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(Citation)
Bulletin of health sciences Kobe,34:1-11

(Issue Date)
2018

(Resource Type)
departmental bulletin paper

(Version)
Version of Record

(JaLCDOI)
https://doi.org/10.24546/81011893

(URL)
https://hdl.handle.net/20.500.14094/81011893

Determinants of physical activity in outpatients with cancer during chemotherapy treatment

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Abstract

Purpose: Physical activity (PA) is a novel intervention that is a feasible and non-pharmacological approach for cancer- and treatment-related problems; however, cancer patients undergoing treatment engage in low PA levels. The aim of this study was to explore the determinants of PA levels among cancer patients receiving chemotherapy.

Methods: In this cross-sectional study, 37 cancer outpatients receiving chemotherapy participated. A triaxial accelerometer was used to measure the number of step counts per day as the PA level. We assessed the patient characteristics, medical information, physical function, psychological factors, social factors, and side-effects. A multiple regression analysis was performed to explore the determinants of PA levels.

Results: The mean number of step counts per day was 4184.5 ± 2427.0 steps. A multiple regression analysis revealed a high positivity for exercise as a psychological factor (standard B = 0.35; p = 0.04) and current drinkers (standard B = 0.30; p = 0.05) remained determinants of PA levels.

Conclusions: Our results revealed that high pros for exercise and current drinkers were determinants of PA levels among cancer patients. Among them, psychological factor was the most important to promote PA level.

Keywords

Cancer patient　Determinants of physical activity　Pros for exercise　Drinking habit

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Introduction

Among cancer patients, the five-year survival rates have increased to 59.1% for men and 66.0% for women from 2006 to 2008,[1] whereas many cancer survivors suffer from physical and psychological problems as adverse events due to cancer and cancer treatment. In particular, cancer patients undergoing chemotherapy treatment often experience fatigue, nausea/vomiting, emotional distress, and physical deconditioning.[2]

Physical activity (PA; i.e., any bodily movement that results in energy expenditure) is recognized as novel intervention that is feasible and non-pharmacological approach for cancer- and treatment- related problems.[3] Multiple studies have suggested that PA prevents reducing muscle fitness, physical deconditioning, fatigue, emotional distress, anxiety, and decreasing cardiopulmonary function in cancer patients during aggressive treatment.[4] Furthermore, PA contributes to the completion of chemotherapy.[5] As described above, multiple studies have indicated the merit of PA; however, some studies have reported that many cancer patients have a low PA level.[6] Thus, these patients could not receive the benefit of PA.[7] Once the PA levels were reduced, it was difficult for the patients to recover to the pre-treatment levels of PA.[8] Thus, to prevent the reduction of PA levels during treatment when it is easy to approach patients for education is important.

For promoting the PA level and approaches to make patients effectively engage in PA, understanding the determinant of PA is more important; however, evidence determinants of PA were not sufficient among cancer patients undergoing chemotherapy. Previous studies have demonstrated that marital status, cancer stage, exercise history, fatigue, and depression were determinants of PA, but they could not examine these factors comprehensively.[9,10] Therefore, it remains unclear what factor was a critical target for effective intervention. Recently, psychological and social factors as important determinants of PA were the focus of some studies in a healthy population-based study.[11] Self-efficacy and decisional balance for PA are often described to be psychological factors. Self-efficacy refers to the confidence in one's ability to successfully engage in a specific behavior. Previous studies have shown that self-efficacy for exercise promoted PA for the prevention disability and metabolic syndrome.[12,13] Decisional balance refers to balance of positive aspects (pros) and negative aspects (cons) for a new behavior; therefore, the more people feel pros or do not feel cons for exercise, the greater the increase in PA levels.[14] In addition, social support for PA, such as the advice and cooperation of family and friends, is often used as social factors.[15] Among cancer patients, these factors have not been significantly investigated and there are no studies regarding patients receiving chemotherapy.[16] Although there are several factors that influence the PA level, comprehensive assessment is required to include not only demographic information or physical function but also psychological and social factors to clear the determinants of PA among cancer patients. The aim of this exploratory study was to investigate the determinants of PA among cancer patients receiving chemotherapy by considering various factors.

Methods

Study design and participants

In this cross-sectional study, 37 cancer outpatients, including non-Hodgkin's lymphoma, multiple myeloma, colorectal cancer, neck cancer, and breast cancer patients undergoing chemotherapy from February to November 2015 were recruited. They received chemotherapy as follows: rituximab plus cyclophosphamide, doxorubicin, vincristine, and prednisone (R-CHOP); bortezomib and dexamethasone (BD); modified 5-fluorouracil/capecitabine plus oxaliplatin

(mFOLFOX); capecitabine plus oxaliplatin (XELOX); and weekly paclitaxel (wPTX); respectively. The PA level was measured by a pedometer and calculated as the number of step counts per day. The determinants of PA were collected from a questionnaire assessing psychological factors, social factors, and subjective symptoms according to treatment, functional measures for handgrip strength and gait speed, and medical records for the demographic and medical information.

