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## Original article

## Evaluation of nutritional care of hospitalized children in a tertiary pediatric hospital



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## SUMMARY

**Background and aims:** Hospitalized children are at risk of malnutrition. The aim of the present study was to evaluate a clinical practice in a tertiary hospital. The nutritional team developed a specific software for screening of malnutrition and risk of malnutrition (Evalnut) that provides also recommendations for the nutritional management of the patient. The data recorded into this program and the tool itself were analyzed and optimizations are highlighted.

**Methods:** A retrospective study analyzed the data collected in 2015 during 4931 consecutive hospitalizations (3984 children) at the University Children's Hospital Queen Fabiola. Pivot tables analysis (Excel) of the database of the screening tool was compared with the clinical practice of the dietitians. First data processing excluded records with abnormal or missing values. Impact of nutritional care analysis needs at least 2 evaluations and a positive patient's height trend. In case of height equality, only length of hospital stays less than 2 weeks were kept.

**Results:** This study highlighted inaccurate database records related to imperfections of the computer program, missing or erroneous measures and incomplete encoding. First analysis on 3219 valid hospitalizations showed statistical correlations. Prevalence of malnutrition on admission was 33%, split into 14,5% acute malnutrition, 15% chronic malnutrition and 3,5% mixed malnutrition. Overall, 30,3% of the children were categorized at risk of developing malnutrition during their stay. Positive impact of nutritional management on the resulting nutritional status was demonstrated on the second data selection (352 hospitalizations): WFH median (interquartile range) increased from 96,1% (87,1–106,4) on admission to 96,9% (89,1–106,1) ( $p < 0,01$ ) on discharge. An optimization of the existing software was finally proposed.

**Conclusion:** In our hospital, the dietitians are the most aware on the importance of nutritional assessment and management during hospitalization. Encouraging results are obtained. Inclusion of a nutritional program in the medical file is useful to raise interest amongst caregivers and is particularly valuable for the nutritional follow up of the patients by the nutrition team.

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**Abbreviations:** AM, Acute malnutrition; AMS, Acute malnutrition Score; CM, chronic malnutrition; HFA, Height for age ratio; H<sub>out</sub>, Height measurement on discharge; H<sub>in</sub>, Height measurement on admission; IQR, interquartile range; LOS, Length of stay; PNRS, Pediatric Nutritional Risk Score; SD, Standard deviation; UCHQF, University Children's Hospital Queen Fabiola; WFH, Weight for height ratio.

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## 1. Introduction

Nutrition plays a key role in health, particularly in children [1]. Macro- and/or micro-nutrient deficiencies interfere with growth, muscular strength and intellectual development, as well as with quality of life [2–4]. Malnutrition during key periods of life has repercussions not only on the child's health but can contribute to the occurrence of illnesses at adult age as well (epigenetic modifications) [2–4].

Malnutrition secondary to illness is attributed to different factors: malabsorption, nutrient loss, increased energy requirements, or reduced food intake. Other factors, such as inflammation can also contribute to illness related malnutrition [5]. A distinction is made between acute, wasting, and long-term malnutrition, stunting, according to the duration.

Hospital malnutrition and its impact on patient outcome, although reported since many years, are still under-recognized. The prevalence of acute malnutrition in children on admission varies between 6 and 41% [6]. Nutritional status of 20–50% of hospitalized children additionally worsens during their hospital stay [7–9].

Malnutrition influences the prognosis of the underlying disease and is correlated with the length of hospital stay (LOS) as well as with the cost of medical care [6,7,9–11]. It is therefore extremely important to identify as soon as possible children at risk of malnutrition and to provide them with optimal nutritional care [8]. In Europe, nutritional support is offered to less than one third of malnourished patients [7].

The diagnosis of malnutrition by anthropometry is well standardized [4,12]. Nutritional risk screening tools on admission have been described and validated by different authors in several countries [9,10,13–15]. The American Society for Parenteral and Enteral Nutrition and the European Society of Pediatric Gastroenterology, Hepatology and Nutrition have recommended screening for undernutrition in hospitalized children [4]. However, it is not a common practice in the majority of the hospitals.

