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Original Article

Effect of health locus of control on physical activity in stable patients with chronic obstructive pulmonary diseases

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Abstract. [Purpose] A strong correlation exists between low physical activity and the prognosis of patients with chronic obstructive pulmonary disease (COPD). The interaction between psychological factors and low physical activity remains unclear in patients with COPD. Here, we investigated the impact of the health locus of control (HLOC) on the response to an education program in patients with COPD. [Participants and Methods] We assessed the physical activities and HLOC in participants with COPD before and after a five-month education program. We assessed physical activity using the Japanese version of the International Physical Activity Questionnaire (IPAQ). We evaluated the HLOC using the Japanese version of the HLOC scales. We provided an identical educational program to all participants after the initial evaluation. [Results] The total activity and walking scores were significantly elevated after the intervention. We observed a significant negative correlation between the IPAQ Total score after the intervention and the supernatural HLOC. We also observed significant negative correlations between the IPAQ Vigorous score after the intervention and Family HLOC and Chance HLOC. [Conclusion] The response of patients with COPD to self-care educational programs was influenced by the HLOC.

Key words: Chronic obstructive pulmonary disease, Physical activity, Health locus of control

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INTRODUCTION

Chronic obstructive pulmonary disease (COPD) is the third leading cause of death worldwide[1)]. Physical activity is the most important prognostic factor in the management of symptoms of COPD[2)]. For instance, many studies have reported that pulmonary rehabilitation improves dyspnea as well as exercise tolerability[3)]; however, these improvements do not lead to increased physical activity[4)]. Thus, many trials geared toward directly enhancing motivation towards physical activity in COPD patients, such as the use of educational programs and telemedicine programs, have been attempted[5–10)]. In fact, all the leading respiratory societies recommend diverse nonpharmacological and educational interventions within their management guidelines[11–13)]. Nevertheless, these attempts have resulted in only modest success and many patients continue to live a

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sedentary lifestyle. To overcome this issue, previous studies have investigated the determinants of physical inactivity among patients with COPD. A previous systematic review demonstrated that physical factors, such as hyperinflation, exercise capacity, dyspnea, and previous exacerbation, in combination with psychological factors, including quality of life and self-efficacy, were related to physical inactivity in patients with COPD[4)].

Based on these findings, we hypothesized that the response of patients with COPD to an educational program would vary depending on the importance they each placed on their own health. Therefore, behavior modification interventions, such as those aimed at the acquisition of exercise habits, should be individualized. However, the influence of the patients' attitudes towards COPD management is currently unknown. The concept of health locus of control (HLOC) refers to the degree to which people believe that they have control over the outcome of health-related events in their lives[14)]. One of the main ways that the HLOC scales have been used is as predictors of health behavior. People who have a high degree of internal HLOC (those who believe that their health behaviors determine their health status) are more likely to perform healthy behaviors. It is also believed that people who score high on the chance HLOC (those who believe that fate, luck, or chance determine their health status) are less likely to perform the recommended healthy behaviors[15)]. Here, we explored the use of HLOC as an indicator of patients' beliefs and investigated how HLOC is associated with health behavior changes in patients with COPD.

PARTICIPANTS AND METHODS

We assessed the physical activity in daily living of 41 individuals with COPD at two clinics that participate in the nonprofit organization, the Hagakure Respiratory Care Network. Among them, 37 participants, who underwent follow-up assessment 5 months later, were included in this study. Of the remaining 4 participants, 2 died, 1 was lost to follow-up, and 1 found it difficult to visit the clinic due to dyspnea. The exclusion criteria at the initial assessment were as follows: bronchial asthma, severe medical complications, movement disorder, mobility-limiting pain conditions, inability to understand the protocol, and obvious dementia.

We conducted this prospective longitudinal study from January 2015 to July 2017. The Ethics Committee of the Saga University Graduate School of Medicine (Approval number: 2015-01-07) reviewed and approved the study, and the study was carried out in accordance with the principles of the Declaration of Helsinki. All participants provided written informed consent.

