The Economics of Malnutrition

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Abstract

Despite extensive information on the adverse physical and psychological consequences of malnutrition, there is little information on its economic consequences. International studies suggest that disease-related malnutrition increases hospital costs by 30–70%. In the United Kingdom the Malnutrition Universal Screening Tool (MUST) was used as the basis for identifying the prevalence of malnutrition in various care settings. Malnutrition increased both the frequency of admissions and length of stay in hospitals, as well as the frequency of visits to a general practitioner and hospital outpatient visits, and residency in care homes. After assigning nationally representative costs to the utilization of these services, the public expenditure on disease-related malnutrition in the UK in 2003 was estimated to be more than GBP 7.3 billion. The large cost of disease-related malnutrition means that small fractional cost savings from intervention can result in substantial absolute cost savings. A summary of nutritional intervention studies with cost analyses (including meta-analyses) and cost-effectiveness analyses are presented, and some of the clinical and ethical implications discussed.

Introduction

Despite extensive information on the prevalence of malnutrition and its clinical and public health consequences, there is comparatively little information on its economic consequences [1]. One of the reasons for this is the difficulty in equating the adverse consequences of malnutrition with monetary values. These values can vary widely according to disease status, socioeconomic status, life expectancy, and the cultural background of the individuals making judgments. They also depend on whether the individual is a patient, a health professional, or a healthy member of the general public. Another problem is that there are different types of economic analyses which may
be confused with each other or poorly understood. Therefore, most studies on malnutrition have not incorporated a formal economic analysis into their study design, and although some retrospective analyses can be undertaken, this is far from ideal. In addition, as malnutrition often coexists with disease, separating their independent effects can be difficult, especially as each can predispose to the other. For this reason the costs of malnutrition and associated disease (disease-related malnutrition) have usually been considered together. The section that follows discusses the cost of disease-related malnutrition, but as this does not reflect the extent to which interventions can result in cost savings, the value of other types of economic evaluations are also briefly considered.

**Estimating the Cost of Disease-Related Malnutrition**

There is virtually no information about the national cost of malnutrition in developed countries. However, the cost might be expected to be substantial because malnutrition predisposes to disease, delays recovery from illness, and increases use of healthcare resources [2]. Some insights into the magnitude of such costs can be obtained from cross-sectional cost analyses of malnutrition in both the hospital and community.

In a study involving two acute hospitals in Pennsylvania, USA, a retrospective review was undertaken of 771 patient charts to assess hospital costs and the likelihood of malnutrition on admission [3]. Those at risk of malnutrition (assessed using objective or subjective criteria) incurred greater costs than those without malnutrition (USD 5,519 vs. 3,372/patient; pre-1988 prices; 67% greater costs and 46% greater charges). A more recent prospective study in Ohio, USA [4], reported that individuals classified as being at risk of malnutrition (56 of 172 patients; assessed using weight status, weight loss or hypoalbuminemia as criteria) had significantly higher hospital costs than those not at risk (USD 6,196 vs. 4,563/patient; pre-1998 prices; 36% greater costs). The at-risk patients were also more likely to use home healthcare services. In yet another study in the USA (Illinois) [5], patients who stayed in hospital for more than 7 days and declined nutritionally (assessed using subjective global assessment) had significantly higher hospital charges compared to those who remained normally nourished (USD 45,762 vs. 28,631/patient; pre-2000 prices; 62% greater charges). A review from the USA suggested that hospital costs for undernourished patients were generally 35–75% greater than for well-nourished patients [6]. A broad estimate of annual hospital costs in the USA incurred by malnourished patients (based on costs of USD 5,000/malnourished patient), was USD 18 billion (pre-1993 prices) [7].

