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Daily energy and protein intake in hospitalized patients in department of infectious diseases: a prospective observational study

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Summary. *Aims:* Malnutrition is associated with increased hospital mortality and morbidity. The aim of this study is to observe the daily energy and protein intake of hospitalized patients at infectious disease department. *Methods:* A prospective observational study was performed in the Hospital of Erciyes University Medical School during May and November 2014. Nutritional assessment was performed within 24 hours of admission to the department of infectious diseases using the Nutritional Risk Screening-2002 score (NRS 2002). The energy and protein from dietary intake was calculated for each meal by a dietician. *Results:* Of the 47 patients in this study, 20 were males (43%) and 27 were females (57%) and their ages ranged from 18 to 88 years (53±18 years). Body weight of patients who had >1000 kcal daily energy deficiency were higher than patients who had normal energy intake and their daily protein intake was significantly low. However, the length of their hospital stay was considerably short. Although the mean values of patients' daily energy intake displayed an increase in the first three days of their stay, there had been a decline in the following days. *Conclusions:* Energy and protein intake at hospital is insufficient and routine dietetic assessment should be performed for all patients, so that at-risk patients for malnutrition may be identified and early nutritional intervention may be instituted during hospitalization. Patients with more body weight experienced more energy and protein deficiencies during their hospital stay.

Key words: Calorie, protein, infection, hospital

Introduction

Malnutrition is associated with increased mortality and morbidity, extends length of hospital stay, reduces quality of life, and increases the healthcare costs (1-6). An early diagnosis is essential to initiate an adequate nutritional regimen, improving the evaluation of the patient. Systematic screening at hospital admission by using the Nutritional Risk Screening-2002 score (NRS-2002) is recommended to detect patients at nutritional risk (7). Implementing screening and nutritional assessment allow malnourished patients to be recognized and protocols to be established to achieve a good nutritional status, increase body weight, improve treatment response, reduce the occurrence of complications and shorten the length of hospital stay (8).

Nutrition is an area of potential importance in the recovery of the patient with infection. Clinical signs and symptoms of infections can increase oxygen consumption and energy requirements. Poor nutrition may slow down recovery from infectious disease due to the adverse effects on host immune function. Conversely, good nutrition has positive effects for patients with infection. Timely and targeted nutritional interventions showed a reduced incidence of infection in perioperative and intensive care patients (9-11).

Nutritional status and daily enegy intake can vary depending on the infection type and location. The worsening of nutritional status and daily energy intake can be multifactorial, due to the infection itself or its treatment: anorexia, metabolic alterations, malabsorption, diarrhea, vomiting, fatigue, anxiety and pain.

Although the hospital diet can provide adequate energy and nutrients, many patients may not consume sufficient food to meet their needs.The aim of this study is to observe the daily energy, protein and liquid intake of patients admitted and hospitalized to infectious disease department and see whether there is a significant difference in the patients' daily energy, protein and liquid intake recorded upon their arrival and the intake recorded during their stay at the hospital. Thus, the role of nutrition at hospital may be evaluated and the importance of dietitians may be underlined.

Material and Methods

A prospective observational study was performed in the Hospital of Erciyes University Medical School during May and November 2014. All the adult patients (older than 18 years) hospitalized to the Infectious Disease wards were included. Patients hospitalized lower than 2 days or patients who did not give a written informed consent were excluded. This study was performed in accordance with the Helsinki Declaration and approved by the Ethics Committee of Erciyes University Medical School (2014/654). The written informed consent forms were obtained from all patients.

At the time of the patients' enrollment, demographic information (age and gender) were recorded. Data on pre-existing conditions including comorbidities, admission diagnosis, clinical characteristics, the condition that prompted admission, length of hospital stay (number of days between admission and discharge) and also post-hospital destination (home, transfer to intensive care unit (ICU) or death) were obtained from the clinical files. On admission, a routine blood sample was taken and tested for complete blood count, routine biochemical parameters, and acute phase reactants. In order to understand the contribution of each variable on adverse clinical outcomes, we monitored and followed patients from admission to discharge from hospital. Data on fever (>38°C) and antibiotics were obtained from the patient charts during hospital stay.

