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Intake of Dietary Supplements and Malnutrition in Patients in Intensive Care Unit

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Abstract

Background:

Malnutrition is prevalent among patients hospitalized in Intensive Care Units (ICUs) and causes various complications. Dietary supplementation to provide appropriate nutritional support may reduce the malnutrition and complications through improvement in nutritional status. This study was carried out to assess the association between dietary supplementation and malnutrition among patients in ICUs.

Methods:

A case–control study was conducted on 180 male patients aged 20–60 years in the ICUs of the hospitals in Ahvaz, Iran in 2013. Data of two groups including 83 patients (cases) who had consumed regular hospital meals and dietary supplements and 97 patients (controls) who had received regular hospital meals were compared. Anthropometric measurements, laboratory values, and dietary intakes were extracted from medical records, and Maastricht index (MI) was calculated. Data were analyzed using the IBM SPSS Statistics 21. *T*-test and paired-sample *t*-test were used to determine the difference between groups.

Results:

Taking supplements increased daily energy intake, carbohydrate, and protein in case group ($n = 83$) significantly ($P < 0.05$). MI changed to 3.1 ± 3.8 and 4.3 ± 4.2 in case ($n = 83$) and control ($n = 97$) groups, respectively. Although the MI fell in both groups, it showed a greater reduction in case group (from 6.3 ± 5.3 to 3.1 ± 3.8).

Conclusions:

Since consuming dietary supplements besides the regular hospital meals increased intake of energy and macronutrients and reduced the MI significantly, it was concluded that it helped supply nutritional requirements more effectively and improved the malnutrition in ICU.

Keywords: Dietary supplement, Intensive Care Unit, Maastricht index, malnutrition, nutritional status

INTRODUCTION

Supply of nutritional requirements is vital for all patients, especially for who cannot meet their nutritional needs normally.[1] In addition, appropriate and timely nutritional support results in reducing mortality rate in hospitalized patients.[2] Patients of Intensive Care Unit (ICU) need special medical care including nutritional care because of the complications caused by acute reaction or dysfunction of one or more body organs including the cardiovascular or respiratory systems.[3] The prevalence of malnutrition is estimated at 50% and 43% for the patients of the general ward and ICU, respectively. Besides, 15–70% of patients suffer from malnutrition on the admission to the hospitals.[4] In recent years, according to the Acute Physiology and Chronic Health Evaluation, mortality rate in ICUs is reported at 13.6–36%.[5] The high prevalence of malnutrition can be caused by the hypermetabolic state, anorexia, admission of the malnourished patients, and hospital infections.[6,7,8] Malnutrition brings several disadvantages, namely, increase in the length of hospitalization, delay in wound healing, immune system dysfunction, loss of muscle mass, and eventually death.[9] Providing the calorie and macronutrients requirements, supportive formulas, and immediate and continuous nutritional assessments can prevent these disadvantages.[10,11] Moreover, consumption of dietary supplements containing multivitamins and minerals can improve the appetite.[12] Thus, anorexia as a prevalent outcome of hospitalization can be prevented to some extent and patients would receive more energy and macronutrients, subsequently.[12] Finally, it may reduce the malnutrition and death rate in the hospitals.[12] Besides the treatment of primary disease, providing the energy requirement of the tissues and organs is the most significant action to rehabilitate the malnourished patients. Nutritional assessment includes biochemical analyses, anthropometric measurements, clinical observation, and dietary evaluation. Biochemical analysis is inevitable to assess the clinical and subclinical deficiencies. Albumin which is a biochemical parameter decreases subsequently in mild and moderate malnutrition.[13] Anthropometric measurements including measurements of body weight and body mass index (BMI) are common methods to screen the malnutrition in hospitalized patients. Malnutrition is defined by more than 10% weight loss or BMI <18.5 kg/m^2.[14] Maastricht index (MI) is one of the best indicators to evaluate nutritional status among the patients. Both anthropometric indicators and biochemical parameters, namely, albumin, prealbumin, and total lymphocyte count (TLC), are involved in MI calculation.[15,16,17] Due to the high prevalence of malnutrition in patients of ICUs and the probable advantage of the dietary supplements on the malnutrition, this study aimed to evaluate the relationship between dietary supplementation and malnutrition status among the patients admitted to the ICUs in Ahvaz, Iran.

METHODS

This case–control study was conducted on 180 patients in 2013. Data were extracted from the medical records of the patients in ICUs in hospitals in Ahvaz, Iran. Participants were 20–60 years old men and could receive their food orally. Those who suffered from malnutrition at admission, diabetes, liver, or kidney diseases were excluded (diabetes, liver, and kidney diseases cause restriction in taking dietary supplements).

