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# Education Program for Male Patients with Chronic Obstructive Pulmonary Disease to Change Dietary Behavior

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**Patients with chronic obstructive pulmonary disease (COPD) need to maintain proper eating behavior in order to maintain muscle mass and prevent weight loss. In this study, we measured the effects of a support program on patient attitude, social influences, and self-efficacy and aimed to positively change their dietary behavior. We recruited male patients from two Japanese outpatient clinics and assigned each to an intervention or a control group. The intervention group participated in a support program and was assisted in acquiring knowledge and skills related to adopting and maintaining suitable eating behavior. Data were gathered through medical records, patient interviews, self-assessment questionnaires, and anthropometric measurements. The follow-up period was approximately 15 weeks. The final sample comprised 22 participants, with 11 each in the intervention and control groups. In the intervention group, the body weight was maintained. However, there were statistically significant improvements in energy intake and dietary measures such as eating fresh foods, compared with the control group. The intervention was observed to increase both meal suitability and energy intake among participants. Future support programs should also incorporate participants' physical activity levels, and the effects should be studied over a longer period.**

Patients with chronic obstructive pulmonary disease (COPD), particularly those with advanced emphysema, often have severe nutritional deficits. Weight loss in COPD patients has been associated with malnourishment (1), and such patients also have high mortality rates (2); therefore, they require nutritional support. However, once these patients lose weight, it is difficult for them to regain it.

Malnourished COPD patients experience a 1.5-times increase in resting energy expenditure, as compared to the healthy population. They present with symptoms such as shortness of breath, fatigue, and reduced gastrointestinal function (3) and find it difficult to consume large amounts of food. COPD patients require an increased energy intake, which necessitates a change in diet and eating behavior. However, surveys have revealed that COPD patients do not consume enough calories to provide them with the needed energy (4,5), and do not have adequate knowledge regarding weight maintenance (6).

Dietary behavior is learned and maintained over many years as part of an individual's lifestyle and daily routine; thus, healthcare interventions seeking to change dietary behavior in isolation are not sustainable. There is a need for a behavioral science–based approach in order to determine how cognitive factors such as attitude toward diet and self-efficacy influence individual eating behavior. The influence that healthcare professionals have, in terms of providing patients with information about diet and eating behavior, also warrants investigation.

Despite the entreaties by behavioral researchers for COPD patients to live healthy lives (7) and the fact that educational interventions have demonstrated improvement in patients' nutritional knowledge (8), there has not been a concerted effort to develop and evaluate educational programs for dietary change in COPD patients. Studies investigating dietary behavioral decisions and related factors have frequently implemented health belief models (9) and stages-of-change models (10), which emphasize risk perception. Such models are not suitable for patients with COPD, as weight loss and low energy intake are not generally perceived as direct health risks. It is crucial to gain an understanding of COPD patients' attitudes toward diet and ensure the understanding and collaboration of people in their social spheres, as they have to adopt a high-energy, high-lipid diet, and eat frequent meals. The Attitude–Social Influence–Self-Efficacy (ASE) model is more appropriate for interventions related to attitudes and social factors (11). The ASE model suggests that an intention to change behavior requires instigation via influencing factors such as attitude, social influence, and self-efficacy (12). Such a model has been proposed for dietary behavior change in patients with COPD but is yet to be verified in this context (11).

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In the present study, we identified COPD patients' awareness of the importance of maintaining weight. We also introduced an intervention program, based on the ASE model (Figure 1), for COPD patients, and evaluated it by measuring changes in factors such as energy intake and body weight. The aim of this study was to implement and evaluate the ASE model as an educational support program for changing the awareness and eating behaviors of COPD patients, as it is related to weight maintenance/gain.