Physical activity was assessed using the Japanese version of the International Physical Activity Questionnaire short form (IPAQ)[16)]. IPAQ has been demonstrated to have high reliability and validity[17)]. Using the IPAQ, we evaluated the time spent performing vigorous intensity activity, moderate-intensity activity, walking, and time in sitting/supine position throughout an ordinary week. Weekly physical activity was calculated by summing the duration (minutes) of vigorous activity ×8.0 metabolic equivalents of tasks (METs), duration of moderate activity ×4.0 METs, and duration of walking ×3.3 METs.

Exercise habits were classified by the Ministry of Health, Labor and Welfare, Japan, into the following three groups: strenuous exercise habit group comprising those who performed exercise for at least 1 hour daily; moderate exercise habit group comprising those who performed exercise for at least 30 minutes, more than twice a week, and the no-exercise habit group who did not exercise regularly[18)].

The HLOC was evaluated using the Japanese version of the HLOC scales (JHLOC)[19)], which was developed by Horige based on the multidimensional HLOC scales proposed by Wallston et al[14)]. Wallston et al.'s multidimensional HLOC scales had limitations in reflecting the Japanese view of health and disease; therefore, in contrast to the traditional internal, powerful others, and chance aspects of the multidimensional HLOC scales, the JHLOC uses 5 subscales to create a reconstructed version. Its reliability has been shown to be at a level that meets the criteria of the multidimensional HLOC scales of Wallston et al[19)]. The JHLOC consists of 5 subscales: internal, professional, family, chance, and supernatural. Each subscale contains 5 questions. Participants answered the degree of agreement for each question using a 6-point Likert scale from 1 (strongly disagree) to 6 (strongly agree).

The Lung Information Needs Questionnaire (LINQ) version 10 was used to evaluate the patient's knowledge on COPD management[20)]. The LINQ contains questions about the understanding of the disease and medications, self-management, smoking cessation, exercise, and nutrition. It is scored on a 25-point scale, with 0 as the least learning need and 25 as the greatest learning need.

We assessed dyspnea using the modified Medical Research Council (mMRC) dyspnea scale[21)]. As recommended in the American Thoracic Society Guidelines, pulmonary function was evaluated using a spirometer (AS-507, Minato Medical Science Co. Ltd., Osaka, Japan)[22)]. The predictive values of forced vital capacity (FVC) and forced expiratory volume in 1 second (FEV_1) were calculated using the formulas proposed by the Japanese Respiratory Society[23)]. The Mini-Mental State Examination was used to screen for dementia.

We provided an identical educational program to all participants after the first evaluation. We recommended COPD sitting calisthenics proposed by Takahashi and colleagues[24)] as the home-based, self-managed exercise. We provided practical guidance and written instructions on the calisthenics to all participants. For patients who were able to watch digital versatile disc movies at home, we also provided a video with instructions on COPD sitting calisthenics. We instructed the patients to perform the calisthenics twice a day, at least twice per week.

A pedometer (HJ-005, Omron Healthcare Co. Ltd., Kyoto, Japan) was distributed to all participants to aid the awareness of their activity. The instructions for usage were based on the three-step pedometer technique, as described in the Plan of Action for Life in the Living Well with COPD program[25]. Briefly, the number of steps a patient took over three consecutive days, in which one weekend day was included, was noted. After the average daily steps were determined, the first objective for patients was to add 1,000 steps to the daily average and maintain this level for over a 1-month period. If the patient achieved this goal, the next objective was to add another 1,000 daily steps and to maintain this new level for 1 month, until the daily number of steps reached 5,000. If the condition allowed, the patient could keep increasing steps up to 10,000 steps per day.

A self-management diary was distributed to all patients to record their general condition, respiratory symptoms, medications, exercise achievement, and the number of steps every day.

To compare the IPAQ scores and exercise habits before and after 5 months of exercise guidance, Wilcoxon's signed-rank test and the χ^2 test were used. The relationship between physical activity after the intervention and participant characteristics was analyzed using Spearman's rank correlation coefficient. The IPAQ scores after the intervention between the exercise program and the non-exercise program group were analyzed using the Mann-Whitney's U test. The correlation between the IPAQ Total Score and the initial supernatural HLOC scores were analyzed using Spearman's correlation coefficient.

