



Original Article

## Nutritional status and management of risks due to physical therapy in patients hospitalized for long periods

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**Abstract.** [Purpose] This study aimed to understand the nutritional status of patients hospitalized for long periods and the risk of physical therapy (PT) for such patients. [Subjects and Methods] Participants were selected from patients who were hospitalized at a designated medical long-term care sanatorium. The participants were divided into 5 groups (A–E) depending on their mode of energy intake and ambulatory ability during PT. The serum albumin level, energy intake, total daily energy expenditure, and total daily energy expenditure per session of PT (EEPT) were evaluated for each group. [Results] Protein-energy malnutrition was observed in 69.6% of the participants. No significant association was identified between the serum albumin level and body mass index. Energy intake was significantly higher in Groups D and E, whose energy intake was via ingestion, than in Groups A and B, whose intake was via tube feeding. EEPT was highest in patients of Group E who had gait independence different from the ability of those in groups A–D. [Conclusion] The actual energy intake is lower with tube feeding than with ingestion. Risk management and energy intake should be revisited in elderly patients who have been hospitalized for long periods and subsequently obtain gait independence.

**Key words:** Malnutrition, Long hospitalization period, Energy balance

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### INTRODUCTION

During 2005–2006, the Japanese Ministry of Health, Labour and Welfare declared that all designated medical long-term care sanatoriums be abolished by March 2011. However, in 2011, the ministry postponed the term until March 2017 because it was difficult to transfer elderly patients and those whose conditions were severe to long-term care health facilities in order to obtain medical treatment. This suggests that there is an increasing number of elderly patients in Japan, a nation with an aging population, who require long-term hospitalization. This in turn results in increasing demands for physical therapy (PT) and medical care in the chronic phase to treat underlying diseases and complications<sup>1</sup>.

The type of PT required in the chronic phase differs from that required during other disease phases considering the nutritional status of the patient. However, limited attention has been given to nutritional assessment, including blood tests, during the chronic phase, which warrants consideration when elderly patients who are hospitalized for long periods are prescribed

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PT. A recent study reported that 40–50% of community-dwelling elderly patients who qualified for long-term care insurance in Japan were malnourished<sup>2</sup>); additionally, almost 60% of elderly patients in hospitals may be malnourished<sup>3–5</sup>).

In a previous study, protein-energy malnutrition (PEM) was observed in 20–70% of patients with chronic obstructive pulmonary disease, 50% of post-stroke patients, and 12–50% of patients with dementia<sup>6</sup>). Malnutrition is known to greatly influence patient prognosis, development of pressure ulcers, and rehabilitation outcomes<sup>7–10</sup>). Therefore, for elderly patients in the chronic phase of a disease, PT should be indicated in consideration of the patient's nutritional status. However, limited knowledge is available regarding the relationship between nutritional status and PT during the chronic phase of a disease.

The purpose of this study was to understand what nutritional status-related factors should be considered when elderly patients who are hospitalized for long periods are treated with PT. We evaluated the serum albumin level, energy intake, total daily energy expenditure (TEE), and energy expenditure per session of PT (EEPT), which reflects ambulatory ability during PT and the mode of nutrient intake, such as ingestion or tube feeding, which is a factor associated with inadequate nutrition intake<sup>11</sup>).

## SUBJECTS AND METHODS

Participants (34 female and 11 male; age:  $80.0 \pm 9.1$  and  $83.0 \pm 7.3$  years, respectively) were selected from among patients who were hospitalized at the Mizuho-kai Ogawa Hospital (a designated medical long-term care sanatorium) and were treated with PT during August 2012.