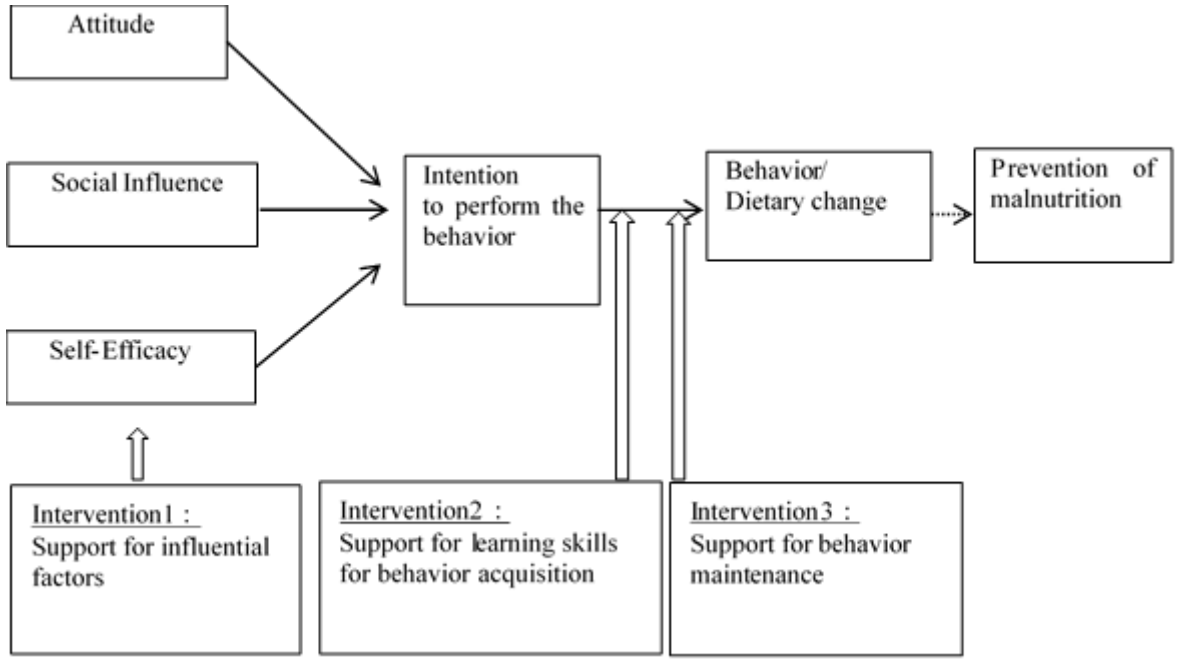


**Figure 1.** A conceptual framework based on the ASE model (De Vries & Backbier, 1994).

## MATERIALS AND METHODS

### Design

This study had a quasi-experimental design. Participants were randomly divided into an educational intervention group (the intervention group) and a regular care group (the control group) according to the order in which they were consulted. The only exception was in the case of patients receiving home oxygen therapy, who were evenly distributed between the groups.

### Sample/Participants

Participants were male COPD patients attending respiratory medicine outpatient clinics at two hospitals from September 2015 to November 2016. The global male-to-female ratio of COPD patients is approximately 2:1 (13); we focused on male patients to control for the effects sex has on eating behavior. The sample size was based on power tests calculated in a study on nutritional supplementation therapy and dietary counseling for patients with COPD (14). The authors determined that a sample size of 26 patients per group was needed for 80% power at a 5% significance level. Moreover, of the 12 studies analyzed in a systematic review of nutritional therapy for patients with COPD (15), the groups had 15 participants each on average. Although a larger group size would have been preferred, time constraints limited us to a maximum group size of 16 participants each. We excluded patients who had experienced an acute exacerbation within one month preceding the study, those aged 75 or older, obese patients (i.e. body mass index [BMI] >25), and those with cancer or a digestive disorder.

### Data collection

Data of both groups were collected at the baseline and after approximately 15 weeks. In addition to collecting participants' COPD-related data (i.e., COPD treatment history, from medical records), patients completed questionnaires (on e.g., behavioral intention, energy intake), underwent anthropometric measurements (e.g., height, weight, brachialis muscle circumference), and participated in interviews (on meal suitability, e.g., consumption of fresh and seasonal ingredients, reduced/increased frequency of meals).

