Original article

Economic and operational burden associated with malnutrition in chronic obstructive pulmonary disease

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S U M M A R Y

Background: Malnutrition is common in patients with chronic obstructive pulmonary disease (COPD). This study aimed to explore its association with all-cause mortality, emergency hospitalisation and subsequently healthcare costs.
Methods: A prospective cohort observational pilot study was carried out in outpatients with COPD that attended routine respiratory clinics at a large tertiary Australian hospital during 2011. Electronic hospital records and hospital coding was used to determine nutritional status and whether a patient was coded as nourished or malnourished and information on healthcare use and 1-year mortality was recorded.
Results: Eight hundred and thirty four patients with COPD attended clinics during 2011, of those 286 went on to be hospitalised during the 12 month follow-up period. Malnourished patients had a significantly higher 1-year mortality (27.7% vs. 12.1%; p = 0.001) and were hospitalised more frequently (1.11 SD 1.24 vs. 1.51 SD 1.43; p = 0.051). Only malnutrition (OR 0.36 95% CI 0.14–0.91; p = 0.032) and emergency hospitalisation rate (OR 1.58 95% CI 1.2–2.1; p = 0.001) were independently associated with 1-year mortality. Length of hospital stay was almost twice the duration in those coded for malnutrition (11.57 SD 10.93 days vs. 6.67 SD 10.2 days; p = 0.003) and at almost double the cost (AUD $23,652 SD $26,472 vs. $12,362 SD $21,865; p = 0.002) than those who were well-nourished.
Conclusion: Malnutrition is an independent predictor of 1-year mortality and healthcare use in patients with COPD. Malnourished patients with COPD present both an economic and operational burden.

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1. Introduction

Disease-related malnutrition is a common problem and presents a significant clinical, economic and operational burden to healthcare systems worldwide. Malnutrition has been suggested to attribute to an increase in hospitalisation costs of 20% [1]. In patients with COPD, up to 60% of inpatients and 45% of outpatients have been found to be at risk of malnutrition [2]. According to the Australasian Nutrition Care Day Survey conducted in 56 hospitals across Australia and New Zealand, the overall prevalence of malnutrition was 32% [3]. A previous study also involving 56 hospitals, included 6150 Dutch patients and found a quarter of patients

to be malnourished but less than half were identified [4]. Malnutrition is associated with several negative clinical outcomes as patients usually have prolonged convalescence from illness, increased length of hospital stay (LOS) and mortality [5,6]. Whilst the negative association between nutritional depletion and mortality in COPD is well known [7], the association between malnutrition, healthcare use and the subsequent healthcare costs associated with it in COPD patients has not been fully explored.

In Australia, COPD is ranked as having the third highest burden of disease in terms of disability-adjusted life years (DALYs) [8] and affects about 14.5% of all Australian adults above the age of 40 [9]. In 2008–2009, health expenditure directly attributed to COPD in Australia was estimated at $929 million [8] highlighting the economic burden of COPD to the Australian healthcare system. The main treatment goals of COPD are to delay disease progression and reduce the frequency of infective exacerbations [10]. Research has suggested that poor health-related quality of life is associated with

the frequency of COPD exacerbations [11] and which is likely to be linked to frequent periods of hospitalisation. In 608 COPD patients hospitalised for an exacerbation in the United Kingdom, patients with a deteriorating nutritional status, indicated by unintentional weight loss exceeding 10% within the 3–6 months preceding the admission, were almost 4-times more likely to be readmitted early [12]. In addition, those patients with a body mass index (BMI) < 18.5 kg/m^2 were twice as likely to die during the admission. It is likely that malnutrition is a significant driver of the large burden of COPD to healthcare systems. In the United States it has been estimated that about 88% of the total direct health expenditure attributed to COPD is associated with acute and ambulatory hospital services [13]. In Australia, inpatient hospital services account for more than half of the direct health expenditure attributed to COPD [8] but to what extent this healthcare use is driven by disease-related malnutrition is unclear. Therefore, this study explored the association between malnutrition in hospitalised COPD patients and its impact on mortality, hospital healthcare use and the subsequent healthcare costs.

2. Methods

2.1. Study subjects and study design

This study utilised electronic hospital records to identify all of those patients that attending the Respiratory Laboratory at Princess Alexandra Hospital for pulmonary function testing during 2011. All patients who had undertaken at least one lung function test during routine respiratory outpatient clinic attendance with a confirmed diagnosis of COPD were included. COPD patients were identified based on FEV$_1$/FVC <0.7 and FEV$_1$ <100% predicted. The nutritional status of patients was identified through the diagnosis-related group (DRG) for malnutrition recorded in the hospital records.