All patients were informed of the study protocol and signed an informed consent form before performing functional measurements and answering the questionnaire in accordance with the Declaration of Helsinki. Ethical approval for the study was given by the Ethics Committee of the Kobe University Graduate School of Health Sciences (Trial Registration: 323-1).

Measures

Physical activity

A triaxial accelerometer, the Yamasa EX-300 (Yamasa Tokei Keiki, Ltd., Tokyo, Japan), was used to measure the number of step counts.[17] The patients received this device at the first day of any treatment cycle during chemotherapy. They were asked to wear this device for 14 consecutive days without bathing and sleeping and to record the number of step counts at the end of each day. After wearing the device all day, the participants mailed us the device and records. We used the days in which the step counts were recorded and the average number of step counts per day were calculated.

Demographic and Medical data

We collected the age, sex, body mass index (BMI), education level, marital status, living condition, employment status, cancer type, cancer stage, recurrence, history of cancer treatment (e.g., surgery and radiotherapy), and days for chemotherapy. In addition, the economic status, history of smoking defined whether they have smoked or not, and current drinking status defined whether they were drinking or not were collected from the questionnaire.

Physical Function

Handgrip strength was measured using a grip dynamometer (Grip strength dynamometer A T.K.K. 50001, Takei Scientific Instruments, Niigata, Japan). Patients in a standing position used the dynamometer with the dominant arm by the side of the body and squeezed the dynamometer as hard as possible. Two trials were carried out and the mean score was used in the statistical analyses.[18] Gait speed was calculated as the time the patients took a walk through an eight-foot (2.44 m) course, with an extra two feet added at either end for acceleration. Two trials were performed and the faster one was used for the analyses.[19]

Psychological Factor

The self-efficacy for the exercise scale whose reliability and internal consistency were found to be acceptable consisted of four items scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). The scale measured perceptions of the confidence of participants engaging in PA when faced with common barriers, including physical fatigue, poor weather conditions, lack of time, and psychology stress. The total score ranging from 4 (low self-efficacy) to 20 (high self-efficacy) was used to calculate the analyses.[20]

The decision balance for exercise measured by Oka's Questionnaire consisted of positive (pros) and negative (cons)

aspects about exercise, and each aspect included 10 items that were scored on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). Examples of items on the pros scale were "Regular exercise would help me sleep significantly" and in the cons "I would have less time for my family and friends if I exercise regularly." Reliability and internal consistency of these scales were confirmed. Each total score ranging from 10 (weakly perceive the feeing) to 50 (strongly perceive the feeling) were used for the analyses.[21)]

Social factors

Social support for exercise was measured using a 5-point Likert scale rated from 1 (strongly disagree) to 5 (strongly agree). The following five functional, emotional, and informational social support items were assessed: 1) advice/instruction; 2) understanding/sympathy; 3) encouragement/reinforcement; 4) joint implementation; and 5) compliment/appreciation. The internal consistency and factorial validity of this scale were confirmed. The total score ranging from 5 (low social support) to 25 (high social support) were calculated for the analyses.[15)]

Symptoms according to treatment

The European Organization for Research and Treatment of Cancer Quality of Life Questionnaire (EORTC QLQ C-30) consisted of 30 questions and was divided into three scales (general quality of life, functional scale, and the symptom scale) used for assessing the symptoms among patients.[22)] Each scale ranging from 0 to 100 was calculated according to the scoring manual.[23)] In present study, we used only a symptom scale that included fatigue, nausea/vomiting, pain, dyspnea, insomnia, appetite loss, and constipation/diarrhea.

Statistical Analysis

The characteristics describing the variables, means for continuous variables, and frequencies and the percentages of the categorical variables were computed. First, univariate analyses were performed to investigate the association between the mean number of step counts per day and each variable. A Student's *t*-test and ANOVA were conducted for categorical variables and Pearson correlations were calculated for the continuous variables. Second, a multiple regression analysis was performed to explore the determinants of PA level. The dependent variable was the mean number of step counts per day and the independent variables consisted of all the variables associated with the mean number of step counts per day in the univariate analyses. Logarithmic conversion was performed for the mean number of step counts per day due to their non-normally distributed variables. To compare differences of determinants between cancer types, we planned sub analyses. We divided patients into solid tumor group and hematological malignancy group, and performed analyses in the same manner as main analysis for each group. A p value of < 0.05 was considered to be statistical significant for all analyses. All statistical analyses were conducted using Stata version 13.1 (StataCorp, College Station, TX, USA).