Infection types were classified into several categories: urinary tract infection, lower respiratory tract infection including pneumonia, soft tissue infection, viral infections, gastrointestinal system infection and other. Other infections included cardiovascular system infection, eye, ear, nose, throat or mouth infection, reproductive tract infection, and skin infection.

The screening of malnutrition was performed within 24 hours of admission to the department of infectious disease using the NRS 2002 (7), and patients who remained hospitalized more than 6 days or longer were re-assessed using the same methodology each week and on the day of discharge. Initial screening was performed firstly. If the patient answered, "Yes" to any question, the screening in step 2 was performed. NRS 2002 step 2 screening combines two scores, the "nutritional score" ranging from 0–3 and the "severity of disease score" ranging from 0–3, plus one point if the patient is above 70 years of age. The NRS-2002 questionnaire was given to patients by physicians or dietitian. The total NRS 2002 score (range 0-7) is the sum of the nutritional score, the disease severity score and the age adjustment.

All patients had a standard energy intake during hospital stay, except patients who had moderately hypocaloric diets (mildly hypocaloric diabetic, easily digestible, astringent, liver protection) or hypocaloric diets (crushed, low-fat soft, diabetic-soft, liquid). Dietary intake was calculated by analysing the differences between consumed and provided meals, snacks, and oral nutritional supplements, supplemental tube feeding and parenteral nutrition.

The amount ingested was recorded depending on whether they had eaten the entire menu, more than half or less than half. The energy from dietary intake was calculated for each meal using the dietary service software Winrest (FSI, Noisy-le-Grand, France) for which a training was done. The predicted energy needs were calculated with the Harris-Benedict formula increased by 10% to cover increased needs due to hospitalization and disease (e.g. stress, fever, digestive or renal losses) (12-15). Protein requirements of the patients were calculated by multiplying their actual weight by a factor of 1.2 g/kg/day.

Anthropometric measurements, including height, body weight, and mid-upper arm circumference were also taken at baseline. Weight loss was evaluated using either self-report of the patients or previous medical records where available. Decreased food intake was assessed either subjectively by the self-report of the patients or objectively by nutritional diaries. The body weight was measured under fasting conditions in the morning after admission and was measured with indoor clothing. Body mass index (BMI, kg/m^2) was calculated as weight (kg) divided by the square of the height in meters (m^2).

Statistical Analysis

Data are expressed as the mean ± standard deviation (SD) or the median (including the lower and upper quartiles). The normality and the homogeneity of the data were evaluated by Shapiro-Wilk and Levene tests, respectively. Comparisons between groups for continuous variables were performed using the Student's t-test (normal distribution) or the Mann-Whitney U test (non-normal distribution). Fisher's exact test or the χ test was used for all categorical data. Pearson correlation was used to evaluate the association of continuous variables. All calculations used the SPSS statistical package (version 15.0; SPSS, Chicago, IL, USA). $p<0.05$ was considered statistically significant.

Results

Of the 47 patients in this study 20 were males (43%) and 27 were females (57%) and their ages ranged from 18 to 88 years (53 ± 18 years). The patients' average body mass index was recorded as 26 ±7 kg/m^2 and their mid-upper arm circumference was 25 ± 5 cm. Median NRS-2002 score of patients on admission was 2 (0 – 6). The malnutrition risk was present in 12 of the 47 patients (25.7%) on admission, in 5 of the 21 patients (23.8%) in the first week and in 4 of the 12 patients (33.3%) in the second week according to the evaluation of malnutrition risk with NRS-2002 (score ≥ 3). The data showed that. 64% of patients were fed orally, while 17% were fed orally and parenterally. Data revealed that 60% of hospitalized patients were admitted through the emergency service and 26% through the outpatient clinics. As shown in Table 1, the daily average intake of energy of the patients were 1299±425 kcal/day, protein intakes were 44±15 gr/day and the amount of liquid were1783±780 ml/day, respectively.