Participants were then divided into two groups according to their IPAQ Total score at the second evaluation, with a cut-off of 1,000 as the low and high activity groups. The cut-off value was set at 1,000 based on the median of the IPAQ Total score of these participants and on the fact that the IPAQ guidelines[26] define moderate activity as having an IPAQ Total score between 600 and 1,500. Baseline data were compared between the low activity and high activity groups. Numerical data with a normal distribution were analyzed using Student's t-test or Welch's t-test, based on the results of Levine's test for equality of variance. Numerical data without normal distribution, namely, the modified Medical Research Council, IPAQ, and LINQ scores, were analyzed using the Mann-Whitney's U test. Categorical data were compared using the χ^2 test. IBM SPSS statistics version 23.0 (IBM Japan, Tokyo, Japan) was used for all statistical analyses. All statistical tests were two-tailed with values of $p<0.05$ indicating a significant difference.

RESULTS

We initially assessed 41 male patients with stable COPD. Out of these, 37 participants were included in this study, all of whom underwent a follow-up assessment 5 months later. Of the remaining 4 individuals, 2 died, 1 was lost to follow-up, and 1 had difficulties visiting the clinic due to dyspnea. All 37 participants (aged 72.1 ± 8.7 years, 29 patients with FEV_1/FVC less than 70% and 8 patients had centriacinar emphysema but did not have an FEV_1/FVC of less than 70%) could complete the follow-up assessment and were analyzed. The participants' demographic features are presented in Table 1. Three participants (8.1%) were current smokers, 1 (2.7%) was a non-smoker, and all the other participants were ex-smokers with a history of 2–180 pack-years (median: 57 pack-years). Twenty-eight participants (75.7%) performed an exercise program at clinics during the observation period.

We presented the physical activity data at the initial examination in Table 2. Patients were provided with instructions for regular exercise, and 5 months later the IPAQ scores and exercise habits were reevaluated (Fig. 1). Comparison of the IPAQ scores between the initial and follow-up assessments revealed that the total activity score and walking score were significantly increased at follow-up. Furthermore, exercise habits changed towards the strenuous exercise habit group ($p<0.01$, χ^2 test).

We analyzed the relationship between physical activity after the intervention and the explanatory factors before the intervention and presented the data in Table 3. Although there was no significant correlation between the IPAQ Total Score and the supernatural HLOC before the intervention ($\rho=-0.248$, $p=0.14$), a significant negative correlation was observed between the IPAQ Total Score after the intervention and supernatural HLOC ($p=0.034$, Table 3). The main change between these two comparisons is that some participants with low supernatural HLOC became much more active after the intervention. The IPAQ vigorous activity score exhibited a negative correlation with the family HLOC ($p=0.022$) and chance HLOC ($p=0.026$).

We also noted the relationships between the IPAQ scores and pulmonary function test data. The IPAQ Total Score correlated significantly with FEV_1 (% of the predicted value) and FEV_1/FVC (%), with p-values of 0.038 and 0.036, respectively. The association between FEV_1/FVC (%) and IPAQ moderate activity score was also significant ($p=0.048$). A significant negative correlation was observed between VC (% of the predicted value) and sitting time ($p=0.026$). Regarding symptoms, the mMRC dyspnea scale score showed a significant negative correlation with the IPAQ scores (IPAQ Total Score; $p<0.001$, IPAQ Walking; $p=0.003$). It is worth noting that IPAQ scores of the exercise program group after the intervention were similar to those in the non-exercise group.

To further confirm the relationship between physical activity and background factors, we compared participant background factors between the high and low physical activity groups. The median IPAQ Total Score after the intervention was 1,188, of which 3 participants had the same score. Therefore, participants with an IPAQ Total Score equal to or higher than 1,188 were partitioned into the high physical activity group (21 patients, scores ranging from 1,188 to 17,598). The remaining 16 patients belonged to the low physical activity group (scores ranging from 0 to 816). Comparison of background factors at initial assessment between the two groups showed that the mMRC dyspnea scale score in the low physical activity group was significantly higher than that of the high physical activity group (2 [2–3] vs. 1 [1–2], $p<0.001$; Table 4). Age and body mass index did not differ between the two groups. Regarding pulmonary function, FEV_1/FVC was 64.3 ± 10.2% and 54.1 ± 14.6% in the high and low physical activity groups, respectively. The predicted FEV_1 was 62.3 ± 14.1% in the high physical

