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Original article

Disease associated malnutrition correlates with length of hospital stay in children☆

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SUMMARY

Background & aims: Previous studies reported a wide range of estimated malnutrition prevalence (6–30%) in paediatric inpatients based on various anthropometric criteria. We performed anthropometry in hospitalised children and assessed the relationship between malnutrition and length of hospital stay (LOS) and complication rates.

Methods: In a prospective multi-centre European study, 2567 patients aged 1 month to 18 years were assessed in 14 centres in 12 countries by standardised anthropometry within the first 24 h after admission. Body mass index (BMI) and height/length <−2 standard deviation scores (SDS, WHO reference) were related to LOS (primary outcome), frequency of gastrointestinal (diarrhoea and vomiting) and infectious complications (antibiotic use), weight change during stay (secondary outcomes) and quality of life.

Results: A BMI <−2 SDS was present in 7.0% of the patients at hospital admission (range 4.0–9.3% across countries) with a higher prevalence in infants (10.8%) and toddlers aged 1–2 years (8.3%). A BMI <−2 to ≥−3 SDS (moderate malnutrition) and a BMI <−3 SDS (severe malnutrition) was associated with a 1.3 (CI95: 1.01, 1.55) and 1.6 (CI95: 1.27, 2.10) days longer LOS, respectively ($p = 0.04$ and $p < 0.001$). Reduced BMI <−2 SDS was also associated to lower quality of life, and more frequent occurrence of diarrhoea (22% vs 12%, $p < 0.001$) and vomiting (26% vs 14%, $p < 0.001$).

Abbreviations: HFA, height/length for age; SDS, standard deviation scores; BMI, body mass index; LOS, length of hospital stay; MUAC, mid upper arm circumference; TSFT, triceps skin fold thickness; ICD, international classification of diseases; IQR, interquartile ranges.

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Conclusion: Disease associated malnutrition in hospitalised children in Europe is common and is associated with significantly prolonged LOS and increased complications, with possible major cost implications, and reduced quality of life.
This study was registered at clinicaltrials.gov as NCT01132742.

1. Introduction

Diseases increase the risk of malnutrition in infants and children. Malnutrition is induced by many childhood diseases, e.g. Crohn's disease[1] or cystic fibrosis,[2] and many others. However, it is not possible to distinguish clearly between severity and chronicity of disease and nutritional status which interact. The prevalence of disease associated malnutrition in hospitalised children in Europe has been reported to range from 6% to 30%.[3,4] This wide variation appears mainly due to the inconsistency of criteria used for defining disease associated malnutrition in paediatric patients.[3] Several different anthropometric indices have been used, which identify different groups and proportions of patients as malnourished.[4,5] The most frequently used criteria for acute malnutrition are the WHO cut-off weight for length/height (WFH) <-2 standard deviation scores (SDS) or alternatively body mass index (BMI) <-2 SDS. Height/length for age (HFA) <-2 SDS is suggestive of stunting and used as a marker of chronic malnutrition in developing countries but also in children with chronic illness.[6]

In adults, adverse effects of disease associated malnutrition defined by anthropometry, and benefits of nutritional intervention on clinical outcomes have been documented.[7] In contrast, the relation between malnutrition in children and outcomes, e.g. length of hospital stay (LOS), has only been reported in a limited number of small paediatric studies.[8,9] Our study aimed at assessing the prevalence of disease associated malnutrition (BMI < -2 SDS) in hospitalised children across Europe and to investigate the possible impact on length of hospital stay and on complication rates.

2. Material and methods

2.1. Definitions

Malnutrition in this context is defined as underweight only, defined by BMI < -2 SDS. The French Paediatric Society recommends the cut-off BMI < -2 SDS or below the third centile for protein-energy malnutrition screening in children.[10] In developed countries WFH standards are less available than age specific BMI standards.[11,12] For the calculation of the prevalence of malnutrition and it's relation to length of hospital stay the degree of malnutrition was classified as moderate (≥ -3 to ≤ -2 SDS) and severe (<-3 SDS). Patients with stunted height, which can be a marker of chronic malnutrition, were classified using height for age (HFA) < -2 SDS. WFH < -2 SDS was investigated for reason of comparison in children <5 years of age as this is the upper limit for WHO tabulation for WFH. A previous cross-validation study in Brazil showed that the performance of BMI and WFH in predicting underweight in children aged 2–19 years was similar.[13]

2.2. Study design

This prospective European multi-centre cohort study was supported by a Network Grant of the European Society for Clinical Nutrition and Metabolism (www.espen.org). Patients admitted to general paediatric and surgery paediatric wards in collaborating centres aged 1 month to 18 years, with an expected hospital stay exceeding 24 h, and not enrolled in the present study during previous admissions, were eligible for study participation. Preterm infants (<37 weeks gestational age) during the first 12 months of life and infants <1-month of age were excluded per protocol, since anthropometric assessment criteria for older patients were expected to be inadequate for these patients. Children admitted to intensive care and day hospital care were not eligible, because data collections were expected to be difficult to achieve without major interference with patient care, and outcomes were expected to be rather different than in patient populations hospitalised on general paediatric wards. Patients with cerebral palsy or genetic syndromes were not excluded per protocol. Participating patients were assessed by standardised anthropometry within the first 24 h after admission.

The primary outcome measure was length of hospital stay (LOS) in days. Secondary outcome measures were frequency of infectious complications (number of days with temperature >38.5 °C, and days with antibiotic use), number of days with vomiting and with diarrhoea, and percent weight loss per hospital day (based on the difference between admission weight and discharge weight in % of admission weight and LOS).

Fourteen tertiary hospitals in 12 countries recruited patients between February 2010 and July 2011. We aimed at a recruitment of 220 newly admitted eligible patients from each country, i.e., about 220 patients from each of the centres in Munich (Germany), Zagreb (Croatia), Petah Tikvah (Israel), Milan (Italy), Lille (France), Oxford (England), Glasgow (Scotland), Cluj-Napoca (Rumania), Thessaloniki (Greece) and Copenhagen (Denmark). In addition we aimed at recruiting about 110 patients from each of the two centres in the Netherlands (Rotterdam and Groningen) and in Poland (two hospitals in Warsaw). Recruitment phase per centre started on the day when the first patient was recruited and lasted until the predetermined number of subjects who fulfilled all inclusion criteria had been achieved at this site. Within this period information on age, gender and attended ward (surgical/general) was collected of all patients admitted to the participating wards in the respective centre (in Glasgow this was not permitted by the local research ethics committee). Recruitment phases varied between 3 and 30 weeks per centre ($\sim$1.8 recruited patients per day) depending on the number of assessors and predetermined number of subjects. The study protocol was reviewed and approved by the local research ethic committees at all centres. A prerequisite for participation was a signed informed consent by parents or caregivers and agreement to an age-adapted consent form by those patients sufficient with understanding.

2.3. Methods

This study was performed according to good clinical practice (GCP) criteria as far as they could be applied to a cohort study. The case report form for data documentation was developed and tested during a pilot phase at the Dr. von Hauner Children's Hospital in Munich, Germany during February to April 2010 in a group of 100 patients. For the subsequent main study, each study centre appointed at least one but not more than three assessors to collect all data at their study site. A training workshop was held in March 2010 at Munich to establish standard operating procedures and