Japanese Journal of Physical Therapy for Diabetes Mellitus OPEN ACCESS

Original article

Effect of exercise instruction using a map from the perspective the motivational regulation style of exercise for diabetes education in a hospital

Katsura Mizoguchi[1]*, Kenichi Kono[2], Yusuke Nishida[2]

1) Department of Rehabilitation Medicine, Shuto General Hospital, JA Yamaguchi Prefectural Welfare Federation of Agricultural Cooperative
2) Department of Physical Therapy, International University of Health and Welfare Graduate School

ABSTRACT

【Objective】A significant risk factor for the development of diabetes mellitus in Japan is physical inactivity. As physical inactivity is also a risk factor for mortality, it is important that activity is maintained and promoted. The ecological model explains the complex environmental and psychosocial factors related to physical activity. The purpose of this study was to examine the psychosocial factors associated with multilevel interventions in an ecological model using a walking course guidance map in patients with diabetes from the viewpoint of motivation to exercise, and to clarify whether physical activity is promoted by instruction using a walking course guidance map.

【Methods】Seventeen patients admitted for diabetes education were included in this study. The Behavioral Regulation Exercise Questionnaire-2 was used to assess psychosocial factors; items with relatively high scores in the sub-items were used as representative regulation styles in motivating the patients to exercise. Physical activity was measured using an activity meter during the hospitalization period, and changes after instruction using a walking course guidance map were compared for each motivation style. A map of the hospital and the hospital grounds was used as the walking course guidance, and walking courses in the ward, the hospital, and hospital grounds were taught. The distance and estimated calorie consumption of each course were also indicated.

【Results】A significant increase in physical activity was observed in the patients with the identified regulation style after instruction using the walking course guidance map.

【Conclusions】In this study, the psychosocial factors that promote physical activity were examined in patients undergoing diabetes education in a hospital using a walking course guidance map. Physical activity was promoted in patients with the identified regulation style in comparison with other motivational regulation styles.

***Correspondence:**
Katsura Mizoguchi
Department of Rehabilitation Medicine, Shuto General Hospital, JA Yamaguchi Prefectural Welfare Federation of Agricultural Cooperative.
1000-1, Kogaisaku, Yanai City, Yamaguchi Pref, 742-0032, Japan
E-mail: rh_k.mizoguchi@hsp-shuto.jp

Key words:
Type 2 Diabetes, Physical Activity, Ecological Model

First submitted Dec. 20. 2021
Accepted Jan. 28. 2022

Introduction

The risk factors for the development of diabetes mellitus in the Japanese population include physical inactivity, hypertension, and dyslipidemia. Variable factors such as obesity, diet, and lack of exercise are particularly important to control as preventive measures against lifestyle-related diseases[1] Physical inactivity is the fourth most important risk factor for death, and is strongly associated with other health-promoting behaviors[2].

To perform exercise, it is necessary to approach the environment through the subject's viewpoint and cognition[3]. The presentation of a local environment suitable for physical activity to the subject is of interest because it has been shown to increase the amount of physical activity the subject performs, leading to health promotion[4,5]. Specifically, instruction using a walking course guide map[6] has been shown to promote awareness of the walking environment, the perception of convenience, and an increase in the number of steps subjects take[7]. In addition, both environmental and psychosocial factors are involved in physical activity[8]. As shown above, physical activity is influenced by environmental factors, psychosocial factors, and other factors in a complex manner, which is explained by the ecological model[9]. This model emphasizes multi-level relationships at the intrapersonal level (sex, age, genetic factors, physiological factors, and psychological factors), individual level (family, friends, social networks, and social factors), organizational level (school and workplace), local level (built and natural environments), and policy level (law and policy). In this study, a multilevel intervention was conducted using a map for walking course guidance. In addition, the Transtheoretical model (TTM)[10] calls for individualized intervention strategies, and it is necessary to evaluate psychosocial factors in detail and intervene. The psychosocial factors related to multilevel interventions in the ecological model using walking course guidance maps in patients with diabetes was examined from motivational factors to exercise, and whether physical activity is promoted by instruction using walking course guidance maps was clarified.

Methods

Participants

Seventeen patients who were admitted for diabetes education from September 2019 to November 2019 and whose physicians instructed physical therapists to provide exercise therapy were included in the study. Patients were admitted for 14 days in the clinical pathway for diabetes education, and exercise therapy instruction and patient education were provided. Specifically, aerobic exercise, muscle-strengthening exercise, risk management, pre-hospital review, and post-discharge goal setting.

Participant characteristics survey

Participant characteristics such as sex, age, height, weight, body mass index (BMI), medication status, and comorbidities were collected from medical records. The survey was conducted on the first day of hospitalization. In our clinical pathway, blood tests and physiological examinations are performed within 3 days of admission, and diabetologists and ophthalmologists evaluate diabetic complications.