Table 1. Participants' baseline characteristics

Number of participants	37
Age (years)	72.1 ± 8.7[a]
Male, n	37 (100%)
BMI (kg/m^2)	22.5 ± 4.1[a]
Current smokers, n	3 (8.1%)
mMRC score	1 (1–2)[b]
Pulmonary function	
VC (%)[c]	80.0 ± 12.5[a]
FEV_1 (%)[c]	55.9 ± 16.9[a]
FEV_1/FVC (%)	59.9 ± 13.1[a]
Airflow obstruction	
Grade 0, n	8 (21.6%)
Grades 1–2, n	16 (43.2%)
Grades 3–4, n	13 (35.1%)
LINQ score	9.0 (5.5–10.0)[b]
MMSE score	27.7 ± 1.9[a]
Exercise program (yes/no), n	28/9
JHLOC scores	
Internal	23.4 ± 3.8[a]
Family	20.7 ± 5.2[a]
Professional	19.4 ± 4.8[a]
Chance	15.0 ± 4.6[a]
Supernatural	14.7 ± 4.9[a]

[a], Value indicates mean and standard deviation; [b], value indicates median and interquartile range; [c], value indicates percentage of the predictive value. BMI: body mass index; mMRC: modified Medical Research Council dyspnea scale score; VC: vital capacity; FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity; LINQ: Lung Information Needs Questionnaire; MMSE: Mini-Mental State Examination; Exercise program: Exercise program performed at clinics during the observation period; JHLOC: Japanese version of Health Locus of Control Scale.

Table 2. Changes in physical activity between initial and follow-up assessments

	Initial	Follow-up
Number of participants	37	37
IPAQ		
Activity scores (METs-min/wk)[a]		
Total	662 (182–1,566)	1,188 (347–2,369)[b]**
Vigorous activity	0 (0–0)	0 (0–0)[b]
Moderate activity	0 (0–400)	40 (0–960)[b]
Walking	330 (0–916)	528 (281–1,386)[b]**
Sitting (min)	180 (150–360)	240 (120–300)[b]
Exercise habit		
Strenuous/Moderate/No, n	6/12/19	13/11/13[c]**

[a], Value indicates median and interquartile range; [b], Wilcoxon's signed-rank test was used for statistical analysis; [c], χ^2 test was used for statistical analysis; **p<0.01; IPAQ: International Physical Activity Questionnaire short form.

activity group and 47.6 ± 17.1% in the low physical activity group; these differences were statistically significant (p values of 0.03 and 0.007, respectively).

Concerning physical activity before the intervention, the IPAQ Total Score was significantly higher in the high physical activity group than in the low physical activity group (median score of 1,150 [421–2,402] vs. 330 [330–636]; p=0.002). The IPAQ scores for moderate activity before the intervention were also significantly higher in the high physical activity group

Table 3. Relationship between physical activity post-intervention and participant characteristics

	IPAQ activity scores[a]				
	Total	Vigorous activity	Moderate activity	Walking	Sitting score
JHLOC scores					
Internal	0.171	−0.166	0.132	0.203	0.003
Family	−0.172	−0.377*	−0.155	0.087	0.080
Professional	−0.071	−0.072	−0.004	−0.048	−0.082
Chance	−0.189	−0.366*	−0.161	−0.047	0.259
Supernatural	−0.350*	−0.244	−0.237	−0.118	0.155
LINQ score	0.207	0.041	0.218	0.114	−0.101
Pulmonary function					
VC (%)[b]	0.080	0.042	0.065	−0.049	−0.367*
FEV_1 (%)[b]	0.343*	0.227	0.309	0.116	−0.287
FEV_1/FVC	0.345*	0.208	0.328*	0.090	−0.179
mMRC score	−0.584***	−0.126	−0.208	−0.471**	0.117
BMI	0.103	−0.043	−0.001	0.248	−0.002
MMSE	−0.049	−0.144	−0.002	0.019	−0.044
Exercise program	Total[c]	Vigorous activity[c]	Moderate activity[c]	Walking[c]	Sitting[c]
Yes (n=28)	1,287 (346–2,379)	0 (0–0)	100 (0–1,080)	552 (305–1,386)	210 (120–300)
No (n=9)	1,188 (382–5,367)	0 (0–1,708)	0 (0–900)	528 (173–1,287)	240 (180–390)