Results

The patient characteristics and the association between each variable and mean number of step counts per day are presented in Table 1. The mean patient age was 62.0 ± 12.4 years. A total of 14 patients (37.8%) were diagnosed with a hematological malignancy and the others (62.2%) were diagnosed with solid cancer. There were 20 patients (54.1%) with early cancer and 17 patients (45.9%) with advanced cancer. The median number of days during chemotherapy was 41 days (1 – 287). The mean number of step counts per day was 4184.5 ± 2427.0 steps, which was associated with only a

drinking habit among the characteristics in the univariate analyses (drinking vs. non-drinking, 5282.5 ± 2392.8 steps vs. 3657.4 ± 2306.4 steps; $p = 0.03$).

Table 1. Association between the mean number of steps counts per day and patient characteristics

All (n = 37)	Mean ± SD or N (%)	*r*	Median of mean step counts per day	*p*
Mean age, years ± SD	62.0 ± 12.4	−0.15		0.36
Gender				0.39
Male (%)	21 (56.8)		4062.0	
Female (%)			3313.7	
BMI, kg/m^2 ± SD	20.5 ± 3.1	0.20		0.25
Education, years ± SD	12.6 ± 3.1	0.04		0.82
Marital status				0.97
Married (%)	29 (78.4)		3233.9	
Not Married (%)			4174.9	
Lodger				0.93
Living with others (%)	27 (73.0)		3110.6	
Living alone (%)			3731.0	
Employment status				0.13
Employed (%)	9 (24.3)		4287.7	
Not employed (%)			3095.1	
Household income level				0.29
Feeling High (%)	5 (13.5)		5572.1	
Feeling Middle (%)	18 (48.7)		3482.4	
Feeling Low (%)	14 (37.8)		3107.2	
Smoking status				
Smoker (%)	9 (24.3)		2662.5	0.41
Nonsmoker (%)			4014.7	
Drinking habit				0.03
Drinking (%)	12 (32.4)		5410.5	
Not drinking (%)			3110.0	
Cancer type				0.18
Hematological malignancy (%)	14 (37.8)		4119.3	
Solid tumor (%)	23 (62.2)		3157.4	
Disease Stage[a]				0.62
I–II (%)	20 (28.6)		3642.6	
III–IV (%)	17 (71.4)		3195.6	
Recurrence				
Yes (%)	11 (29.7)		3660.6	0.73
No (%)			3233.9	
Previous Surgery				
Experienced (%)	17 (45.9)		3157.4	0.64
Not experienced (%)			3520.7	
Previous Radiation Therapy				0.98
Treated (%)	9 (24.3)		3233.9	
Not treated (%)			3520.7	
Time since treatment, days ± SD	58.8 ± 58.9	−0.00		0.99
Mean step counts per day, steps	4184.5 ± 2427.0			

Abbreviations: SD, standard deviation; BMI, body mass index a Some cases could not determine the stage of the patient.

The correlations of the mean step counts per day and physical function, psychological factors, social factors and symptoms measured by the EORTC QLQ C-30 is shown in Tables 2 and 3. Grip strength ($r = 0.35$; $p = 0.03$), gait speed ($r = 0.37$; $p = 0.02$), self-efficacy ($r = 0.35$; $p = 0.03$), and pros ($r = 0.47$; $p < 0.01$) were significantly correlated with the mean number of step counts per day.

Table 2. Correlation between the mean number of step counts per day with physical function, psychological factors, and social factors.

Variables	*r*	*p*
Physical function		
Grip strength	0.35	0.03
Normal gait speed	0.37	0.02
Psychological factor		
Self-efficacy for exercise	0.35	0.03
Pros	0.47	<0.01
Cons	−0.04	0.83
Social factor		
Social support for exercise	0.23	0.16

Table 3. Correlation between the mean number of step counts per day and the symptom scale of The European Organization for Research and Treatment quality of life questionnaire

Variables	*r*	*p*
Fatigue	−0.21	0.22
Nausea and vomiting	−0.05	0.75
Pain	−0.09	0.60
Dyspnea	−0.25	0.14
Insomnia	−0.14	0.42
Appetite loss	−0.16	0.34
Constipation	0.25	0.14
Diarrhea	−0.08	0.62
Financial Difficulties	−0.10	0.54

All variables associated with the mean number of step counts per day among the univariate analyses were adopted as the independent variables in the multiple regression analyses. Throughout this analysis, drinking habit (standard B = 0.30; $p = 0.05$) and pros (standard B = 0.35, $p = 0.04$) remained the determinants (Table 4). Sub analyses showed that pros remained the determinants (standard B = 0.44, $p = 0.007$) in solid tumor group, and drinking habit remained the determinants (standard B = 0.57, $p = 0.03$) in hematological malignancy.