Ethical clearance was obtained from the University Research Ethics Committee of Ahvaz Jundishapur University of Medical Sciences, Iran and written informed consent was obtained to use the information of their medical records.

Participants included case group (n = 83) who had consumed regular hospital meals with supplements and control group (n = 97) who had received only regular hospital meals. Regular hospital meals had been provided to both groups during the study.

Anthropometric measurements including weight and height, intakes of energy and macronutrients, and laboratory values including albumin, prealbumin, and TLC were extracted from the medical records of the patients at the start and end of a 10-day period of hospitalization in ICUs. BMI and MI were calculated.

Ideal body weight (IBW), which was used to calculate the Maastricht Index, was determined by its specific formula.[13] MI was determined for all patients using the following formula:[16]

MI = 20.68 − (0.24 × serum albumin g/L) − (19.21 × serum prealbumin g/L) − (1.86 × TLC [106 cells/L])

− (0.04 × IBW).

The result of this calculation is a score which determines the level of malnutrition in the patient. Scores lower than zero indicate nutritional adequacy while zero and greater values determine the malnutrition status.[15,16,17]

The dietary supplement used was Fortimel (Nutricia Factory, the Netherlands) [Table 1]. Case group had received one-third to half of their energy requirements from supplement and the rest had been from regular hospital meals. In control group, all nutritional needs including daily energy had been supplied by the hospital meals alone. Energy requirement had been calculated using resting metabolic rate based on the physical activity level, stress, surgery, infection, and disease by ICU nutritionists and dietitians. The amounts, compositions and frequency of meals, probable plate wastes, and supplements had been recorded by the expert nutritionists and dietitians of ICUs in hospitals in the medical records of the patients. In this study, this information was used to calculate the intakes of energy, macronutrients, and dietary supplements using 7-day food record by the Nutritionist 4 software version 3.5.2 (N-Squared Computing, San Bruno, CA, USA).

In general, the normal range of serum albumin is proposed as 3.4–5.4 g/dL. Low levels of albumin can indicate different complications, namely, malnutrition.[18] Prealbumin is a marker in monitoring the response to the nutritional support. Its reference value is 19–38 mg/dL.[19]

Data were analyzed using the IBM SPSS statistics 21 (IBM Corp., Armonk, NY, USA). Normal distribution of data was tested using skewness. Skewness values between −2 and +2 were considered acceptable. *T*-test and paired-sample *t*-test were used to compare the groups. $P < 0.05$ was considered statistically significant.

RESULTS

In this study, there were no significant differences between the age of the case (54.3 ± 8.7 years) and control (55.1 ± 9.2 years) groups ($P > 0.05$). In addition, IBW of cases (78.1 ± 7.9 kg) and controls (80.3 ± 8.7 kg) was not statistically different ($P > 0.05$). While there were no significant differences in energy intake and the percentage of energy from macronutrients between two groups at the baseline of the study, daily intake of energy, carbohydrate, and protein of the case group was significantly higher at the end of the study ($P \leq 0.01$) [Table 2].

Results of this study showed that in case group, albumin (35.8 ± 6.1 g/L) and prealbumin (18.3 ± 6.7 mg/L) were significantly higher and TLC (1327.865 ± 901.1 cell/mm^3) was significantly lower at the 10^{th} day ($P = 0.001$) whereas the two groups had no significant differences at the beginning of this study ($P > 0.05$) [Table 3]. In addition, MI, which had no differences between case (6.3 ± 5.3) and control (4.7 ± 4.2) groups at the baseline of the study ($P = 0.06$), declined significantly after 10 days in both groups with a greater drop in those in case group (MI: Case group: 3.1 ± 3.8; control group: 4.3 ± 4.2, $P = 0.001$) [Table 4].

DISCUSSION

Results of this study showed that consuming dietary supplements besides the regular hospital meals can help the patients to meet their nutritional needs and improve their malnutrition. This is consistent with the findings of the study in Tehran, Iran, by Hosseinpour-Niazi *et al*. who found that dietary supplements increased BMI of the patients by one unit and reduced the prevalence of malnutrition by 17%.[17] In addition, another study among 100 patients in ICU showed that 61% of patients received insufficient daily energy from regular hospital meals and the mid-arm circumference which indicates malnutrition severity declined in 69%. Therefore, they concluded that ICU patients were at risk of failing to meet their nutritional requirements and dietary supplementation besides the regular hospital meals was necessary to avoid this problem.[20] Moreover, it is approved that dietary supplementation of ICU patients not only improves laboratory values but also decreases the malnutrition and mortality rate caused by infection.[21]