[a], Value indicates Spearman's rank correlation coefficients ρ; statistical analysis of the relationship between IPAQ and numerical explanation indexes was performed by calculating Spearman's rank correlation coefficients; [b], percentages of the predictive value were used for analysis; [c], value indicates median and interquartile range of IPAQ score after the intervention; Mann-Whitney's U test was used to compare the IPAQ data between the exercise and non-exercise program groups; *$p<0.05$; **$p<0.01$; ***$p<0.001$. The total number of participants was 37. IPAQ: International Physical Activity Questionnaire short form; JHLOC: Japanese version of health locus of control; LINQ: Lung Information Needs Questionnaire; VC: Vital Capacity; FEV_1: Forced expiratory volume in 1 second; FVC: forced vital capacity; mMRC: modified Medical Research Council dyspnea scale score; BMI: body mass index; MMSE: Mini-Mental State Examination; Exercise program: exercise program performed at clinics during the observation period.

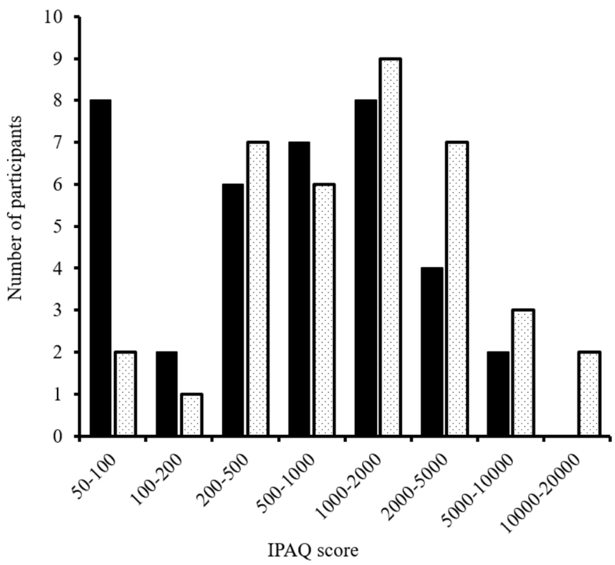

Fig. 1. Histograms of IPAQ Total scores. Scores at the initial assessment (black bars) and the follow-up assessment, performed 5 months after the initial assessment (dotted bars). IPAQ, International Physical Activity Questionnaire −short form.

than in the low physical activity group (240 [0–780] vs. 0 [0–0], p=0.02). The walking scores were higher and sitting scores were lower in the high physical activity group; however, the differences were not statistically significant. These data indicate that some patients in the high physical activity group had high levels of activity before the intervention.

Table 4. Analysis of factors affecting the IPAQ score

	Physical activity level at the follow-up[a]	
	High	Low
Number of patients	21	16
Age (years)[b]	73.1 ± 9.6	70.6 ± 7.4[e]
BMI (kg/m^2)[b]	23.3 ± 3.6	21.4 ± 4.3[e]
Current smoker, n	1	2[f]
mMRC score[c]	1 (1–2)	2 (2–3)[g]***
Pulmonary function		
VC (%)[b, d]	82.1 ± 13.6	77.3 ± 10.8[e]
FEV_1 (%)[b, d]	62.3 ± 14.1	47.6 ± 17.1[e]**
FEV_1/FVC (%)[b]	64.3 ± 10.2	54.1 ± 14.6[e]*
LINQ score[c]	10.0 (5.5–10.5)	8.5 (5.3–9.8)[g]
MMSE score[b]	27.6 ± 2.1	27.7 ± 1.7[e]
Exercise habit		
Strenuous/Moderate/No, n	5/7/9	1/5/10 [f]
Exercise program (yes/no) , n	16/5	12/4 [f]
IPAQ		
Activity scores (MET-min/wk)[c]		
Total	1,150 (421–2,402)	330 (330–636)[g]**
Vigorous[c]	0 (0–0)	0 (0–0)[g]
Moderate[c]	240 (0–780)	0 (0–0)[g]*
Walking[c]	693 (83–1,485)	289 (0–433)[g]
Sitting (min)[c]	180 (120–270)	300 (180–600)[g]
JHLOC scores		
Internal[b]	24.0 ± 2.8	22.6 ± 4.8[e]
Family[b]	20.3 ± 4.1	21.1 ± 6.3[e]
Professional[b]	19.1 ± 4.6	19.8 ± 5.1[e]
Chance[b]	14.7 ± 4.7	15.3 ± 4.5[e]
Supernatural[b]	13.2 ± 4.3	16.5 ± 5.2[e]*