The increased hospital costs associated with disease-related malnutrition have also been reported in European [2, 8–10] and other countries, including
Brazil [11]. For example, in a UK hospital the cost of disease-related malnutrition, identified with the Malnutrition Universal Screening Tool (MUST), was found to be 40% higher in patients with medium plus high risk of disease-related malnutrition compared to low risk patients (p < 0.001, n = 857). However, this extra cost varied from 11% in surgical wards, 36% geriatric wards, 44% orthopedic wards and 71% in medical wards [10]. In Brazil [11], a survey was undertaken in 709 patients randomly selected from 25 hospitals using subjective global assessment to categorize patients into malnutrition risk. The hospitals were part of a larger hospital survey of hospital malnutrition, which was carried out in 1996. The malnourished patients had a mean daily expenditure of USD 228/patient compared to USD 138/patient in the well-nourished, an increase of 65%. No estimates were made of community costs.

Some insights into community costs can be obtained from a retrospective analysis of the 1987 National Medical Expenditure Survey (Household Survey) in the USA [12]. There was a progressive increase in the annual healthcare expenditure in men from USD 1,300 in those with a body mass index (BMI) of 21 to USD 3,250 in those with a BMI of 15 (2003 prices) [12]. Expenditure below a BMI of ~18.5 was greater than for obese men (e.g. only USD 1,700 in those with a BMI of 39). The increased cost for underweight women was less pronounced than that for men, and at a BMI of 15, it was lower than at a BMI of 39. This analysis did not take into consideration recent weight loss or the magnitude of weight loss, which may also indicate malnutrition or risk of developing malnutrition. In addition, the study could not estimate the total

\[\text{Fig. 1.} \] The estimated annual cost and incremental cost (public cost only) of disease-related malnutrition in the UK in 2003. The incremental cost is the additional cost of treating patients with malnutrition compared to treating the same number of patients without malnutrition (low risk of malnutrition according to MUST). The arrows at the top of the bars indicate that the costs represent minimum values as they do not include all services. Based on Elia et al. [8].
community cost of malnutrition because it did not include subjects older than 65 years which account for a major proportion of total national expenditure on health.

It seems that the information on the cost of disease-related malnutrition is patchy, collected in various countries at different times, and sometimes based on rudimentary calculations that involve different criteria for identifying malnutrition. This makes it difficult to establish a single accurate national estimate of the total expenditure on disease-related malnutrition arising from various care settings at a point in time. However, an attempt to do this has recently been made in the UK using consistent criteria for detecting malnutrition across care settings [8].

**Estimating the Cost of Disease-Related Malnutrition in the UK**

In 2001, a paper briefly reported that the cost of disease-related malnutrition in the UK was as high GBP 15–20 billion/year [13], corresponding to 20–27% of the total expenditure on health (a total of GBP 74,883 billion in the same year according to the Organisation of Economic Co-operation and Development (OECD) [14]). Unfortunately, the estimated cost of disease-related malnutrition was very informal, with no information as to the basis of the calculations.

A more formal analysis of the cost of disease-related malnutrition in the UK (2003 prices) was undertaken by the Health Economic Group of the British Association for Parenteral and Enteral Nutrition [8]. It brought together information on the prevalence of malnutrition in the hospital and community in people above and below 65 years (e.g. in their own homes and different types of residential accommodation), and the rate of utilization and cost of healthcare resources. Each of these is discussed below, but special attention is given to malnutrition in older individuals in the community. This is not only because little information is available in this age group and setting, but also because it illustrates important health inequalities, which are relevant to economic models of care and social justice.

*The Prevalence of Malnutrition in the Community (Outside Hospital)*

The prevalence of malnutrition was established using MUST [15] or MUST-type criteria, which were applied to secondary analysis of a National Diet and Nutrition Survey [16] and studies involving various hospital wards and alternative care settings.