The mean serum albumin in patients when accepted to the ward was 3.38 ± 0.57 g/dl (range: 2.26-4.20) while it was 3.28 ± 0.81 g/dl (range:1.46-4.49) when they were discharged from hospital. Patients were discharged with a mean stay of 8 days at hospital ranging from minimum 2 – maximum 42 days.

The patients were assigned to four groups. In the first group, there were patients with normal or excessive energy intakes, the second group covered those who had an energy intake 500 calories less than normal limits, the third group was composed of patients whose energy intakes were ranging between 500 to 1000 calories less than the normal figures and the last group consisted of patients whose energy intakes were more than 1000 calories less than normal limits. The patients' general features were compared within these groups (Table 2). There was significant difference among groups in respect to their body weights when hospitalized, the length of stay at hospital and their daily protein intakes. Body weight of patients who had >1000 kcal daily energy deficiency were higher than patients with normal energy intake and their daily protein intake was significantly low. However, the period those patients stayed at hospital was considerably short. There were no significant difference between these groups for complete blood count and routine biochemical parameters, and acute phase reactants.

Although the mean values of patients' daily energy intake displayed an increase in the first three days of their hospital stay, there had been a decline in the following days. Mean values of the patients' daily energy intakes have been shown in Figure 1. Furthermore, we showed the changes in energy and protein intake at admission and discharge in figure 2 and 3.

Discussion

Malnutrition is an independent factor associated with morbidity and mortality in infectious diseases. It is particularly common and may increase during hospitalization. Insufficient dietary intake is one of the main risk factors for malnutrition, which in turn is related

Table 1. The basic characteristics of the patients

Variables	n = 47
Age (year), mean ± SD	53±18
Gender, n(%)	
Male	20 (43)
Female	27 (57)
Body weight at admission (kg), mean ± SD	66.1 ± 18.5
Height (cm), mean ± SD	159.6 ± 11
BMI (kg/m2), mean ± SD	25.7 ± 6.7
Mid-upper arm circumference, mean ± SD (cm)	25 ± 5
Length of hospital stay (day), median (range)	8 (2 – 42)
Death, n(%)	1(2.1)
Types of infection, n(%)	
Urinary infections	5 (10.6)
Pneumonia	10 (21.3)
Soft tisue infections	10 (21.3)
Viral infections	4 (6.4)
HIV	1 (2.1)
Gastroenteritis	1 (2.1)
Septic artritis	1 (2.1)
Febrile Neutropenia	3 (6.4)
Other infections	12 (25.5)
Nutrition type during hospital stay, n(%)	
Oral	30 (63.8)
Enteral	4 (8.5)
Oral plus parenteral	8 (17)
Oral plus enteral	4 (8.5)
Oral plus Enteral plus parenteral	1 (2.1)
Patients with NRS-2002 score ≥ 3, n(%)	
on admission	12 (25.7)
at first week	5 (23.8)
at second week	4 (33.3)
at third week	2 (25)
Place of hospitalization to infectious disease clinic, n(%)	
Emergency Department	28 (59.6)
Policlinics	12 (25.5)
Intensive care unit	3 (6.4)
Other clinics	4 (8.5)
Daily energy requirements (kcal), mean ± SD	1820 ± 428
Daily energy intake (kcal), mean ± SD	1299 ± 425
Daily protein requirements (gr), mean ± SD	79.4 ± 22.2
Daily protein intake (gr), mean ± SD	43.6 ± 15.2
Daily fluid intake (ml), mean ± SD	1783 ± 780

Data are expressed as the mean ± SD, median (including the lower and upper quartiles) or noun (percentage).
BMI: Body mass index, HIV: Human immunodeficieny virus, gr: gram, ml: mililiter

to infections, increased length of stay and higher costs (1,16). The present study assessed whether changes in energy intake during the hospital stay (worsening vs. improvement) could have an impact on clinical outcome in infectious disease clinic. To our knowledge, this is the first study to report detailed information about the daily energy and protein intakes and to highlight the lack of dietetic assessment in hospitalized patients admitted to the infectious disease department. This study confirmed our hypothesis that low energy and protein intakes are common for many patients admitted to infectious department and for some is persistent through many days of the hospitalization. Therefore, our findings strongly support the need of early dietetic evaluation in all hospitalized patients in infectious disease department in order to identify the patients at-risk for malnutrition, so that early nutritional intervention may be instituted during hospital admission and also after discharge.