The participants were divided into 5 groups. Group A consisted of 8 patients ( $80.9 \pm 8.1$  years) whose nutrition intake was via tube feeding and who underwent PT while they were bed-ridden. Group B consisted of 11 patients ( $78.0 \pm 8.9$  years) whose nutrition intake was via tube feeding and who underwent PT in the sitting position. Group C consisted of 11 patients ( $85.4 \pm 7.9$  years) whose nutrition intake was via ingestion and who underwent PT in the sitting position. Group D consisted of 9 patients ( $80.2 \pm 9.6$  years) whose nutrition intake was via ingestion and who underwent PT in the form of gait exercise but did not have gait independence. Group E consisted of 6 patients ( $78.3 \pm 9.0$  years) whose nutrition intake was via ingestion and who underwent PT in the form of gait exercise and had gait independence.

This study was cross-sectional in nature, approved by the human research ethics committee of the Mizuho-kai Ogawa hospital, and conducted in accordance with the guidelines proposed in the Declaration of Helsinki. This investigation was performed in cooperation with a dietitian in the hospital. Written informed consent was obtained from all participants.

Malnutrition, energy intake, TEE, and EEPT were evaluated using the following method. The body mass index (BMI) and serum albumin levels were used as indices of malnutrition. For the purpose of this study, a serum albumin level below 3.5 g/dl or BMI below  $18.5 \text{ kg/m}^2$  was considered to indicate malnutrition. Energy intake was estimated using medical records compiled by a dietitian in the hospital every day. TEE was evaluated by using the Harris Benedict equation for a single day. EEPT was estimated using the following formula: energy expenditure value (kcal/kg/min)  $\times$  body weight (kg)  $\times$  duration of activity during PT (20 or 40 minutes)  $\times$  correction factor. We presumed that the energy expenditure value in the Japanese would be lower than that in Caucasians owing to differences in height and weight; therefore, the energy expenditure value reported in the Omori study was used as a reference to calculate energy expenditure during activities of daily living among the Japanese patients<sup>12</sup>). Moreover, the “energy balance without PT-associated energy load” was calculated by subtracting the TEE from the energy intake, and the “energy balance with PT-associated energy load” was calculated by subtracting the EEPT from the “energy balance without PT-associated energy load.”

Differences between groups in terms of TEE, energy intake, EEPT, and energy balance with and without PT-associated energy load were analyzed based on the one-way analysis of variance using the SPSS ver. 23 (SPSS, Chicago, IL, USA). A post hoc test (Bonferroni correction) was applied to identify differences between groups. Differences in TEE and energy intake between groups were analyzed using the t-test. The results of statistical tests were considered significant when  $p < 0.05$ .

## RESULTS

Results are expressed as the mean  $\pm$  standard deviation (SD) or percentage. The levels of long-term care required by participants in the Mizuho-kai Ogawa Hospital were as follows: care level 5, 58.4%; care level 4, 30.0%; care level 3, 7.6%; care level 2, 2.7%; care level 1, 1.1%. The required rate of the level of long-term care (care level  $>3$ ) was almost the same between the Mizuho-kai Ogawa Hospital and the designated medical long-term care sanatoriums in Japan, as reported by the Ministry of Health, Labour and Welfare, in 2012.

The mean serum albumin level was 3.21 g/dl (SD=0.50) and the mean BMI was  $17.8 \text{ kg/m}^2$  (SD=2.9). A total of 69.6% participants showed PEM. No significant association between the serum albumin level and BMI was observed ( $r=0.168$ ,  $p=0.27$ ). Table 1 shows the relationship between the serum albumin level and BMI for each group; there were no significant differences between the groups.

Table 2 shows the difference in the energy balance of each group. There were no significant differences between the groups with regard to TEE. Energy intake was significantly higher in Groups D and E than in Groups A and B. EEPT was significantly higher in Group E than in the other groups. Furthermore, there were significant changes in the energy intake and TEE in Group A and B.