[a], Patients were divided into two groups according to their IPAQ Total Score at the follow-up assessment; clinical features at the initial assessment were compared between the two groups; [b], value indicates mean and standard deviation; [c], value indicates median and interquartile range; [d], percentages of the predictive value were used for analysis; [e], Student's t-test or Welch's t-test was used for statistical analysis; [f], the χ^2 test was used for statistical analysis; [g], Mann-Whitney's U test was used for statistical analysis; *p<0.05; **p<0.01; ***p<0.001; BMI: body mass index; mMRC: modified Medical Research Council dyspnea scale score; VC: vital capacity; FEV_1: forced expiratory volume in 1 second; FVC: forced vital capacity; MMSE: Mini-Mental State Examination; LINQ: Lung Information Needs Questionnaire; Exercise program: exercise program performed at clinics during the observation period; IPAQ: International Physical Activity Questionnaire short form; JHLOC: Japanese version of health locus of control.

Supernatural HLOC was significantly higher in the low physical activity group than in the high physical activity group (16.5 ± 5.2 vs. 13.2 ± 4.3, p=0.044). Other HLOCs were similar between the two groups (Table 4). There was no difference in the scores of Mini-Mental State Examination, a screening test for cognitive disorders, between the two groups. Knowledge of COPD and its management, as assessed by the LINQ, was also similar in the two groups (Table 4).

DISCUSSION

In this study, the physical activity of COPD patients was significantly increased after the intervention. Exercise habits had also improved in 38% of the patients at the second evaluation. In contrast, 11 patients did not respond to exercise guidance regarding exercise habit modification. As presented in Fig. 1, the histogram of the IPAQ Total Score at follow-up shifted towards the right and exhibited a biphasic distribution, indicating that physical activity increased in some patients, but not in others. This suggests that some patients were more likely to be active, while others led a sedentary lifestyle. These findings are consistent with previous studies, where it was observed that some patients with COPD responded well to educational programs, which enhanced the patients' daily activities, while others did not respond[27)].

To evaluate factors that keep individuals with COPD from increasing physical activity, we examined the relationship between IPAQ scores and participants' characteristics. We found a negative effect of severe airflow obstruction and dyspnea on physical activity. These observations are consistent with the study by Soicher et al[28].

Interestingly, higher supernatural HLOC scores were associated with lower IPAQ Total score at the follow-up evaluation. Higher Family HLOC and Chance HLOC scores were also found to be significantly associated with lower levels of vigorous activity after follow-up. Non-responders to exercise tended to have higher supernatural HLOC than responders (16.1 ± 5.8 vs. 13.3 ± 3.5). Locus of control, a concept from Julian Rotter's Social Learning Theory, is the degree to which people believe that they have control over the outcome of events in their lives[29]. The locus of control is critical in an individual's perception of control and behavior related to an outcome, such as health and illness. Within the multidimensional HLOC scales, the internal locus of control refers to the degree to which an individual perceives one's own health status or health-related outcomes as being contingent upon one's behavior[14]. Individuals may also attribute control to external sources, such as friends, family members, physicians, and others (powerful others locus of control), or to chance (chance locus of control).