According to NRS-2002 results, on admission 25% of our patients had nutritional risk, which shows the importance of nutritional screening and assessment in patients who were hospitalized at infectious disease department. Our prevalence of patients with nutritional risk is similar with recent studies performed in Norwich (29%) and Switzerland (30.1%) hospitals (17, 18). An important part of our work was to evaluate the spectrum of poor energy intake extending into the hospitalization as well. Descriptive statistics revealed that the mean energy intake of patients during hospital stay was χ71% of their energy requirements and χ55% of their protein requirements. Similar to a previous study, it has been observed that old age does not comprise a risk in the patient's inadequate energy intake (17).

In 2010, Agarwal et al. (19) conducted a multicenter study in Australia and New Zealand analyzing the acceptance of inpatient hospital diets. In this study, insufficient dietary intake was associated with longer hospital stay, more readmissions, and higher mortality in hospitalized patients. On the contrary, our study revealed that the hospitalization period of patients belonging to the highest energy deficiency group was significantly short. This result might be related to the small number of patients and some special factors of the diseases. There are many factors other than dietary intake

Table 2. The patients' general features according to caloric deficiency level

Variables	Normal energy intake (n = 8)	<500 kcal daily energy deficiency (n = 16)	500 – 1000 kcal daily energy deficiency (n = 14)	>1000 kcal daily energy deficiency (n = 9)	P
Age (year)	48.4 ± 19.9	55.1 ± 20.2	58.1 ± 17.8	46.7 ± 10.4	0.164
Gender, male / female	4 (20) / 4 (14.8)	5 (25) / 11 (40.7)	5 (25) / 9 (33.3)	6 (30) / 3 (11.1)	0.410
Height (cm)	159.3 ± 8.7	157.3 ± 13.6	157.9 ± 11.5	166.8 ± 11	0.333
Body weight (kg)	52.3 ± 12.1	63.9 ± 17.2	66.4 ± 19.4	81.9 ± 13.9[a]	0.008
BMI (kg/m^2)	20.8 ± 5.6	25.4 ± 6.6	26.4 ± 6.5	29.6 ± 6.6	0.067
Length of hospital stay (day)	13 (9.75 -16)	8 (5.25 – 17.75	7 (4.75 – 15.75)	5 (3 - 7)[a]	0.040
Daily fluid intake (ml)	2245 (1440-2980)	1631 (1144-2178)	1518 (1225-2255)	1600 (584-2543)	0.354
Daily protein intake (gr)	56.8 ± 13.7	49.4 ± 12.1	38.7 ± 13.1	28.9 ± 9.1[b]	<0.001
Albumin on admission	3.3 ± 0.4	3.3 ± 0.6	3.3 ± 0.7	3.7 ± 0.5	0.421

[a]There was a significant difference between patients with normal energy intake and >1000 kcal daily energy intake deficiency. [b]There was a significant difference between patients with normal energy intake, <500 kcal daily energy intake deficiency and >1000 kcal daily energy intake deficiency. Data are expressed as the mean ± SD, median (including the lower and upper quartiles).

(e.g. severity of infection) that may determine the duration of hospital stay. In our study, protein deficiency was correlated with energy deficiency. Similarly, previous studies rather emphasize that both the protein intake and energy intakes are equally influencial (20).

Our study revealed that there has been a gradual decrease in patients' daily energy intake despite the increase in the first three days of their stay at hospital. This situation also suggests that staying at hospital might be a major source for insufficient energy intake.