Demographic and clinical information such as age, gender, body mass index (BMI), lung function (%FEV$_1$, %DL$_{CO}$), and COPD disease severity according to Global Initiative for Chronic Obstructive Lung Disease (GOLD) classification [14] were collected. Additionally, malnutrition status, 1-year healthcare use and admission data (emergency and elective hospitalisation rate and subsequent LOS and associated costs (AUD$)) as well as 1- and 2-year mortality were collected using electronic hospital records. BMI was classified as underweight (<21 kg/m^2), normal weight (21–25 kg/m^2), overweight (>25–30 kg/m^2) and obese (>30 kg/m^2) categories according to the American Thoracic Society/European Respiratory Society Task Force [15]. Ethical approval for the study was awarded from the hospital Human Research Ethics Committee and Governance Unit and the Queensland University of Technology (QUT) Research Ethics Unit (TPCH: HREC/13/QPCH/220, QUT: 1300000774). The reporting of this paper also conforms to the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) recommendations [16].

3. Nutrition assessment

In order to receive a DRG code for malnutrition, patient's nutritional status was assessed using the Subjective Global Assessment (SGA) tool [17] and was completed by a dietitian. The SGA is a validated nutrition assessment tool which involves a clinical domain: assessing weight and dietary intake changes over a period of time, nutrition impact symptoms, functional capacity and a physical assessment domain: assessing fat and muscle wasting, the presence of nutritionally-related oedema and a patient's functional capacity [17]. The SGA categorises patients into three groups, well-nourished, mild/moderately malnourished and severely malnourished. Patients diagnosed as malnourished (mild/

moderately or severely malnourished) during their hospital admission were coded as such using the relevant DRG code.

3.1. Healthcare use

Hospital admission data (frequency, LOS, type (emergency or elective)) and costs were also collected from electronic hospital records. Costs related to each hospital admission were estimated using the institution's own health economics modelling techniques which derive costs from DRG codes. All costs were recorded in Australian Dollars (AUD$).

3.2. Statistical analysis

Statistical analyses were performed using the Statistical Package for the Social Sciences (SPSS) for Windows Version 20 (SPSS Inc., Chicago, IL, USA). Continuous variables such as LOS and costs are presented as mean ± standard deviation (SD), unless otherwise stated. Categorical variables such as malnutrition status and 1-year mortality are presented as n (%). A p-value ≤ 0.05 was considered statistically significant.

Differences between two categorical variables were tested using Pearson's chi-square test. Further statistical analyses using purposeful selection with binary logistic regression were also used to predict odds ratios with the associated 95% confidence interval (95% CI) which allowed adjustment for potential confounders associated with mortality. Differences between a categorical and continuous variable were evaluated by comparing their mean ± SD using one-way ANOVA test. Interrogation of the data in this manner allowed identification of independent associations between malnutrition status, healthcare use, mortality and healthcare costs.

4. Results

4.1. Patient characteristics

A convenience sample of 834 unique outpatients with a confirmed diagnosis of COPD was obtained. Of those outpatients, 286 went on to experience at least one hospitalisation within a year of their test date which allowed their nutritional status to be identified (Fig. 1). Characteristics of the patients included are described in Table 1. Compared to those patients that were not hospitalised (n = 548) the patients included in the study (n = 286) were significantly older (mean age 66.6 SD 11.0 years vs. 64.8 SD 11·7 years; p = 0.030) and had a significantly lower BMI (mean BMI
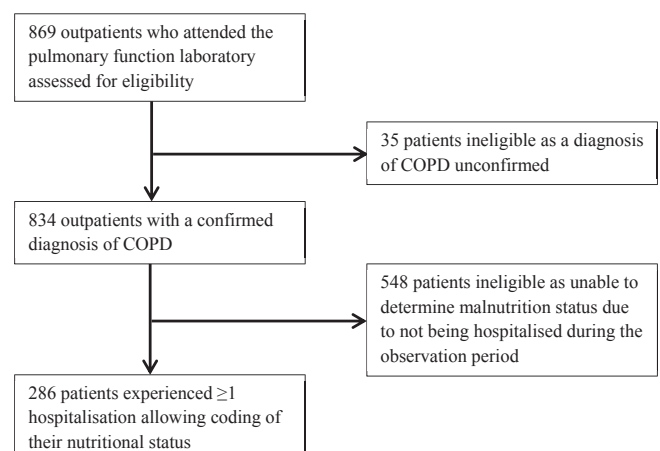

Fig. 1. Flow diagram showing the identification of eligible COPD patients.