Since more than 10 years, the nutrition team of the University Children's Hospital Queen Fabiola (UCHQF), a tertiary level hospital of 165 beds, has organized a systematic nutritional assessment at the admission of each patient. Eight part-time dieticians (80 h/week) in charge of the inpatient feeding have collected data in order to establish the nutritional status and the nutritional risk of the patients in the different wards of the hospital. They have developed a software, called EvalNut, to facilitate their work. This program is specifically designed for the screening of children at risk of malnutrition, the diagnosis of acute and long-term malnutrition, and the follow-up and nutritional management of hospitalized children.

The aim of the present study was to evaluate the clinical practice of the nutritional team of UCHQF, included their specific EvalNut software.

## 2. Subjects, materials and methods

### 2.1. Patients

This was a retrospective study conducted at UCHQF, which is a pediatric tertiary care center in Brussels (Belgium). All departments of pediatric and pediatric surgery are available excepted neurosurgery and liver transplantation. Between the 1st of January and the 31st of December 2015, 7021 children were admitted. All hospitalization units were surveyed except the departments of pedopsychiatry, neonatology and hospitalization less than 24 h (one-day). This selection reduces the number of patients to 3984. All children from the other wards were included unless missing and aberrant anthropometric records. The dieticians collected and

encoded in the EvalNut program, on a routine basis, data from the medical and nurse records: age, weight, height, severity of the pathology, pain and reduction of food intake. These data were anonymized before statistical analysis.

### 2.2. The EvalNut program

The EvalNut software combines a nutritional risk assessment tool and a nutritional diagnostic tool, and provides also recommendations for the nutritional management of the patient.

Risk of malnutrition is evaluated according to the Pediatric Nutritional Risk Score (PNRS) [15] which takes into account the severity of the pathology, pain and reduction of food intake.

Malnutrition was assessed by anthropometry using the Waterlow score [12]. Weight and supine length (<2 years of age) or standing height (>2 years of age) measurements were taken by the nursing staff, which is routinely trained to carry out all measurements in a standardized way, using standard equipment (digital scales, length measuring rod and stadiometer). Weight is measured every day in children less than 1 year of age and at least once a week in older patients. Length or height is measured every 2 weeks and/or on discharge. Anthropometric values are transmitted daily to the dietician (nutrition team).

All anthropometric data were compared with published standards [16,17]. A low weight-for-height ratio (WFH) is an indication of acute malnutrition (AM). A WFH within the ranges 80–90%, 70–80% or below 70% corresponds to mild AM (acute malnutrition score - AMS - of 1), moderate AM (AMS of 2) and severe AM (AMS of 3), respectively. A low height-for-age ratio (HFA) is an indication of long-term or chronic malnutrition (CM). A HFA within the ranges 90–95%, 85–90% or below 85% corresponds to mild CM, moderate CM and severe CM, respectively. A child can present with combined acute and chronic malnutrition.

The EvalNut software provides also recommendations [18] on energy and protein requirements according to the age and the weight of the patient. Taking into account the results of the nutritional risk assessment and of the anthropometric evaluation, a personalized nutritional management is proposed by the dietician with the agreement of the pediatrician in charge of the patient. The criteria for a nutritional follow up is: children at risk of malnutrition and/or malnourished (WFH <90%, HFA <95%, PNRS >0) (Fig. 1).

The prescribed diet is recorded in the program: oral nutrition (breast feeding, meal adaptation, energy and protein supplementation, etc.), enteral feeding (type, product, etc.), parenteral nutrition (total or partial, product, flow rate, etc.). This evaluation is repeated at least every week.

### 2.3. Program evaluation

Each entry field of EvalNut was analyzed by Excel pivot tables. It highlighted use rate and identified relevant and reliable data. Their usefulness and relevance were also reviewed in the light of the clinical experience of the nutrition team. Encoding problems and data accuracy were handled as well. An optimization of EvalNut was then proposed taking into account all these considerations.

### 2.4. Statistical analysis

Statistical analysis was performed using Statistica<sup>®</sup> software [19]. A  $p < 0,05$  was considered statically significant. Data distribution was first analyzed with Kolmogorov Smirnov test and Shapiro–Wilk test. Normally distributed continuous data were compared using Student T-Test or Anova as appropriate. Non-normally distributed continuous data and categorical data were compared using Wilcoxon or Kruskal–Wallis for more than 2

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