Walking course guidance

For providing guidance of the walking course, a map of the hospital and the hospital grounds was used to

introduce the walking course in the ward (Flatland course: distance 350m, estimated calorie consumption 63kcal/20min), the walking course in the hospital (Flatland and stairs course: distance 600m, estimated calorie consumption: 72kcal/20min), and the walking course on the grounds (Flat and hilly course: distance 550m, estimated calorie consumption: 68kcal/20min). The distance and estimated calorie consumption for each course was also provided. A map of the walking course with the expected calorie consumption for each subject was distributed, and the subjects were instructed that the combination of courses was free and that the calorie consumption varied depending on the time spent walking. The day of instruction was the sixth or seventh day of hospitalization.

Assessment of psychosocial factors

Psychosocial factors at the intrapersonal level were assessed using the Behavioral Regulation Exercise Questionnaire-2 (BREQ-2)[11], which is a measure of the strength of motivation for exercise. The BREQ-2 is a scale developed on the basis of self-determination theory[12] and consists of 19 items measuring five motivational regulation styles for exercise: (1) intrinsic regulation, (2) identified regulation, (3) introjected regulation, (4) external regulation, and (5) non-regulation. Intrinsic regulation is a state in which a person is motivated by the enjoyment and satisfaction obtained from exercising, and is positioned as intrinsic motivation. Extrinsic motivation includes identified regulation, introjected regulation, and external regulation. Identified regulation is a state in which the importance of an action is recognized as one's own value, and one exercises "because it is important to me. Introjected regulation is a state in which the value of the task is recognized and is being adopted as one's own value system, but is still accompanied by a sense of obligation, such as "I have to do it. External regulation is a state in which the individual does not recognize the value of the task, but exercises out of a sense of being forced to do so by external forces, and is the most externally motivated state. Non-regulation is a state in which there is no sense of purpose and the behavior is not self-determined at all. Subjects were asked to respond to each of the sub-items of the BREQ-2 on a 5-point Likert scale ranging from "not at all" (1 point) to "very much" (5 points), and items with relatively high scores from the sub-items were used as representative regulation styles to motivate each subject to exercise[13, 14]. The evaluation day was the first day of hospitalization.

Assessment of physical activity

The amount of physical activity during hospitalization was evaluated using an activity meter (Lifecorder GS, Suzuken) for 14 consecutive days. Patients were asked to wear an activity meter on their left hip throughout the day, except during sleep. Instruction using a walking course guidance was given on days 6 or 7. The median number of steps taken before the intervention, on days 2 to 5 of hospitalization, and the median number of steps taken after the intervention, on days 8 to 11 of hospitalization, were evaluated.

Statistical analysis

The representative regulation styles for each subject were calculated using simple aggregation. The amount of physical activity before and after walking course guidance was compared using Wilcoxon's signed rank test for each regulation style. For statistical analysis, SPSS Version 15.0 (IBM) was used, with significance

set at 5%.

Ethical Considerations

This study was conducted in accordance with the Declaration of Helsinki and ethical guidelines for clinical research. The purpose of the study and the voluntary nature of participation in the study were explained to the subjects, and their consent was obtained. The study was conducted with the approval of the Ethics Review Committee of International University of Health and Welfare (Approval No. 19-Ifh-054) and registered in UMIN-CTR (UMIN000046652).

Results

Sixteen patients were included in the analysis, with the exception of one patient who had missing data on the number of steps on their activity meter. The participants' characteristics are presented in Table 1. The representative regulation styles were intrinsic regulation in two cases, identified regulation in 10 cases, introjected regulation in one case, external regulation in two cases, and non-regulation in one case (Table 2).

The changes in the number of steps for each regulation style are listed in Table 3. The median number of steps for each regulation style (before/after intervention) was 4119.5/3940.5 for intrinsic regulation, 3581.5/4198 for identified regulation, 9945/12702 for introjected regulation, 3933.5/3705.5 for external regulation, and 2757.5/2764.5 for non-regulation. The 10 subjects with identified regulation showed a significant increase in physical activity after instruction using the walking course guidance map.