Table 4. Multiple regression analysis for identifying the determinants of the mean number of step counts per day.

Variables	Standard β	*p*
Grip Strength	0.19	0.22
Normal gait speed	0.15	0.35
Self-efficacy for exercise	0.06	0.74
Pros	0.35	0.04
Drinking habit	0.30	0.05
Adjusted R^2	0.32	

Discussion

In the present study, we found that a dinking habit and pros for exercise were determinants of the PA level among cancer patients undergoing chemotherapy.

We performed comprehensive analyses that included psychological and social factors based on behavioral models to investigate the determinants of PA, and only pros were associated with the PA level. Moreover, this association was found only in solid tumor group. Several studies of healthy subjects examined the effect of pros on the level of PA. Furthermore, a longitudinal study suggested that pros had contributed to the promotion of PA.[24] However, few studies have examined the effect of pros on the PA level among cancer patients. Thus, our results suggest that pros are also important factors when determining PA among cancer patients. Whereas pros are associated with PA level, self-efficacy, cons, and social support as social factors were not correlated with the PA level. Some studies investigating patients with arteriosclerosis or bronchitis demonstrated that pros were associated with PA level, whereas self-efficacy and cons have not been associated with PA level.[24,25] These results were similar to our results. Furthermore, some studies examining the effect of psychological and social factors on the PA level among healthy women revealed that social support for exercise did not have a direct effect, which differs from psychological factors and only exhibited an indirect effect via structural equation modeling.[26] In our study, psychological factors may have a more direct effect on the PA level than social factors among cancer patients. Therefore, future studies are required to confirm these findings using similar modeling.

In addition to psychological factors, the presence of a drinking habit was significantly associated with the PA level. Moreover, this association was found only in hematological malignancy. This association was also established among healthy subjects by some researchers. One review reported that individuals with a drinking habit had a higher PA level.[27] In cancer patients, a similar trend was shown in Andrea et al.'s study that a drinking habit had predicted a high PA level among colorectal cancer patients.[28] In our study, patients with a drinking habit were more likely to be walkers compared to the others. This association remained even after multiple analyses considering psychological and social factors; thus, drinking habit was strong predictive factor for PA among the cancer patients.

We suggest that interventions for both psychological factors and lifestyle, as well as physical function and symptoms due to cancer and cancer treatment are required for the promotion of PA among cancer patients during treatment. In cancer patients, the time after the diagnosis and during treatment was the preferred teachable moment. This indicates that education for patients at this moment is extremely important for the promotion of long-term health.[29,30] Our results explored the determinants of PA level at this moment,and revealed beneficial information in education for patients. Intervention methods for pros were investigated in a previous study that demonstrated that web-based intervention for patient education programs promoted pros and had contributed to promoting the level of PA.[31] While investigating the beneficial intervention for pros, few studies were conducted to examine the effect of a drinking habit on physical activity. Our results suggest that to make a habit of drinking could contribute to promoting the level of PA, but don't reveal the appropriate alcohol consumption. A large cohort study in Japan shows that heavy drinking more than 300g of ethanol per week was strong risk of cancer occurrence.[32] Similarly, some researches indicate excessive drinking lead to cancer occurrence and mortality;[33,34] thus, further study to find the optimal amount of alcohol is required to develop an intervention for the drinking habit to increase PA levels.

In this study, physical function and symptoms due to cancer and cancer treatment were not associated with PA levels. Such associations have been discussed in some reports. There was a relationship between the PA level, physical function, and symptoms with no definitive opinion in a review about the determinants of PA among cancer patients.[35] However, fatigue and anxiety were often focused as the important determinants of PA in several reports. Despite these findings, our results did not identify the association between these symptoms and PA. This inconsistency was the result of a questionnaire. Previous studies have used a questionnaire measuring each symptom more specifically in detail compared to the EORTC QLQ C-30 that we used.[36,37] Further studies are required to investigate the association between symptoms measured by these questionnaires and PA level in consideration of other aspects, including psychological factors.

The advantages of the present exploratory study was to investigate the determinants of PA level, including the psychological and social factors exhibited by cancer patients and to identify pros and presence of a drinking habit, which could be altered with an appropriate intervention. Some limitations that exist in this study include the small sample size and various cancer types and treatments were included. Although previous studies also include different cancer types and treatments, research into particular cancer type or treatment is a better method of investigating the specific determinants of PA. Therefore, we require further investigation involving multiple samples with one cancer type receiving one form of treatment.

Conclusion

We found that pros and a drinking habit were determinants of the PA level among cancer patients treated with chemotherapy. These findings suggest that considering these factors could be beneficial to promoting the PA level among cancer patients during treatment, with substantial opportunity to educate patients.

Acknowledgement

The authors are very grateful to the patients who participated in this study and to the staff of the Division of Clinical Oncology and Hematology.

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