The relationship between HLOC and health-associated behaviors has been previously investigated[30, 31]. A meta-analysis demonstrated that stronger internal HLOC orientations were related to greater engagement in two health-enhancing behaviors[32]. While powerful other HLOC orientations were unrelated to engagement in any of the specific health behaviors, stronger chance HLOC orientations were associated with less adoption of a healthy diet and increased smoking[32]. In patients with cardiac diseases, higher internal HLOC was associated with higher levels of leisure-time physical activity[31]. Finally, an increasing chance HLOC was related to lower levels of leisure-time physical activity and a higher likelihood of being a smoker[31].

Some studies have been conducted to apply HLOC to the understanding of the psychological background of responses to behavioral education[30, 31, 33]. Health-related behaviors in patients with chronic diseases appear to be associated with both internal and external HLOC, but it is not related to a specific diagnosis[34]. Cramer et al. reported that HLOC could predict the practice frequency of aerobic exercise at 3 months and of relaxation techniques at 3-, 6-, and 12-months post-intervention[35].

The supernatural HLOC, a perspective that health is determined by gods and ancestors, is one of the subscales of the Japanese version of the HLOC scales[19]. This subscale as well as the professional, family, and chance subscales, reflect the individuals' susceptibility to external factors. In this regard, the supernatural HLOC could weaken an individual's response to behavioral education. Our results are consistent with those of the study by Nakata and colleagues[36], where it was observed that, in hyperlipidemic patients, the supernatural HLOC subscale score was significantly greater in the non-improvement group than in the improvement group 1 year after an educational program. There were no differences in other external HLOCs between the two groups, while the internal HLOC tended to be higher in the improvement group. The results of our study showed that the Supernatural HLOC scores of the non-improved group were not as high as those of the other items. However, Nakata et al.[36] reported that the mean Supernatural HLOC score of the non-improved group was 12.4 ± 0.5. This suggests that the Supernatural HLOC score of Japanese patients with chronic diseases is generally low. Therefore, the fact that the mean Supernatural HLOC score of the non-improved COPD patients in this study was 16.5 ± 5.2 suggests that the Supernatural HLOC is considered to be a strong degree of Supernatural HLOC. Although previous studies on the relationship between COPD and HLOC are scarce and unclear, Kaplan et al. examined the relationship between changes in exercise behavior and HLOC in patients with COPD and found no significant association[37]. Although the results of this study were different in that regard, they were consistent with those of previous studies in that they showed that the intensity of external HLOC in chronic diseases interferes with health behaviors[31, 32, 36], and this may be the case in COPD. In this study, in addition to the Supernatural HLOC, Family HLOC and Chance HLOC were also related to educational effectiveness, which also supports the findings of the aforementioned studies. These findings suggest that external HLOC is associated with lower responses to educational programs, and in particular, Supernatural HLOC reflects an aspect related to a lack of self-control.

One limitation of this study is that since a relatively small number of participants were analyzed, dividing them further into subgroups resulted in a loss in statistical power. Although there was no significant difference in the amount of physical activity after the intervention between those with and without the exercise program at the hospital, it is necessary to increase the number of participants and examine the results separately in the future because there is a possibility that the educational effect may be biased. Furthermore, it was difficult to perform multivariate analysis. Poor physical condition due to dyspnea and lower %FEV1 may enhance the supernatural HLOC. To overcome these limitations, future studies that investigate uniform patient groups with a larger sample size are needed. Another limitation is that we measured physical activity using a questionnaire, but not using the 3-axis accelerometer. A previous systematic review demonstrated that a self-reported assessment overestimates the level of physical activity compared to measurements made objectively by activity monitors[38]. Another systematic review recommended that studies should use both questionnaires and accelerometers to obtain the most complete physical activity information[39]. Therefore, our results should be interpreted with caution concerning physical activity.

Although the relationship between behavioral interventions and HLOC in COPD has been unclear in previous studies, our results suggest that supernatural HLOC is one of the factors that may influence the response to behavioral interventions in COPD patients.

In conclusion, we suggest that the response of individuals with COPD to self-care educational programs is influenced by the HLOC. Thus, individualization of self-care programs based on the HLOC may lead to more efficient improvement and maintenance of physical activity in COPD patients.

Conference presentation

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Conflicts of interest

The authors declare no conflict of interest.

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