**Participant attributes**

Participants reported their age, employment status, family cohabitation, nutritional education history, home oxygen therapy, and degree of shortness of breath via a questionnaire. COPD treatment history was collected from participants' medical records.

**Nutritional status**

Anthropometric measurements (brachialis muscle circumference) were performed using an Abbott Nutrition Assessment Kit (Abbott Japan Co., Ltd., Tokyo, Japan). BMI and ideal body weight percentage (%IBW) were calculated using patient height and weight. Mid-upper arm circumference/brachial circumference (AC) was determined using a measuring tape, and %AC was calculated. A formula was used to calculate arm muscle circumference (AMC) and %AMC, which are indicators of muscle protein content. In order to enhance the reliability of measured values, all measurements were performed by the same person, and the mean values of three measurements were used.

**Behavioral intention**

Behavioral intentions were assessed using a visual analogue scale from 0 (not intending to) to 10 (intending to). Respondents had to rate the degree to which they intended to practice eating behaviors that could maintain or increase their weight.

**Dietary behavior (energy intake and meal suitability)**

Energy intake was estimated using the brief-type self-administered diet history questionnaire, validated by Kobayashi et al. (16). To assess meal suitability, participants rated eight items on a scale of 1 (not at all) to 4 (always) (17). The meal suitability score was calculated by summing all item scores, and ranged from 8 to 32, with higher scores indicating more suitable meals.

**Contents of intervention program**

The dietary behavior support program involved three interventions. On three occasions (over approximately 15 weeks), support was provided to enhance influencing factors (Intervention 1), to teach skills for adopting healthy eating behavior (Intervention 2), and to teach skills for maintaining healthy eating behavior (Intervention 3).

We produced educational materials in the form of "COPD (Chronic Obstructive Pulmonary Disease) and Nutrition" pamphlets, as well as self-monitoring diaries. The pamphlets were used during each intervention session, and participants were instructed to complete one self-monitoring diary per week, which included body weight, meal composition, meal suitability, and symptoms.

Intervention 1 (4–6 weeks after baseline) involved an interview to harness influencing factors (attitude, social influence, and self-efficacy) in order to increase participants' intention to engage in dietary behavior to prevent malnutrition. Attitudes toward healthy dietary behavior were examined, correct information was supplied using pamphlets, and participants were guided to assess their dietary behavior based on energy intake and meal suitability. This intervention also involved the participation of family members, wherever possible, to increase the degree of positive social influence, as family members were often responsible for COPD patients' eating behavior. Where family members were unable to attend, participants were instructed to explain the program to them. For self-efficacy, participants had to set goals for adopting healthy, yet feasible, dietary behaviors.

Intervention 2 (8–12 weeks after baseline) involved an interview with the purpose of evaluating eating behavior and endeavoring to maintain and reinforce appropriate eating behavior. Participants kept a self-monitoring diary, which was evaluated during each interview. If eating behavior was inappropriate, this was discussed with the participant.

Intervention 3 (10–15 weeks after baseline) was a telephonic interview to support participants' continuation of healthy eating behavior.

**Statistical analysis**

Statistical analysis was performed using SPSS 20.0 for Windows (IBM Corp., Armonk, NY, USA), and we selected a statistical significance threshold of $p=0.05$. Baseline values of basic characteristics, behavioral intention, dietary behavior (i.e. energy intake and meal suitability), and nutritional status (i.e. %IBW and %AMC) were assessed for equality between the intervention and control groups using the $\chi 2$ test and Mann–Whitney U-test.

For dietary behavior and nutritional status, pre- and post-intervention differences were calculated and assessed to determine the effect of the intervention. The change in dietary behavior and nutritional status was compared between the intervention and control groups using the Mann–Whitney U-test.

