]	—	Hip fracture patients	42
Norway[16]	244	Surgery	39
Poland[17]	3,310	12 hospitals	10
Singapore[18]	307	Surgery	49
Spain[19]	201	Stroke patients	31
Spain[20]	Inpatient population	Tertiary care	13
UK[21]	105	Surgical	50
UK[22]	500	Multiple departments	40
UK[23]	850	Multiple departments	20
UK[24]	219	Medical, surgical	13
US[25]	131	Surgery	50
US[26]	251	General medicine	44
US[27]	134	General medicine	48
US[28]	288	General medicine	38
US[29]	Inpatient population	Tertiary care	25 (acute) 27 (chronic)
US[30]	837	Sub-acute care centre	29

Medicines

The use of medicines, particularly when three or more drugs are used, usually indicates the presence of severe disease or multiple physical and psychosocial problems and, for those reasons among others, is associated with an increased risk of undernutrition.

More specifically, medication can increase the risk of undernutrition by:

- Reducing appetite (eg, amantadine, digoxin, fluoxetine, levodopa, lithium, metformin, penicillamine)
- Changing taste (eg, ACE inhibitors, allopurinol, amiodarone)
- Suppressing saliva production and causing dry mouth (eg, antihistamines, tricyclics, benzatropine, orphenadrine, oxybutinin, procyclidine, propantheline, trihexyphenidyl hydrochloride, selegeline)
- Causing confusion and/or depression. Any drug with a sedative effect could increase the possibility of reduced food consumption.
- Causing gastrointestinal adverse effects such as those listed in Panel 2 (p357).

Use of medicines is also associated with reduction in the bioavailability of specific nutrients. Anti-epileptic therapy is associated with reduced folic acid and raised homocysteine levels, and also with an increased risk of fracture, for which calcium and vitamin D supplementation should be considered. Proton pump inhibitors and H_2-receptor antagonists may reduce vitamin B_{12} absorption. However, this effect has been seen mainly in patients taking these medicines for prolonged periods (eg, for more than four years). Colchicine and metformin are also associated with reduced bioavailability of vitamin B_{12}. Probably the most well known examples of drugs reducing nutrient absorption are tetracyclines, quinolones and penicillamine which form insoluble complexes with minerals and trace elements, and liquid paraffin, which can reduce the absorption of fat-soluble vitamins.

Consequences

Undernutrition can manifest itself in a variety of ways and affects every system in the body, producing adverse effects on physical and social well-being, including the following:[2]

- Impaired immune response, predisposing to infection and delayed recovery when infection occurs.
- Impaired wound healing, which can lead to prolonged recovery from illness and increased length of hospital stay.
- Reduced muscle strength and fatigue, contributing to inactivity, inability to work, poor self-care and predisposition to falls.
- Reduced respiratory muscle strength, predisposing to delayed recovery from chest infections and difficulty in coming off a ventilator.
- Inactivity, particularly in bed bound patients, leading to pressure sores and thromboembolism.
- Impaired thermoregulation, leading to hypothermia, particularly in older people.
- Menstrual irregularities, with the potential for infertility and osteoporosis.
- Vitamin and mineral deficiencies (eg, scurvy, B vitamin deficiencies in alcoholism, iron deficiency anaemia, trace element deficiencies).
- Water and electrolyte disturbances, such as potassium, phosphate and magnesium depletion and overload in sodium and water.
- Psychosocial effects, including apathy, depression, self-neglect, lack of interest in food, poor motivation for compliance with therapy.

Nutritional assessment

In hospital, it would not normally be the role of a pharmacist to perform a nutritional assessment. However, it is important to be aware that undernutrition is often unrecognised and not treated in hospital and other care settings. The pharmacist's role in the detection of undernutrition is outlined in Panel 3. A study in Glasgow[24] found that 70 per cent of patients admitted to hospital were not recognised as having protein energy malnutrition, while a US hospital study[32] showed that malnutrition went unrecognised in 62 per cent of patients. Studies of hospital outpatients suggest that 45–100 per cent of cases of undernutrition go undetected.[33]