The overall prevalence of malnutrition in the community in the UK (medium and high risk according to MUST-type criteria) increased with age, so that in those aged 65 years and over it exceeded 10%. This result reflects the overall combined prevalence of malnutrition among a representative sample of people living in their own homes and in residential accom-
modation in the UK. The prevalence in those aged 65 years and over was as high as 19.4% in northern England compared to 12.3% in central England and 11.3% in southern England (p < 0.001). These differences are mirrored by a north–south divide in the prevalence of vitamin C deficiency, and differences in circulating vitamin C, carotenoids and vitamin D concentrations [17]. Such inequalities in malnutrition are linked to a cluster of other inequalities, including inequalities in educational and economic status, which can only explain part of the geographic differences in the prevalence of malnutrition.

A separate study using MUST examined inequalities in malnutrition within the same geographic area [18]. One thousand subjects admitted to hospital were assigned a multiple deprivation index based on national criteria that were applied to the local community wards in which the patients lived. Those with malnutrition (medium and high risk using MUST) had more deprivation than those without malnutrition (low risk), after adjusting for age and sex. In addition, those who were more deprived and more malnourished were more likely to die in hospital. The economic implications of these inequalities are briefly discussed below, after consideration of the national expenditure on disease-related malnutrition.

Cost of Services

In the health economic report on malnutrition [8], the rate of utilization of healthcare services was established and their costs estimated using information from the Department of Health (www.dh.gov.uk) and Netten and Curtis [19]. It was found that many services were utilized more frequently by malnourished than non-malnourished individuals. For example individuals aged 65 years and over had 82% more hospital admissions (0.503 vs. 0.276/year), with about 30% longer length of stay per admission, 65% more GP visits to a general practitioner (GP; 7.096 vs. 4.307/person and year), and 33% more hospital outpatient visits (1.355 vs. 1.019/person and year). They also had more admissions to care homes.

Estimated Public Health Expenditure on Health

The estimated public health expenditure on disease-related malnutrition in the UK was estimated to be at least GBP 7.3 billion in 2003, of which about half was due to hospital care and the other half to community care, predominantly for older individuals. In the community, the costs were mainly due to long-term care (~GBP 2.6 billion) and GP visits (>GBP 0.5; probably GBP 0.5–1 billion). The annual expenditure on artificial nutrition and oral nutritional supplements in the community was only about GBP 0.15 billion, and in the hospital setting it was even less (GBP 0.054 billion; table 1). Five points can be made about these findings.

First, the overall expenditure on disease-related malnutrition is large. In 2003, the OECD estimated that the total expenditure on health in the UK
was GBP 87.647 billion, of which GBP 74.872 billion was public expenditure, and GBP 12.775 billion private expenditure [14]. This means that public expenditure on disease-related malnutrition (>GBP 7.3 billion) accounted for about 10% or more of the total expenditure on health. Since the public expenditure on health in 2003 was 6.8% of the gross domestic product (GDP; ~GBP 1,257/capita), malnutrition accounted for more than 0.68% of the GDP.

Second, the public health expenditure on malnutrition appears to exceed that on obesity, which was estimated to be GBP 3.4–3.7 billion/year by a House of Commons Health Committee (2002 prices) [20]. The cost of malnutrition was similar to the combined cost of obesity and overweight, which was estimated to be GBP 6.6–7.4 billion/year by the same House of Commons Health Committee. The media seem to focus more on overweight/obesity than malnutrition. However, both are important, both have large economic implications, and both deserve appropriate preventive and therapeutic measures. It is perhaps surprising that only 0.5–5.9% of the total expenditure on health was estimated to be on prevention and public health in 18 OECD countries in 2005 [14].

Third, a disproportionately large fraction of the expenditure on disease-related malnutrition in both the hospital and community involves older people. Thus, well over half of the public expenditure on disease-related malnutrition involves people aged 65 years and over (mainly for hospital and long-term care), who account for only about 15% of the general population. This expenditure may increase in the future, as the older population represents one of the fastest growing segments of the general population. The United Nations estimated that in the more developed regions of the world the proportion of people aged 65 years and over will have increased from 14% in 2000 to 21% in 2025.