**Ethical considerations**

Ethical approval was obtained from the Research Committees of our university and the two participating hospitals. This study is registered with the University Hospital Medical Information Network Clinical Trial Registry of Japan (UMIN000018943).

## RESULTS

**Participant characteristics**

We assigned 32 individuals, who gave their consent to participate in the study, to either the intervention or the control group. Several participants from each group dropped out of the study; of the 12 patients who completed the study in each group, 11 were included in the analysis, while 1 in each group was excluded as an outlier in terms of energy intake (Figure 2).

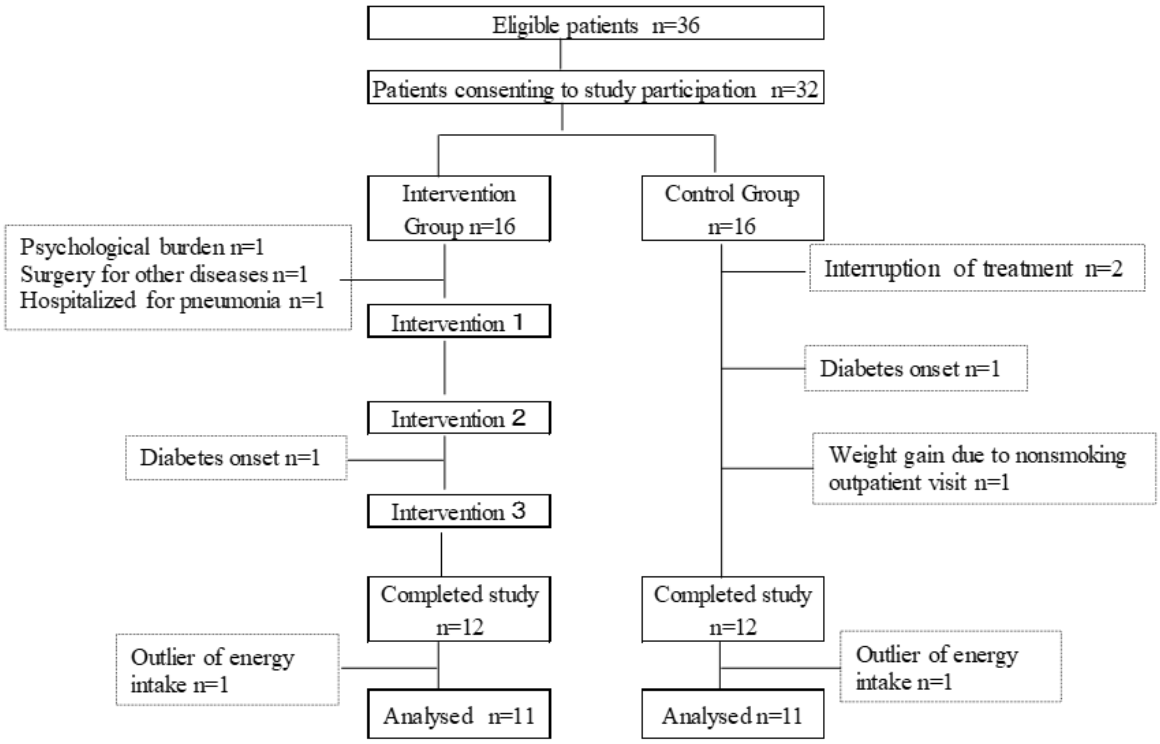


**Figure 2.** Participant flowchart.

There were no differences in terms of participant characteristics, respiratory status, dietary behavior, or nutrition between the two groups at the baseline (Table I). Two patients received home oxygen therapy in each group; those patients' spouses attended all three interventions. One participant (9.1%) in the intervention group and three (27.3%) in the control group had previously received nutritional education for COPD. Three participants (27.3%) in the intervention group and one (9.1%) in the control group prepared their own meals, while family members prepared the other participants' meals.

