Clinical Nutrition ESPEN 10 (2015) e107–e111

Contents lists available at ScienceDirect

Clinical Nutrition ESPEN

journal homepage: http://www.clinicalnutritionespen.com

Original article

Energy- and protein intake of surgical patients after the implementation of energy dense hospital menus

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ARTICLE INFO

Article history:
Received 21 August 2014
Accepted 24 March 2015

Keywords:
Patients
Energy intake
Hospital
Energy density

SUMMARY

Background and aims: Malnutrition is common among hospitalized patients and is associated with negative health consequences. Oral nutrition supplements (ONS) have been used to improve nutritional status of malnourished patients. Considering the costs and the sometimes poor acceptance of ONS, the present study investigated the effects of changing hospital food composition on patients' energy- and protein intake.

Methods: One-hundred-and-six patients admitted to the Department of Cardio Thoracic Surgery at University Hospital in Iceland in 2013 were recruited. Inclusion criteria were age ≥18 years, hospital stay of ≥five days and ability to eat. In 2012 a new hospital menu was implemented and the meals contain more energy dense foods in comparison to earlier. Energy- and protein intake from the five meals provided daily were estimated using a validated plate diagram sheet on days 3–5 after surgery and compared to similar data retrieved in 2011.

Results: In 2013 92 participants finished the study, data from 69 patients were available from 2011. Energy- and protein requirements were similar between years. Energy provided by meals was higher in 2013 (1711 ± 199 vs. 1946 ± 65 kcal, $P < 0.001$), accordingly energy intake from meals was higher in 2013 (1096 ± 340 vs. 1293 ± 386 kcal/d; $P = 0.001$). Protein intake from meals was not different. However, the total energy- and protein intake of patients was unchanged between 2011 (1374 ± 394 kcal; 62.1 ± 17.8 g) and 2013 (1452 ± 389 kcal; 60.2 ± 17.2 g) because the consumption of in-between meals (ONS or food brought from home) was less in the 2013 (170 ± 171 vs. 282 ± 207kcal, $P < 0.001$ and 13.2 ± 10.3 vs. 6.9 ± 6.5 g, $P < 0.001$, respectively).

Conclusions: Our study shows that an increase in energy density increases energy consumed from hospital meals, however, they did not increase total energy intake due to a decrease in use of ONS and home brought food.

1. Introduction

Malnutrition is common among hospitalized patients and is associated with negative consequences, e.g., higher rates of complications [1–4] and longer hospital stay [5,6]. Frequently, patients are malnourished on admission and in many cases malnourishment worsens during hospital stay [4,7] which is possibly caused by poor food intake and/or progressing disease [8]. Traditionally, ready-to-use oral nutrition supplements (ONS) have been used to improve nutritional status of malnourished patients [9,10]. However, only few studies have assessed the effects of changing hospital food composition on energy intake or bodyweight of patients [11,12] as an alternative to ONS. This might be an interesting option considering the costs of ONS and sometimes poor acceptance of ONS in patients [13–15].

In a previous study in autumn 2011, our group found that energy- and protein intake of patients at the Department of Cardio-Thoracic Surgery at the University Hospital in Reykjavik, Iceland

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http://dx.doi.org/10.1016/j.clnesp.2015.03.081

was considerably lower than estimated energy- and protein requirements [16,17]. Furthermore, about 36% of the food provided by the kitchen was not eaten at all [16,17] and thus discarded. Independent from our study in 2011, hospital menus were changed in 2012, with the aim of suiting better patients' energy needs, i.e., the energy density of the meals was increased by including energy dense ingredients or food items in meal preparation [18].

In order to see whether increased energy density in hospital meals affects dietary intake in patients, the aim of the present study was to compare data from 2011 to 2013 and to investigate:

1) energy and protein provided by served hospital meals,
2) actual amount of energy and protein consumed from the hospital meals, and
3) total amount of energy and protein consumed daily with inclusion of ONS or food brought from home.
4) whether changes in hospitals meals lead to increased energy- or protein intake.

Participants were surgical patients at the Department of Cardio Thoracic Surgery and the results were compared to results from the study of 2011. A secondary aim was to explore whether the implementation of the new menus affected food waste.

2. Material and methods

2.1. Subjects

One-hundred-and-six patients admitted to the Department of Cardio Thoracic Surgery at the Landspitali-University Hospital in Iceland from August to December 2013 were recruited. The inclusion criteria were the same as in the previous study conducted in 2011 [17]: Age $\geq$ 18 years, an estimated hospital stay of at least five days and ability to eat *per os*. The study was approved by the hospital's Bioethics Committee (29/2011) and all persons gave their informed consent prior to their inclusion in the study.