In this cross-sectional study, dietary supplement was a commercial formula. It provided the standard amounts of energy and nutrients. Interestingly, Abbasinazari *et al*. who compared the nutritional status of two groups of patients received enteral nutrition showed that patients who consumed the commercial formula had lower MI than those who received hospital-made formula. This result approved the better nutritional status of patients who were fed by the standard feeding formula.[22]

Results of this study showed that dietary supplements significantly increased intake of energy, carbohydrate, and protein, reduced malnutrition severity, and improved nutritional status and laboratory values including albumin, prealbumin, and TLC in ICU patients. Similarly, another study on 207 patients in ICU showed that increased amounts of energy and protein led to lower rate of infection and better clinical outcomes.[23] In addition, Alberda *et al*. in an observational cohort study in 167 ICU centers in 37 countries found that an increase of 1000 kcal/day in energy intake or 30 g/day in protein intake was related to reduced 60-day mortality rate and increased number of days that patients could live without ventilator. These effects were reported in patients who had a BMI of <25 kg/m^2 or equal or >35 kg/m^2 while those who had a BMI between 25 kg/m^2 and 35 kg/m^2 showed no significant association. They concluded that increased intake of energy and protein improved clinical outcomes in critically ill patients with BMI <25 kg/m^2 or >35 kg/m^2.[24]

This study had some limitations similar to other studies. First, the inclusion of only male patients reduced the representativeness of the sample and thus the generalizability of results. In addition, patients who needed enteral nutrition were not included.

CONCLUSIONS

Dietary supplements alongside the regular hospital meals may help provide the nutritional requirements including energy and macronutrients more effectively and prevent or improve malnutrition in ICU patients, subsequently. Further research including randomized clinical trials is needed to approve the effect of dietary supplementation on the malnutrition status in ICU.

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Conflicts of Interest

There are no conflicts of interests.

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Figures and Tables

Table 1

Average contents	In 100 g	In 100 ml (23 g powder)
Energy (kcal)	420	100
Protein (g)	21.9	5
Fat (g)	14.5	3.3
Carbohydrate (g)	53.5	12.3
Fiber (g)	2.6	0.6
Osmolarity (mOsmol/L)	370	-

Dietary information of the Fortimel supplement

Table 2

Variables	Mean±SD		P^a
	Case	Control	
BMI (kg/m^2)			
Base	23.8±2.7	24.1±3.4	0.07
10th day	24.3±2.7	23.9±3.4	0.05
P^b	0.04	0.05	-
Energy (kcal)			
Base	1928±291	2119±235	0.05
10th day	2321±188	2062±241	0.001
P^b	0.001	0.08	-
Carbohydrate (%EI)			
Base	51±3.6	51±2.8	0.05
10th day	54±4.1	52±3.2	0.01
P^b	0.02	0.1	-
Protein (%EI)			
Base	20±4.6	19±5.6	0.05
10th day	23±4.4	19±4.5	0.001
P^b	0.01	0.09	-
Fat (%EI)			
Base	29±3.6	28±3.6	0.05
10th day	23±3.6	29±3.6	0.001
P^b	0.001	0.07	-

%EI: Percentage of energy intake; $^a P$ value for independent sample *t*-test, $^b P$ value for paired sample *t*-test. SD: Standard deviation, BMI: Body mass index

Comparison of body mass index, energy intake, and percentage of energy from macronutrients between two groups

Table 3

Variables	Mean±SD		P^a
	Case (dietary supplements + regular hospital meals)	Control (regular hospital meals)	
Albumin (g/L)			
Base	32.3±4.2	33.4±5.2	0.07
10th day	35.8±6.1	33.9±5.4	0.001
P^b	0.02	0.18	-
Prealbumin (mg/L)			
Base	10.8±5.5	10.1±4.1	0.07
10th day	18.3±6.7	11.3±4.9	0.001
P^b	0.001	0.08	-
Total lymphocyte count (cell/mm^3)			
Base	2713.933±510.2	1943.886±645.2	0.06
10th day	1327.865±901.1	1432.924±832.2	0.001
P^b	0.001	0.06	-

[a]*P* value for Independent sample *t*-test, [b]*P* value for paired sample *t*-test. SD: Standard deviation

Comparison of albumin, prealbumin, and total lymphocyte count between two groups

Table 4

Maastricht index	Mean±SD		P^a
	Case (dietary supplements + regular hospital meals)	Control (regular hospital meals)	
Base	6.3±5.3	4.7±4.2	0.06
10th day	3.1±3.8	4.3±4.2	0.001
P^b	0.001	0.07	-

[a]P value for independent sample *t*-test, [b]P value for paired sample *t*-test. SD: Standard deviation

Comparison of Maastricht index between two groups