**Effectiveness of intervention programs**

After the intervention program, in terms of nutritional status, there was no statistically significant difference in the change in %IBW ($p=0.99$) or %AMC ($p=0.81$) between the groups (Table II).

Energy intake increased from 1,505 kcal/day to 1,754 kcal/day in the intervention group; the change in intake differed from that of the control group, which reduced over the same time period ($p=0.03$; Table III). In terms of meal suitability, the median score of the intervention group increased by 4 points, whereas the median score of the control group remained the same; there was a statistically significant difference in the change of score between these two groups ($p=0.04$; Table III).

Regarding the eight items for meal suitability, changes after the intervention were also compared between the two groups (Table IV). There was a statistically significant increase in the intervention group, as compared to the control group, for the item "Consumption of fresh and seasonal ingredients" ($p=0.04$), while the difference was

not statistically significant for the items “Reduce quantity and increase frequency of meals” (p=0.05) and “Utilization of dietary supplements” (p=0.05; Table IV).

**Table I.** Baseline characteristics of participants and comparison between the groups

| Characteristics | Intervention Group n=11 | Control Group n=11 | *p*-value‡ |
|---|---|---|---|
| Age, median (range) | 67 (61–74) | 72 (60–74) | 0.33 |
| Treatment History, median (range) | 5.0 (1.0–17.0) | 5.5 (0.3–30) | 0.90 |
| Employed, n (%) | | | *p*-value§ |
| -Yes | 5 (45.5) | 3 (27.3) | 0.66 |
| -No | 6 (54.5) | 8 (72.7) | |
| Living with Family, n (%) | | | |
| -Yes | 10 (90.9) | 9 (81.8) | 1.00 |
| -No | 1 (9.1) | 2 (18.2) | |
| Previous Nutritional Education on COPD, n (%) | | | |
| -Yes | 1 (9.1) | 3 (27.3) | 0.14 |
| -No | 10 (90.9) | 8 (72.7) | |
| Home Oxygen Therapy, n (%) | | | |
| -Yes | 2 (18.2) | 2 (18.2) | 1.00 |
| -No | 9 (81.8) | 9 (81.8) | |
| Shortness of Breath†, n (%) | | | |
| -Grade 0 | 3 (27.3) | 3 (27.3) | |
| -Grade 1 | 5 (45.5) | 4 (36.4) | |
| -Grade 2 | 2 (18.2) | 2 (18.2) | - |
| -Grade 3 | 1 (9.1) | 1 (9.1) | |
| -Grade 4 | 0 (0.0) | 1 (9.1) | |

Note. †Shortness of breath: The Modified Medical Research Council Dyspnea Scale (Mahler DA, Wells CK. Evaluation of clinical methods for rating dyspnea. Chest 93:580-586, 1988)

Grade 0: Not troubled with breathlessness except with strenuous exercise

Grade 1: Troubled by shortness of breath when walking briskly on the level or walking up a slight incline

Grade 2: Walks slower than people of the same age on the level because of breathlessness, or has to stop for breath when walking at own pace on the level

Grade 3: Stops for breath after walking approximately 100 m or after a few minutes on the level

Grade 4: Too breathless to leave the house, or breathless when dressing or undressing

‡ Mann-Whitney U-test, §$\chi 2$ test

COPD, chronic obstructive pulmonary disease

**Table II**. Comparison of changes in nutritional status after intervention between the groups

| Characteristics | Intervention Group n=11 Median (interquartile range) | | | Control Group n=11 Median (interquartile range) | | | *p*-value§ |
|---|---|---|---|---|---|---|---|
| | Pre | Post | Change | Pre | Post | Change | |
| %IBW | 98.9 (36.0) | 97.9 (31.4) | 0.3 (6.6) | 95.2 (29.7) | 96.1 (42.1) | 0.4 (56.5) | 0.99 |
| %AMC | 88.7 (27.0) | 88.1 (44.1) | -7.3 (35.2) | 88.3 (35.9) | 83.5 (28.6) | -2.3 (38.5) | 0.81 |