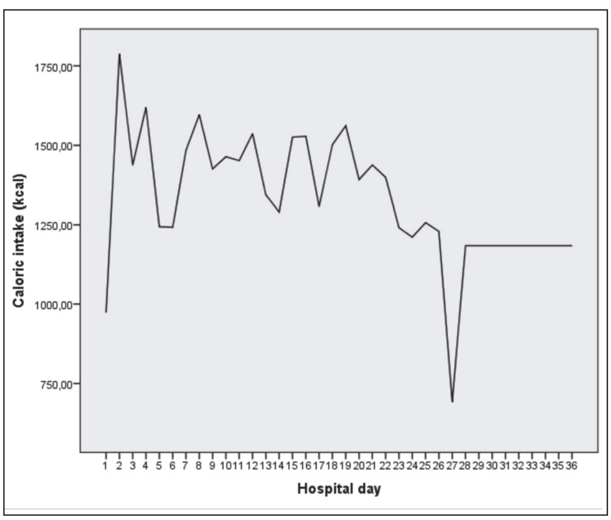

Figure 1. The mean values of daily energy intake of patients during hospital stay. The length of hospital stay for the patients ranged from 1 to 7 days (n=23), from 8- 14 days (n=12), from 15 to 21 days was 4 and >21 days (n=8).

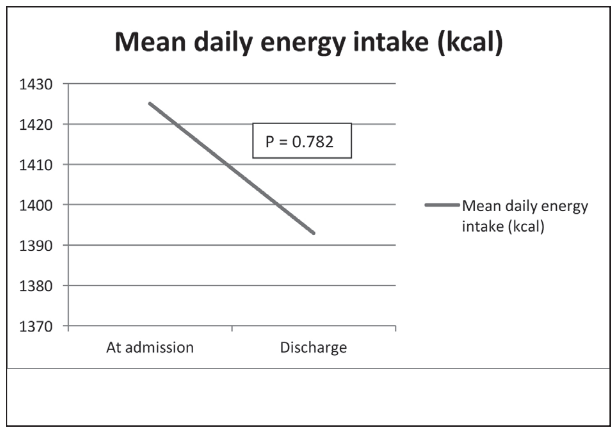

Figure 2. Mean daily energy intake of patients at admission and discharge

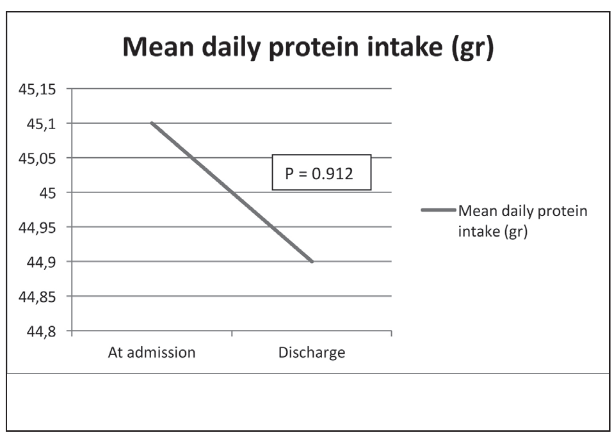

Figure 3. Mean daily protein intake of patients at admission and discharge

This reduction in nutrient intake in patients is likely to be multi-factorial in infectious disease department. A study performed in Geneva by Thibault et al. (12) compared the results of hospital menu intake in 1999 and 2008. The results from 1677 inpatients showed that the main reasons to consider a diet unacceptable were inadequate flavor, time of receipt, inadequate cooking and little variability in the menu. Monotony in hospital diets may be one of the main reasons for non-consumption after one week of hospitalization. As a result, patients did not cover their energy and protein requirements. Appetite is also reduced owing to increased inflammatory cytokines and alterations in appetite regulating hormones in these patients.Also, the severity of disease could influence intake and nutritional status. It is possible that the observed weight loss in these patients is due to a reduced energy intake linked to anorexia associated with the disease. Paradoxically, the lack of nutrient intakes also influence the function of the gastrointestinal tract. In healthy and critically ill patients, enteral nutrient deprivation is associated with mucosal atrophy, increased intestinal permeability and infections (21,22). The use of enteral nutrition in critically ill and surgical patients has been shown to prevent the development of these adverse changes to the gastrointestinal tract (22, 23), and has been associated with reduced morbidity, particularly septic complications (24, 25).