2.2. Implementation of a new menu

In 2012 a new hospital menu was implemented at our hospital which was based on the Swedish recommendations for hospital patients [18] and on recommendations made for the general public [19]. The menu contains more energy dense foods in comparison to earlier. Energy and protein distribution throughout the day did not change, however the amount of food to be eaten to achieve a given amount of kcal has decreased. Energy density was increased both by adding ingredients such as butter and cream to recipes and by decreasing portions sizes of foods with low energy density. For example the mean amount of potatoes given in study 2011 was 100 g but was 80 g in study 2013. The mean amount of soup given in study 2011 was 200 mL but was 180 mL in study 2013. However, typical meals from the old menu and from the new menu, e.g., lunch, provide roughly the same amount of energy (582 and 600 kcal, respectively) and protein (21.8 and 22.5 g, respectively) (values calculated).

2.3. Assessment of energy and protein intake

Energy- and protein intake of patients from the five meals provided daily by the hospital kitchen were estimated using a validated plate diagram sheet [17] on the third to fifth day after surgery in both studies. After each meal, trained ward staff estimated the proportion of the meal consumed (0%, 25%, 50%, 100%). The plate diagram sheet has previously been shown to estimate energy and protein intakes with fair accuracy in hospitalized patients, especially at the group level [17]. Food and beverages consumed in between meals, such as ONS, which were mostly milk-based, or food brought from home and consumed in addition to the provided meals, were also recorded in both studies by hospital staff. Energy and protein content from hospital food as well as from home brought food were analyzed using Kostplan for Windows, version 1.0 (AIVO AB, Stockholm, 1996) in the 2011 study and using Aivo2000 for Windows, version 1.12.0.1 (AIVO AB, Stockholm, 2012) in the 2013 study. Both programs used the Icelandic nutrient composition database (ISGEM). None of participants received enteral or parenteral nutrition during the registration days.

2.4. Other information

Reasons for hospital admission and information about height and weight were collected through hospital medical record. Energy- and protein requirements were based on lower values of estimated energy- and protein requirements according to the European Society for Clinical Nutrition and metabolism (ESPEN) [20], i.e., 25 kcal/kg body weight/d and 1.2 g/kg body weight/d, respectively. The estimation presumes that the patient's BMI is < 25 kg/m^2. Adjustments were made before calculations if a patient's BMI was $\geq$25 kg/m^2 [21] and consequently calculations were made according to a BMI = 25. Thus, energy- and protein requirements shown in Table 1 are based on adjusted body weight for participants with BMI $\geq$25 kg/m^2.

2.5. Statistical analysis

Statistical analyses were carried out using SPSS (IBM, Statistical Package for the Social Science, version 20). Data are shown as mean ± standard deviation (SD). According to power calculations we estimated that our sample size of 69/91 participants was sufficient to identify a difference of 150 kcal between groups as significant (power 0.8, alpha 0.05). Independent sample t-test was used for comparison of the characteristics of subjects in the 2011 and 2013 studies. Multivariate linear regression was used to investigate the adjusted mean difference and 95% CI's for the two studies. Adjustments were made for potential confounding variables, such as sex, patients group (heart- or thoracic surgery) and estimated energy need [20]. Statistical significance was set to be $p < 0.05$.

Table 1
Patients' characteristics.

	Study 2011 (n = 69)	Study 2013 (n = 92)	*p*-value
Male *n* (%)	49 (71.0)	71 (77.2)	
Female *n* (%)	20 (29.0)	21 (22.8)	
Cardiovascular surgery patients *n* (%)	54 (78.3)	71 (77.2)	
Thoracic surgery patients *n* (%)	15 (21.7)	21 (22.8)	
Age[a]	62.9 ± 16.8	62.8 ± 13.7	0.951
Weight (kg)[a]	82.4 ± 18.6	84.7 ± 14.2	0.375
Height (cm)[a]	173.2 ± 9.6	174.5 ± 9.4	0.405
BMI (kg/m^2)[a]	27.4 ± 5.0	27.8 ± 4.0	0.529
Energy requirement (kcal/day)[a,b]	1906 ± 278	1953 ± 267	0.278
Protein requirement (g/day)[a,b]	80.9 ± 8.63	82.0 ± 8.47	0.408

[a] Values are based on independent samples T-test and reflect the mean ± SD.
[b] Calculations are based on lower value of estimated energy- and protein requirement for other than ICU patients (25 kcal/kg/day) and (1.2/kg/day). Adjustments were made before calculations if a patients BMI was >25/kg/m^2. Where kcal per kilogram body weight or grams protein per kilogram body weight are presented they refer to the adjusted weights of overweight subjects.