Note. %IBW: % Ideal Body Weight; %AMC: % Arm Muscle Circumference

§ Mann-Whitney U-test

**Table III.** Comparison of changes in behavioral intention after intervention between the groups

| Characteristics | Intervention Group n=11 Median (interquartile range) | | | Control Group n=11 Median (interquartile range) | | | *p*-value§ |
|---|---|---|---|---|---|---|---|
| | Pre | Post | Change | Pre | Post | Change | |
| Behavioral Intention † | 6.8 (7.0) | 8.2 (9.4) | 0.6 (8.4) | 6.2 (5.2) | 5.5 (10.0) | -0.2 (10.8) | 0.07 |
| Meal Suitability Score‡ | 18.0 (15.0) | 21.0 (15.0) | 4.0 (11.0) | 17.0 (17.0) | 16.0 (16.0) | 0.0 (16.0) | 0.04* |
| Energy Intake (kcal/day) | 1,505 (1,750) | 1,754 (3,654) | 376 (2,618) | 1,675 (2,669) | 1,609 (1,155) | -50 (2,690) | 0.03* |

Note. † Behavioral Intention: rated on a visual analogue scale from 0 (not intending to do) to 10 (intending to do)

‡ Meal Suitability Score: calculated as the sum of all item scores, ranging from 8 to 32

§ Mann-Whitney U-test, * $p<0.05$

**Table IV.** Comparison of changes in dietary behavior after intervention between the groups

| Characteristics | Intervention Group n=11 Median (interquartile range) | | | Control Group n=11 Median (interquartile range) | | | *p*-value§ |
|---|---|---|---|---|---|---|---|
| | Pre | Post | Change | Pre | Post | Change | |
| Quit smoking | 4.0 (3.0) | 4.0 (3.0) | 0.0 (2.0) | 4.0 (2.0) | 4.0 (2.0) | 0.0 (-3.0) | 0.50 |
| Reduce quantity and increase frequency | 1.0 (2.0) | 2.0 (2.0) | 0.0 (2.0) | 1.0 (2.0) | 1.0 (1.0) | 0.0 (-2.0) | 0.05 |
| Consume small amounts of high-energy, high-protein foods | 1.0 (2.0) | 3.0 (3.0) | 1.0 (3.0) | 1.0 (3.0) | 1.0 (3.0) | 0.0 (-1.0) | 0.16 |
| Avoid foods that cause bloating | 1.0 (3.0) | 2.0 (3.0) | 1.0 (4.0) | 2.0 (3.0) | 1.5 (3.0) | 0.0 (-1.0) | 0.11 |
| Include refreshing food | 3.0 (2.0) | 3.0 (2.0) | 0.0 (2.0) | 2.5 (3.0) | 2.5 (3.0) | 0.0 (-2.0) | 0.55 |
| Preparation of the eating environment | 3.0 (3.0) | 3.0 (3.0) | 0.0 (3.0) | 2.0 (3.0) | 1.5 (3.0) | 0.0 (-2.0) | 0.13 |
| Consumption of fresh and seasonal ingredients | 3.0 (2.0) | 3.0 (3.0) | 0.0 (2.0) | 3.0 (3.0) | 2.5 (2.0) | -0.5 (-2.0) | 0.04* |
| Utilization of dietary supplements | 1.0 (1.0) | 1.0 (2.0) | 0.0 (3.0) | 1.0 (3.0) | 1.0 (2.0) | 0.0 (-3.0) | 0.05 |

§ Mann-Whitney U-test, * $p<0.05$

## DISCUSSION

Participants completing the dietary behavior education program had a median age of 67 in the intervention group and 72 in the control group, which was comparable to previous studies on eating behavior in patients with COPD (4,5). We observed that the baseline energy intake (median) was 1,505 kcal/day in the intervention group and 1,675 kcal/day in the control group. Both these values were below the Japanese estimated energy requirements of 2,100 kcal/day for males aged 50–69 years and 1,850 kcal/day for males aged ≥70 years (18); thus, COPD patient energy intake was not adequate, in agreement with previous studies (4,5).