Table 1. Descriptive characteristics of participants (n=16)

Variables	Mean (SD) or Total
Sociodemographic	
Age, mean (SD), y	68.6(8.4)
Sex Female	9
Male	7
BMI, mean (SD), kg/m2	23.1(4.7)
Hospitalization, mean (SD),d	13.8(1.4)
Disease duration, mean (SD), y	7.6(10.3)
Medication status	
rapid-acting insulin analogue	13
long-acting insulin analogue	12
GLP-1 receptor agonist	1
biguanide	4
SU	1
DPP-4 inhibitor	11
SGLT2 inhibitor	5
Laboratory Data	
CBG, mean (SD), mg/dL	254.4(115.8)
HbA1c, mean (SD), %	9.3(2.2)
TC, mean (SD), mg/dL	201.3(39.8)
TG, mean (SD), mg/dL	189.1(116.7)
HDL-C, mean (SD), mg/dL	57.6(16.2)
LDL-C, mean (SD), mg/dL	114.9(30.8)
Cr, mean (SD), mg/dL)	0.8(0.3)
Diabetic complication	
SDR	5
PPDR	1
DPN	8
early nephropathy	2
overt nephropathy	2

BMI, body mass index; GLP-1 receptor agonist: glucagon like peptide-1 receptor agonist, SU, sulfonylurea; DPP-4 inhibitor, dipeptidyl peptidase-4 inhibitor; SGLT2 inhibitor, sodium glucose cotransporter 2 inhibitor; CBG, casual blood glucose; HbA1c, hemoglobin A1c; TC, total cholesterol; TG, triglycerides; HDL-C, high-density lipoprotein cholesterol; LDL-C, low-density lipoprotein cholesterol; Cr, creatinine; SDR, simple diabetic retinopathy; PPDR, preproliferative diabetic retinopathy; DPN, diabetic peripheral neuropathy.

Table 2. Number of participants with each regulation style (n=16)

Regulation style	total
intrinsic regulation	2
identified regulation	10
introjected regulation	1
external regulation	2
non-regulation	1

Discussion

In the present study, psychosocial factors related to the promotion of physical activity were assessed in diabetes education inpatients using each participant's regulation style of motivation for exercise. The majority of patients adopted the identified regulation style, which is a state in which the importance of an action is recognized as one's own value, and one decides to exercise because it is important to them[12]. It is also reported as a state in which there is an important goal beyond the action, and that the action is seen as a means to achieve that goal[13]. Therefore, it can be inferred that many inpatients with diabetes education in this study viewed the treatment and patient education provided throughout their hospitalization as a means to improve their health.

In addition, patients with an identified regulation style showed an increase in physical activity after instruction using a walking course guidance map. Patients with an identified regulation style are thought to view their target behavior (physical activity) as a curative measure, and it becomes necessary to check how well they are performing their behavior (physical activity) in relation to the goal of diabetes treatment. This confirming behavior is called a metacognitive strategy, and previous studies have reported that identification adjustment is associated with executive goal orientation[16]. Therefore, this increase in physical activity observed in the patients in this study with the identified regulation style can be attributed to metacognitive strategy. Metacognition plays a role in monitoring and controlling one's own cognitive activities, and includes planning strategies to make plans and work on them, monitoring strategies to understand one's own efforts, and self-regulation strategies to adjust one's own behavior and cognitio[17]. Sato defined a metacognitive strategy as "a strategy that takes into account the current situation and adjusts the progression of later cognitive behavior" and reported that identified regulation requires the use of a metacognitive strategy to predict cognitive behavior[18]. Identified regulation is associated with stronger effort beliefs than intrinsic regulation, suggesting that metacognitive strategies can be used to motivate people to persistently engage in uninteresting cognitive behaviors even in difficult situations[16]. To achieve the goal of diabetes treatment, the subjects in this study also recognized physical activity as a means to an end and used a metacognitive strategy to perform physical activity "because it is necessary," which is thought to have caused the change in the number of steps. In this study, a guidance map of the walking courses was also used that included information about environmental factors. It is suggested that the involvement of patients in environmental factors is effective for patients with diabetes who are motivated by the above-mentioned identified regulation style, and it is necessary to assess psychosocial factors and intervene on a subject-by-subject basis.

One of the limitations of this study is that the subjects were patients who were admitted to an

Table 3. Comparison of the number of steps taken for each regulation style

	steps		
Regulation style	before	after intervention	*p* -value
intrinsic regulation(n=2), median	4119.5	3940.5	0.18
identified regulation (n=10), median	3581.5	4198	0.05
introjected regulation(n=1), median	9945	12702	-
external regulation(n=2), median	3933.5	3705.5	0.18
non-regulation(n=1), median	2757.5	2764.5	-

educational hospital for diabetes, and thus it is difficult to generalize the results to the general patient population with diabetes. In this study, it was found that the number of steps was changed by providing walking course guidance, but as a comparison was not performed against intervention without the walking course guidance map, the factor causing changes in the number of steps was not clear. In addition, because the patients in the educational hospital participated in individual exercise therapy instruction and diabetes classes in addition to the walking course instruction during their hospitalization, it is necessary that a comparative study be conducted to clarify which instruction caused the change in cognitive behavior. In addition, because of the small number of cases other than those with identified regulation, we have not been able to clarify the effect of instruction using a walking course guidance. It is necessary to increase the target sample and confirm the effectiveness of the instruction using walking course guidance and to examine the intervention strategy for each regulation. Finally, the motivational regulation style with the highest score among the subjects was treated as representing the individual's motivation, but at the same time, there is a possibility that activities are carried out due to more than one regulation style[19]. Therefore, it is necessary to increase the target sample size and verify the classification of the motivational regulation styles.