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**Table 1.** The estimated annual cost of parenteral nutrition, enteral tube feeding and oral nutritional supplements in hospital and the community in the UK in 2003

<table>
<thead>
<tr>
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<th>Hospital GBP millions/year</th>
<th>Community GBP millions/year</th>
<th>Total GBP millions/year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Parenteral nutrition</td>
<td>47.5</td>
<td>17.6</td>
<td>65.1</td>
</tr>
<tr>
<td>Enteral tube feeding</td>
<td>3.2</td>
<td>66.4</td>
<td>69.1</td>
</tr>
<tr>
<td>Oral nutritional</td>
<td>2.8</td>
<td>65.3</td>
<td>68.1</td>
</tr>
<tr>
<td>supplements</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Total</td>
<td>53.5</td>
<td>149.3</td>
<td>202.8</td>
</tr>
</tbody>
</table>

Based on Elia et al. [8].

1 The commonest indication for home enteral tube feeding (own homes + care homes) is cerebrovascular accident, accounting for about a third of the total point prevalence.

2 These supplements only refer to those containing a mixture of macronutrients and micronutrients.
Fourth, one of the general aims of guidelines targeted at healthcare workers [21–23] is to improve health inequities by promoting a better, more uniform approach to treatment. However, since most healthcare workers typically only deal with individuals that access the healthcare system, this approach does not address many of the underlying causes of health inequalities, some of which lie outside the healthcare sector. A different approach is required to deal with individuals who do not access healthcare services, or who access them late, so that their malnutrition becomes more severe. One approach to this problem is to increase awareness amongst patients and the public, and direct this awareness into practical pathways of prevention and care. Such recommendations were the focus of a recent report on malnutrition in older people in the community, which was launched in the House of Commons (UK) in 2006 by a group of non-governmental organizations [24]. However, improvement in health among poorer [25], less privileged people may cost more than improvement of the same amount of health in more educated and more privileged individuals. There are many reasons for health inequities, including better compliance to treatment and better access and use of healthcare services by the more privileged and educated individuals. What is the most appropriate balance between the efficiency of a healthcare system on the one hand, and equity and fairness on the other? When there is a conflict between the two, to what extent should health inequalities be sacrificed at the expense of efficiency [26]? What exactly is equity and fairness? More detailed discussions on the ethics and philosophy of issues concerning health inequalities/inequities can be found elsewhere [25, 27–29].

Fifth, one of the limitations of simply estimating the cost of disease-related malnutrition is that it does not reflect cost savings associated with interventions, which are of particular interest to managers and health planners. Since the overall cost of disease-related malnutrition is large, a small fractional cost saving will result in a large absolute cost saving, e.g. a 1% cost saving from the annual expenditure on malnutrition in the UK corresponds to >GBP 73 million. Intervention studies of oral nutritional supplementation in hospital have shown that they can save up to 10% or more of the total cost of care [8], depending on the type of patient, as well as the type and duration of the intervention. Specific examples of nutritional interventions are considered next to illustrate the advantages and limitations of different types of economic evaluations, and how they can be used together with cross-sectional evaluations in order to inform policy.

**Economic Evaluations of Nutritional Interventions**

*Cost Analyses*

Some examples of cost-analyses involving randomized controlled trials of nutritional support are enumerated below:
Hospital

(1) An analysis of 7 randomized controlled trials comparing the effects of oral nutritional supplements vs. routine care in hospital (1 surgery, 1 elderly, 1 stroke, 1 fracture neck of femur and 4 abdominal surgery patients) revealed a cost saving of GBP 320–5,040/patient in favor of supplementation, which was associated with a reduction in length of hospital stay [9].