**Table 1.** Relationship between serum albumin level and body mass index (BMI) in each group

	Gr.A	Gr.B	Gr.C	Gr.D	Gr.E
Alb (g/dl)	3.1 ± 0.5	3.0 ± 0.5	3.1 ± 0.5	3.5 ± 0.4	3.7 ± 0.5
BMI (kg/m <sup>2</sup> )	17.2 ± 3.9	16.8 ± 2.9	18.6 ± 2.1	18.6 ± 2.0	18.7 ± 3.9
Correlation coefficient	0.169	0.215	-0.531	-0.258	0.59

**Table 2.** Difference in energy balance in each group

	Gr.A	Gr.B	Gr.C	Gr.D	Gr.E
TEE	1,184.3 ± 256.7*	1,151.8 ± 207.5*	1,197.0 ± 163.9	1,228.9 ± 179.6	1,442.7 ± 264.3
Energy intake	876.9 ± 330.1*	872.7 ± 119.1*	1,162.7 ± 283.0	1,339.4 ± 230.5*	1,450.0 ± 197.5*
EEPT	8.9 ± 3.2	10.2 ± 4.5	14.4 ± 5.9	28.5 ± 14.2	65.7 ± 33.8*
Energy balance without PT-associated energy load	-307.4 ± 315.1	-279.1 ± 267.8	-34.2 ± 394.0	110.5 ± 228.4	7.3 ± 149.8
Energy balance with PT-associated energy load	-316.3 ± 313.3	-289.3 ± 269.3	-48.6 ± 393.7	82.0 ± 233.5	-58.4 ± 187.1

Mean ± SD (kcal), \*p<0.05

Gr.: Group; TEE: total daily energy expenditure; EEPT: energy expenditure per session of physical therapy

## DISCUSSION

The main purpose of this study was to understand the nutritional status of patients who were hospitalized for long periods and the risk of PT for such patients. Herein, 69.6% of our study participants demonstrated PEM on the basis of their serum albumin level and 65.2% on the basis of their BMI, similar to previous studies that also reported that >60% of elderly patients in hospitals were at risk for malnutrition<sup>13, 14</sup>. Previous studies have also found that serum albumin level and BMI were not always equally associated with malnutrition in patients<sup>15-17</sup>. Similarly, we found no association between the serum albumin level and BMI; however, the relationships between the serum albumin level and BMI within groups were not the same. Thus, it is likely that the relationship between the serum albumin level and BMI could change according to the patient's ambulatory ability during PT and the mode of nutrient intake.

Our results showed that, in Group A and B, the energy intake was lower than the TEE. Moreover, regardless of the patient's ambulatory ability, the average energy balance without PT-associated energy load was negative in patients whose energy intake was via tube feeding (Groups A and B). Thus, the insufficient energy intake in these patients might be promoted by PT. In Group C, the average of energy balance between with and without PT-associated energy load was negative. Therefore, the energy intake via ingestion might be insufficient. In Group D, wherein the serum albumin levels were almost the same as the threshold level, increasing physical activity would likely result in insufficient intake of protein, even though the average energy balance with PT-associated energy load was positive. Moreover, in group E, the average energy balance with PT-associated energy load was negative. This indicated that energy expenditure is increased by improvement in gait ability, which would promote malnutrition in patients treated with PT. Additionally, the EEPT in Group E was higher than that in the other groups, including Group D. If patients, such as those in Group D whose energy balance with PT-associated energy load was positive, obtain gait independence, then the physical therapist should reconsider their risk management and energy intake by consulting a dietitian in the hospital. Furthermore, PT-associated energy load might negatively affect the energy balance of all groups.

There are several limitations of this study. First, only a small number of patients obtained gait independence. Second, the TEE calculated using the Harris Benedict equation does not reflect the total energy expenditure. Third, the EEPT was estimated on the basis of the energy expenditure value for healthy Japanese individuals in the Omori study. Accordingly, the TEE and EEPT may be lower than the actual energy expenditure because the participants had several underlying diseases and complications, which would result in increased activity and stress. If the TEE and EEPT calculated in this study are lower than the actual energy expenditure, then the risk of PT will be higher.

In conclusion, this study is important because the results indicate that malnutrition in patients hospitalized for long periods occurred owing to changes in their ambulatory ability during PT and the mode of nutrient intake. Such patients would benefit from closer examination of this critically important but typically understudied topic.

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