Panel 3: The pharmacist's role in detecting undernutrition

- Consider the possibility of undernutrition when conducting medication reviews at any point in the patient's health care journey
- Consider the possibility of the patient's medication as a risk factor for undernutrition
- Consider the possibility of undernutrition as a risk factor for adverse drug reactions
- Ask questions about the patient's pre-admission eating habits, appetite, problems around preparing and eating food, social isolation, changes in the fitting of clothes, recent unintentional weight loss.
- Check the patient's notes to see if nutritional status is being assessed and documented
- Check (on ward visits) whether the patient is eating during the hospital stay

Panel 4: Nutritional factors that influence cytochrome P activity[35–37]

Nutritional factor	Species	Tissue	CYP activity
Energy restriction	Rat	Liver	↑CYP3A4
Protein deficiency	Human	Whole body	↑CYP1A2
Protein and calorie restriction	Rat	Liver	↓CYP1A2
			↓CYP2A1
			↓CYP2C11
			↓CYP2E1
			↓CYP3A1/A2
Starvation	Rat	Liver	↓CYP1A
			↓CYP2C11
			↑CYP2B
			↑CYP 2E1
			↑CYP3A
Iron deficiency	Rat	Intestine	↓Total CYP
Thiamine deficiency	Rat	Liver	↑CYP2E1
Vitamin A deficiency	Rat	Liver	↓CYP2C1
Vitamin C deficiency	Guinea pig	Liver	↓CYP1A2

Failure to recognise malnutrition occurs because of general lack of awareness of this issue, arising from lack of training of health professionals in nutrition. While health professionals may understand the nutritional implications of conditions such as diabetes mellitus, cardiovascular disease and obesity, the most fundamental nutritional disorder, ie, undernutrition, is often overlooked. The symptoms of malnutrition are often mistaken for those of the disease itself, resulting in a negative impact on the patient's condition, which in turn worsens the malnutrition. Little attention may also be paid to the fact that, when ill, patients' nutritional requirements are likely to increase because of the illness, metabolic changes or the treatment.

Early detection of nutritional risk is the best way of diagnosing malnutrition. Various screening tools are available for this purpose, including the Malnutrition Universal Screening Tool (MUST),[34] which can be used to screen both undernutrition and obesity.

The NICE guideline on treatment of malnutrition recommends that all hospital inpatients on admission and all outpatients on their first clinic appointment should be screened (weighed, measured and BMI calculated). Screening should be conducted weekly for inpatients and when there is clinical concern for outpatients.[2]

Panel 2: Gastrointestinal adverse effects

The following gastrointestinal adverse effects, which can be caused by the medicines indicated, increase the risk of undernutrition.

- Oesophagitis and oesophageal obstruction (can be caused by doxycycline, ferrous sulphate, modified release potassium chloride, tetracycline and slow-release formulations of other drugs
- Pancreatitis (azathioprine, oestrogens, furosemide, opiates or valproate)
- Dyspepsia, bleeding and ulceration (non-steroidal anti-inflammatory drugs)
- Pseudomembranous colitis (antibiotics)
- Diarrhoea (magnesium salts)
- Nausea and vomiting (chemotherapy)
- Constipation (anticholinergics)

Management

Management of undernutrition involves tackling the underlying causes. Nutrition support should be considered for any patient unable to consume enough food and fluid to meet their requirements. Oral options include dietary counselling to facilitate the addition of ingredients high in energy and/or protein, adopting a pattern of three meals a day with snacks in between, the inclusion of nourishing fluids, and the use of proprietary oral supplements. If oral intake is limited,

enteral tube feeding or parenteral nutrition may be required (see p362). Detailed guidance on the appropriate use of nutritional support is covered in the NICE guideline.[2]

Altered drug handling

Malnutrition is associated with variable but potentially important effects on the bioavailability, binding, metabolism and renal clearance of drugs. It is important to note that much of the research in this area to date has been conducted either in animals, or in children with protein energy malnutrition (PEM) in developing countries. Although this research cannot readily be translated to the UK hospital situation, pharmacists should be aware that differences in drug response could occur in malnourished patients in the UK.

Restriction of protein and energy and vitamin and mineral deficiencies can influence the activity of the cytochrome-P (CYP) enzymes in the liver and other tissues (see Panel 4, p357). Effects on other hepatic drug metabolising enzymes have also been noted.[35] As a result of these effects, drug metabolism and disposition can be altered.