(2) An analysis of 7 randomized controlled trials and 1 cross-over trial based on length of stay costs in patients undergoing abdominal and orthopedic surgery (oral nutritional supplements, ONS, vs. no ONS) [8] revealed a consistent net cost saving in favor of supplementation (mean of GBP 1,166/patient; GBP 966 for the lower quartile and GBP 1,368 for the upper quartile). A separate economic model based on complication costs using specific unit costs provided by the Department of Health of England for 2003, also revealed significant cost savings in favor of supplementation (average cost saving of GBP 321/patient; GBP 392/patient for the upper quartile and GBP 233/patient for the lower quartile).

(3) A meta-analysis of 6 studies of patients undergoing abdominal surgery (n = 418 subjects; ONS vs. no ONS) showed a significant net cost saving in favor of supplementation [8]. When only the 5 studies carried out in the UK were considered in the meta-analysis (n = 358 subjects), the results remained significant [8].

(4) A meta-analysis of enteral nutritional support prevented the development of pressure ulcers [30], which translated into significant economic benefits [31].

(5) Cost analyses are also reported in studies of patients receiving ‘immunonutrition’ perioperatively (a feed containing n-3 fatty acids, RNA and arginine; Impact, Sandoz) [32–34], with overall results in favor of ‘immunonutrition’.

Community

(1) Three studies involving preoperative supplementation for about 2 weeks before admission to hospital for surgery were associated with a significant net cost saving in favor of supplementation (GBP 688/patient; p = 0.008; lower quartile GBP 497/patient, upper quartile GBP 828/patient) [8].

(2) A longer term randomized controlled trial involving oral nutritional supplementation or no supplementation of malnourished patients discharged from hospital prospectively examined the costs of hospital admissions, prescriptions, and both GP and hospital outpatient visits. No overall economic benefits were found during 6 months of supplementation in this mixed group of patients [35]. However, the largest expenditure in both groups was on hospital admissions, which accounted for over 70% of the total expenditure.

Cross-sectional studies in the UK indicate that although less than about 3% of malnutrition is found in hospital, about half the estimated expenditure on malnutrition involves hospital care. Interventions that reduce this large
expenditure would obviously be welcomed. However, potential conflicts could arise when there are separate funding streams for community and hospital care. For example oral supplements prescribed in the community add to the costs there, but may reduce hospital admissions and hospital costs [8].

**Cost-Effectiveness Analysis**

Cost-effectiveness analysis (CEA) involves a comparison of the relative expenditure (costs) and outcomes (effects) associated with two or more alternative treatments. Cost-effectiveness is typically expressed as an incremental cost-effectiveness ratio: the ratio of change in costs (treatment A – treatment B):change in effects (treatment A – treatment B). The unit of effectiveness may vary from study to study, making comparisons between studies difficult. However, in cost-utility analysis, which can be regarded as a special type of CEA, the same unit of effectiveness is often used (e.g. quality adjusted life years, (QALY), which combines both quality and quantity of life), making it possible to compare a range of different treatments in different fields of medicine. Few CEAs have been undertaken in the field of nutritional support, but some examples are given below.

1. CEA studies (using cost per complication-free patient as the measure of effectiveness) involving ‘immunonutritional’ feeds have reported with some favorable results [32–34].

2. A CEA was undertaken by the National Institute of Clinical Excellence (NICE; www.nice.org.uk) in the UK to evaluate the impact of a nutritional screening program for individuals over 65 years, which included treatment with ONS [21]. It concluded that the intervention was cost-effective, producing a favorable incremental cost-effective ratio which was as low as GBP 5,000–10,000/QALY, when the baseline mortality was 3–5% and prevalence of malnutrition 4–8%. The results of this CEA should be interpreted with caution as several unsubstantiated assumptions were made, including assumptions about the long-term mortality of the control group.

3. A cost-utility analysis of home parenteral nutrition (PN), undertaken in the UK in 1995 and reported in 1996 [36], estimated that the cost/QALY was GBP 69,000 (almost GBP 100,000 in 2007, if the result is discounted at a rate of 3%/year).