The "Dietary Guidelines" (19), formulated as a tool by the Japanese government to support citizens' healthy dietary habits, are the source most commonly referred to by individuals in their sixties for information about a healthy diet (20). If COPD patients better understood the necessity of altered eating behavior, it would theoretically be easier for them to adopt desirable eating behaviors (i.e., diets for maintaining and gaining weight).

Through the program we presented in the present study, we transferred specific knowledge and skills related to proper eating behavior to the participants. Participants' behavioral intentions tended to improve by including

family members in the program, who had an influence on participants' eating behavior, as well as by having participants set measurable and feasible dietary goals. The intervention group had a statistically significant increase in energy intake, when compared to the control group, achieving the recommended 1,850 kcal/day for males aged over 70. A possible cause for this increase was an increase in meal suitability. The pamphlet we provided repeatedly emphasized eight dietary principles of suitable meals, which the participants were ostensibly able to incorporate into their eating behavior.

In this study, no statistically significant differences in the change in nutritional status (%IBW) were observed between the two groups. It is conceivable that their physical activity increased concomitantly with increased energy intake, or that the intervention period was not long enough to allow for weight gain. One study of elderly women with COPD, providing participants with nutritional guidance, determined weight gain and grip strength one year after the intervention (21). Long-term interventions and evaluations are thus necessary to confirm whether educational support alone is sufficient to modify and maintain healthy dietary behavior and lead to an increase in body weight.

Few participants in this study had ever received nutritional guidance for maintaining and gaining weight, and meals were often prepared by relatives. The latter fact may have influenced their self-efficacy in adopting proper eating behaviors. However, by equipping participants with knowledge about food choice and preparation methods, such as to discuss their meals with their families, they could include fresh, seasonal products, and adopt more suitable eating habits.

This program was based on the ASE model, in which behavioral intention is promoted by improving influencing factors. We demonstrated that it is potentially an appropriate model to prevent malnutrition and deterioration, as we observed an increase in energy intake and meal suitability after supplying participants with related knowledge and skills.

This study has four main limitations. First, the reliability of statistical analysis is limited due to the sample size being smaller than that of previous studies in the field. This may be because COPD patients are an older population and typically have multiple complications, which lead to a high drop-out rate during long-term interventions. In consideration thereof, we will increase the number of participating facilities and subjects in future and aim to verify these results. Second, we included only Japanese men in the study, limiting its interpretation in terms of gender and ethnic groups. Third, behavioral intention and dietary behavior were subjectively assessed using questionnaires. There is a need for development of more reliable and valid methods of assessment. Finally, as physical activity was not measured, its role in increased energy intake and weight change was not fully considered.

Future studies may be able to shed additional light on these factors by increasing the number and diversity of cooperating hospitals and participants, as well as by measuring physical activity as a component of a similar program.

In conclusion, the support program discussed in this report is based on the ASE model, aiming to establish and maintain suitable dietary behaviors of COPD patients, in order to prevent malnutrition and physical deterioration. The intervention was observed to increase both meal suitability and energy intake among participants, illustrating its effectiveness. However, body weight was maintained, and did not increase. More effective support programs need to be developed in future, incorporating physical activity and comparing the intervention's effectiveness in terms of nutritional state over a longer period of time.

## ACKNOWLEDGEMENTS

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## DISCLOSURE

There are no conflicts of interest to disclose.

## AUTHOR'S CONTRIBUTIONS

T.M and C.H contributed to the conception and design of this study; T.M and C.H performed the statistical analysis and drafted the manuscript; and J.U. and K.T. critically reviewed the manuscript and supervised the whole study process. All authors read and approved the final manuscript.

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