Severe malnutrition may lead to lower plasma protein concentrations. For highly plasma protein bound drugs this can increase the amount of free drug able to exert its therapeutic effects and its adverse effects. Reduction in adipose tissue can lead to increased plasma concentrations of fat-soluble drugs. Glomerular filtration rate may also be reduced in severely malnourished individuals, potentially increasing plasma concentrations of parent drug or active metabolites. Half-lives of drugs, including sulphonamides, chloramphenicol, isoniazid, penicillin G and metronidazole have been shown to be longer in malnourished than in healthy children. Studies in rats with PEM have shown that clearance of methotrexate, 5-fluouracil and paracetamol is reduced while clearance of salicylates is increased with variable effects for other drugs, including diuretics and antibiotics.

References

1. Elia M, Stratton R, Russell C, Green C, Pan F. The cost of disease-related malnutrition in the UK and economic considerations for the use of oral nutritional supplements (ONS) in adults. British Association for Parenteral and Enteral Nutrition, 2005.
2. National Collaborating Centre for Acute Care. Nutrition support for adults. Oral nutrition support, enteral tube feeding and parenteral nutrition. Commissioned by the National Institute for Health and Clinical Excellence. http://www.nice.org.uk. Accessed 3/10/06. 2006.
3. Wyszynski DF, Perman M, Crivelli A. Prevalence of hospital malnutrition in Argentina: preliminary results of a population-based study. Nutrition 2003;19:115–9.
4. Zador DA, Truswell AS. Nutritional status on admission to a general surgical ward in a Sydney hospital. Australian and New Zealand journal of medicine 1987;17:234–40.
5. Middleton MH, Nazarenko G, Nivison-Smith I, Smerdely P. Prevalence of malnutrition and 12-month incidence of mortality in two Sydney teaching hospitals. Internal Medicine Journal 2001;31:455–61.
6. Waitzberg DL, Caiaffa WT, Correia MI. Hospital malnutrition: the Brazilian national survey (IBRANUTRI): a study of 4000 patients. Nutrition 2001;17:573–80.
7. Barreto Penie J. State of malnutrition in Cuban hospitals. Nutrition 2005;21:487–97.
8. Kondrup J, Johansen N, Plum LM, Bak L, Larsen IH, Martinsen A, et al. Incidence of nutritional risk and causes of inadequate nutritional care in hospitals. Clinical Nutrition 2002;21:461–8.
9. Constans T, Bacq Y, Brechot JF, Guilmot JL, Choutet P, Lamisse F. Protein-energy malnutrition in elderly medical patients. Journal of the American Geriatrics Society 1992;40:263–8.
10. Pirlich M, Schutz T, Kemps M, Luhman N, Burmester GR, Baumann G, et al. Prevalence of malnutrition in hospitalized medical patients: impact of underlying disease. Digestive Diseases 2003;21:245–51.
11. Hosseini S, Amirkalali B, Nayebi N, Heshmat R, Larijani B. Nutrition status of patients during hospitalization, Tehran, Iran. Nutrition in Clinical Practice 2006;21:518–21.
12. Correia MI, Campos AC. Prevalence of hospital malnutrition in Latin America: the multicenter ELAN study. Nutrition 2003;19:823–5.
13. Aoun JP, Baroudi J, Geahchan N. Prevalence of malnutrition in general surgical patients. Le Journal Médical Libanais 1993;41:57–61.
14. Naber TH, Schermer T, de Bree A, Nusteling K, Eggink L, Kruimel JW, et al. Prevalence of malnutrition in nonsurgical hospitalized patients and its association with disease complications. American Journal of Clinical Nutrition 1997;66:1232–9.
15. Hanger HC, Smart EJ, Merrilees MJ, Framptom CM. The prevalence of malnutrition in elderly hip fracture patients. New Zealand Medical Journal 1999;112:88–90.
16. Bruun LI, Bosaeus I, Bergstad I, Nygaard K. Prevalence of malnutrition in surgical patients: evaluation of nutritional support and documentation. Clinical Nutrition 1999;18:141–7.