4. A CEA was undertaken of patients with stroke receiving home enteral tube feeding (ETF) [37]. The cost (GBP)/QALY for patients receiving ETF in their own home was GBP 12,816 (95% CI, GBP 10,351–16.826). In the nursing home the costs ranged from GBP 10,304 to 68,064, depending on the contribution of the state to healthcare (private expenditure is often taken into account in CEA).

Two important modifications to CEA have recently been introduced in the UK.

1. Restricted practice: this involves selective withdrawal of treatment in those who do not respond. This improves the cost-effectiveness amongst
those who comply and respond to treatment. An example of this concerns the use of the drug xenical for the treatment of obesity [38].

(2) Risk sharing – the concept of outcomes guarantee: in this scheme the National Health Service (NHS) pays for the cost of treatment only when there has been a response. If a drug fails to meet expectations, industry will refund the NHS the cost of the drug. Such a scheme was established in 2002 for the use of interferon-β (and glutamine acetate) in multiple sclerosis, with a computed cost per QALY of GBP 36,000 for those who responded to treatment (GBP 70,000; GBP 35,000–104,000/QALY if all patients receiving treatment are considered). A progress report on the 5,000 patients recruited by 2005 is awaited [39].

The above data can be used to illustrate two issues. First, CEA does not indicate whether a condition is common or rare, and the incremental cost-effectiveness ratio does not reflect the overall cost of treatments. For example, CEA on home ETF and PN does not reflect the 50-fold greater use of home ETF than home PN in the UK or the costs of these treatments (table 1), which in combination account for only about 1% of the public expenditure on disease-related malnutrition. Therefore, in making policy decisions about the distribution of limited finances, it seems reasonable to take into account more than one type of economic analysis, including cross-sectional analysis.

Second, regulatory agencies using CEA to help them to decide how to distribute limited financial resources may face problems because the philosophy of CEA may be at odds with practice and societal values. In 1999, NICE was established as a special Health Authority in the UK, with the mission of providing patients, health professionals and the public with authoritative, robust and reliable guidance on current practice. Since it brought CEA into one of the largest European markets, its decisions have been monitored by the Treasury. Treatments that cost more than about GBP 30,000/QALY are unlikely to get approval from NICE, whilst treatments that cost <GBP 20,000/QALY are much more likely to be approved [39, 40]. The value for home PN is well above the ‘threshold’ of about GBP 30,000/QALY and well above the most expensive cost/QALY approved by NICE. The continued funding of home PN by government challenges the principle of using CEA alone as a measure of social justice, since it denies other patients more cost-effective treatments, which have been declined by NICE. The use of ETF outside hospital is also problematic because when the treatment is provided at home the cost/QALY is well below the threshold of GBP 30,000, whereas in nursing homes it ranges from well below to well above the GBP 30,000 ‘threshold’(GBP 10,000–70,000) depending on the contribution of the state. The calculations do not take into consideration the burden of care that falls on relatives who are often elderly with health problems which are made worse through caring. Such issues need to be discussed openly and take into account general societal values. Cost containment in a NHS through restricted practice and risk sharing also needs to be openly discussed.
Concluding Remarks

Since 1990 expenditure on health has grown faster than the GDP in most developed countries [14]. Such countries aim to improve the efficiency of their health services and to reduce health inequities, although these two aims may conflict on financial grounds. In the UK social and geographic inequalities exist in obesity as well as malnutrition. The cost of malnutrition is high and appears to exceed that of obesity, accounting for about 10% of the total public expenditure on health. Economic evaluations, such as CEA, are important but they have been little used in studies of prevention and treatment of malnutrition. Controversies continue to exist as to the best method to distribute limited resources, and although CEA has found considerable application in some countries (e.g. UK), it has not in others (e.g. USA). Differences in attitudes, culture and history may explain at least some of the differences.

References

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