Conclusion

In this study, the psychosocial factors that promote physical activity were examined in patients with diabetes by teaching environmental factors using a walking course guidance map with instruction based on motivational regulation styles. Psychosocial factors appeared to promote physical activity in patients with an identified regulation style.

Conflict of Interest

No conflicts of interest to be disclosed.

Acknowledgments

We would like to express our heartfelt gratitude to Dr. Yusuke Nishida and Dr. Kenichi Kono, Graduate School of Health and Welfare, International University of Health and Welfare, for their guidance in compiling this study.

References

1) World Health Organization: Global action plan on physical activity 2018-2030: more active people for a healthier world. https://apps.who.int/iris/handle/10665/272722 (November. 01. 2021).
2) World Health Organization: Global health risks:

mortality and burden of disease attributable to selected major risks. https://apps.who.int/iris/handle/10665/44203 (November. 01. 2021).

3) Giles-Corti B, Donovan RJ: The relative influence of individual, social and physical environment determinants of physical activity. Social Science & Medicine 2002; 54: 1793-1812.
4) Sallis JF, Owen N, Fisher EB: Ecological Models of Health Behavior. pp 465-485; Glanz K, Rimer BK, Viswanath K, et al.: Health Behavior and Health Education 4th ed 2008, Jossey-Bass.
5) Inoue S: Relationship between society/environment and physical activity and the possibility of increasing physical activity by improving the environment. Japanese Journal of Clinical Sports Medicine 2014; 31: 60-66. (in Japanese).
6) Japan Certification Organization for Diabetes Care and Education: Basics of Diabetes Care and Education (Patient Education). pp 112-121; Japan Certification Organization for Diabetes Care and Treatment (JCDT): Diabetes Care and Treatment Guidebook. 2017, Medical Review, Inc. (in Japanese).
7) Itakura M, Oka K, Takeda N, et al: Relationship between social support for exercise and perception of walking environment and promotion of physical activity and exercise. Japanese Journal of Physical Fitness and Sports Medicine 2005; 54: 219-228. (in Japanese).
8) Harada K: Trends in psychological research on the promotion of physical activity: mechanisms of behavioral change, differences by motivation, and the role of environmental factors. Japanese Journal of Research in Exercise Epidemiology 2013; 15: 8-16. (in Japanese).
9) Sallis JF, Cervero RB, Ascher W, et al: An ecological approach to creating active living communities. Annual Review of Public Health 2006; 27: 297-322.
10) Prochaska JO, Velicer WF: The Transtheoretical Model of health behavior change. American Journal of Health Promotion 1997; 12: 38-48.
11) Matsumoto H, Takenaka K, Kouke N: Development of a Motivational Scale for Continuing Exercise Based on Self-Determination Theory: An Examination of Reliability and Validity. Japanese Journal of Health Promotion 2003; 5: 120-129. (in Japanese).
12) Ryan RM, Deci EL: Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. American Psychologist 2000; 55: 68-78.
13) Wilson PM, Rodgers WM, Fraser SN: Examining the psychometric properties of the Behavioral Regulation in Exercise Questionnaire. Measurement in Physical Education & Exercise Science 2002; 6: 1-21.
14) Wilson PM, Rodgers WM, Blanchard C, et al: The relationship between psychological needs, self-determined motivation, exercise attitude, and physical fitness. Journal of Applied Social Psychology 2003; 11: 2373-2392.
15) Hayami T: Achievement motivation located between extrinsic and intrinsic motivation. Japanese Journal of Society of Japanese Psychological Review 1995; 38: 171-193. (in Japanese).
16) Yamauchi H, Tanaka K: Relations of autonomy, self-referenced beliefs, and self-regulated

learning among Japanese children. Psychological Reports 1998; 82: 803-816.

17) Pintrich PR, DeGroot EV: Motivational and self-regulated learning components of classroom academic performance. Journal of Educational Psychology 1990; 82: 33-40.

18) Sato J: Effects of learners' perceptions of utility and costs, and learning strategy preferences. Japanese Journal of Education Psychology 1998; 46: 367-376. (in Japanese).

19) Okada R: Relationships among motivational concepts in self-determination theory. The Japanese Journal of Personality 2010; 18: 152-160. (in Japanese).