The results obtained from a study in 2006 confirmed the relationship between reduced intake and mortality (26). This study has demonstrated that eating a quarter of provided meals only was an independent risk factor for hospital mortality. Of all patients surveyed, 73% gave a reason as to why they rejected the hospital menu; among the causes of non-consumption were anorexia, nausea and inadequate food flavor. In the study by Tangvic et al. (17), decreased dietary intake was associated with a doubling of one year mortality. As only one patient had been died, a statistically significant difference between lower intake and higher death rate was not observed in our study. This situation could be related to an insufficient sample size.

Previous studies showed that measured energy intake < 70% of predicted energy needs is associated with health care associated infections (HCAI) in hospitalized patients (18). Improving energy intake with supplemental parenteral nutrition to cover 100% of energy needs in critically ill patients after an initial phase of enteral nutrition was effective in reducing by 29% HCAI incidence (9). The incidence of postoperative infectious complications was shown to be significantly reduced by the enteral administration of immunomodulatory nutrients in oncologic patients undergoing abdominal surgery (10). In surgical patients, the European Society for Clinical Nutrition and Metabolism (ESPEN) recommend to initiate a postoperative nutritional support if patients do not meet 60% of their predicted energy needs during the ten days following surgery (27,28).

Fuchs et al. (20) evaluated 117 inpatients in Mexico. They calculated the energy and protein coverage of the prescribed diets in cancer patients, obtaining approximate consumptions of 1000 kcal and 42 gr of protein, which was 67% of inpatient requirements. Those values are similar to our data. A similar study was conducted by Barton et al. (29) evaluating whether hospital diets and actual intake covered energy and protein requirements and also the percentage of food rejected by patients. They determined that hospital diets covered only 71% and 77% of their needs. Schindler et al. (30) observed that 47% of patients studied in 2008 did not meet their energy and protein requirements even though they consume 100% of the hospital diet.

There have been numerous reports that the nutritional intake of many hospitalized patients is suboptimal, however there is little published information about patients' diets in infectious disease department. The total daily energy expenditure in patients with infectious disease is presumed to be high, because of an increase in the basal metabolic rate, a reason for the weight loss observed in these patients. However, hospitalized patients receive a standard intake. This intake is insufficient for some patients. Although there are figures of not having been sufficiently nourished at hospital obtained through research on patients with various diseases especially cancer there is very little data on patients hospitalized in infectious disease department. In our study, we compared the total daily energy and protein intakes of patients in infectious disease department with the ideal amount they should take as to determine the deficiency and provide some data for this gap. Our study showed that the group of patients with more body weight experienced more caloric and protein deficiency during their hospital stay and this finding was recorded for the first time in the current literature. This situation may be explained as the result of diet given in accordance with standart figures and not being determined by dietitian considering the patients individual requirements according to their weight. This problem may be solved with the contribution of dietitians taking active role in the process.

There are several limitations for our study. We evaluated nutrition of the patients by measuring only one aspect (energy and protein intake). There are other specific nutrients such as fatty acids, vitamins, and other nutrients that may have an impact on recovery from infection that could not be evaluated in our study (31, 32). Furthermore, this study has a limitation related to the sample size, especially after 10 days of hospitalization. Prospective interventional studies are needed to verify this hypothesis and future randomized trials should aim at demonstrating that an early nutritional intervention in hospitalized patients identified with insufficient dietary intake would decrease the length of hospital stay and infection-related mortality.

In conclusion, the prevalence of disease-related malnutrition in hospitalized patients is high; many patients do not meet individual nutrition requirements. Our study showed that energy and protein intakes at hospital are insufficient. This insufficiency suggests that a closer dietitian interest is inevitable and routine dietetic assessment should be performed on all patients who are hospitalized at infectious disease department, so that at-risk patients for malnutrition may be identified and early nutritional intervention may be instituted during hospitalization however, also after discharge. Hospital menus usually do not cover nutritional requirements. However, most patients do not consume meals completely. Patients who experienced the worst health status consumed the least. Therefore, it is necessary to re-evaluate them and plan a specific one for patients who hopitalized at infectious disease department. In our study, patients with more body weight experienced more calorie and protein deficiency during their hospital stay. These findings are important, however are needed to be confirmed by further investigation.

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