17. Dzieniszewski J, Jarosz M, Szczygiel B, Dlugosz J, Marlicz K, Linke K, et al. Nutritional status of patients hospitalised in Poland. European Journal of Clinical Nutrition 2005;59:552–60.
18. Tan YS, Nambiar R, Yo SL. Prevalence of protein calorie malnutrition in general surgical patients. Annals of the Academy of Medicine, Singapore1992;21:334–8.
19. Gariballa SE, Parker SG, Taub N, Castleden M. Nutritional status of hospitalized acute stroke patients. British Journal of Nutrition 1998;79:481–7.
20. Perez de la Cruz A, Lobo Tamer G, Orduna Espinosa R, Mellado Pastor C, Aguayo de Hoyos E, Ruiz Lopez MD. [Malnutrition in hospitalized patients: prevalence and economic impact]. Medicina Clínica 2004;123:201–6.
21. Hill GL, Blackett RL, Pickford I, Burkinshaw L, Young GA, Warren JV, et al. Malnutrition in surgical patients. An unrecognised problem. Lancet 1977;1:689–92.
22. McWhirter JP, Pennington CR. Incidence and recognition of malnutrition in hospital. BMJ 1994;308:945–8.
23. Edington J, Boorman J, Durrant ER, Perkins A, Giffin CV, James R, et al. Prevalence of malnutrition on admission to four hospitals in England. The Malnutrition Prevalence Group. Clinical Nutrition 2000;19:191–5.
24. Kelly IE, Tessier S, Cahill A, Morris SE, Crumley A, McLaughlin D, et al. Still hungry in hospital: identifying malnutrition in acute hospital admissions. QJM 2000;93:93–8.
25. Bistrian BR, Blackburn GL, Hallowell E, Heddle R. Protein status of general surgical patients. JAMA 1974;230:858–60.
26. Bistrian BR, Blackburn GL, Vitale J, Cochran D, Naylor J. Prevalence of malnutrition in general medical patients. JAMA 1976;235:1567–70.
27. Weinsier RL, Hunker EM, Krumdieck CL, Butterworth CE, Jr. Hospital malnutrition. A prospective evaluation of general medical patients during the course of hospitalization. American Journal of Clinical Nutrition 1979;32:418–26.
28. Coats KG, Morgan SL, Bartolucci AA, Weinsier RL. Hospital-associated malnutrition: a reevaluation 12 years later. Journal of the American Dietetic Association. 1993;93:27–33.
29. Hendricks KM, Duggan C, Gallagher L, Carlin AC, Richardson DS, Collier SB, et al. Malnutrition in hospitalized pediatric patients. Current prevalence. Archives of Pediatrics and Adolescent Medicine 1995;149:1118–22.
30. Thomas DR, Zdrowski CD, Wilson MM, Conright KC, Lewis C, Tariq S, et al. Malnutrition in subacute care. American Journal of Clinical Nutrition 2002;75:308–13.
31. Aznarte Padial P, Pareja Rodriguez de Vera A, de la Rubia Nieto A, Lopez Soriano F, Martinez de Guzman M. [Impact of hospitalization on patients with nutrition status evaluation at admission]. Nutrición Hospitalaria 2001;16(1):14–8.
32. Mowe M, Bohmer T. The prevalence of undiagnosed protein-calorie undernutrition in a population of hospitalized elderly patients. Journal of the American Geriatrics Society 1991;39:1089–92.
33. Miller DK, Morley JE, Rubenstein LZ, Pietruszka FM, Strome LS. Formal geriatric assessment instruments and the care of older general medical outpatients. Journal of the American Geriatrics Society 1990;38:645–51.
34. Elia M. The 'MUST' report: nutritional screening of adults: a multidisciplinary responsibility. Development and use of the Manutrition Universal Screening Tool ('MUST') for adults. A report by the Malnutrition Advisory Group of the British Association for Parenteral and Enteral Nutrition. Redditch: British Association for Parenteral and Enteral Nutrition (BAPEN), 2003.
35. Lee JH, Suh OK, Lee MG. Pharmacokinetic changes in drugs during protein-calorie malnutrition: correlation between drug metabolism and hepatic microsomal cytochrome P450 isozymes. Archives of Pharmacal Research 2004;27:693–712.
36. Guengerich FP. Influence of nutrients and other dietary materials on cytochrome P-450 enzymes. American Journal of Clinical Nutrition 1995;61:651S-658S.
37. Loannides C. Effect of diet and nutrition on the expression of cytochromes P450. Xenobiotica 1999;29:109-54.