The factors that affect exercise therapy for patients with type 2 diabetes in Japan: a nationwide survey

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Abstract

Purpose: This study was performed to investigate important factors of exercise therapies for the patients with diabetes in Japan.

Methods: Subjects were 5,100 patients with type 2 diabetes mellitus. Data from 3,685 patients (88.2% effective answer rate) who answered the question whether they exercised regularly or not by the questionnaire were analyzed. We used multiple logistic regression analysis to assess the factors associated with exercise therapy in the patients with diabetes.

Results: Exercise and non-exercise therapy groups had 1,926 and 1,759 patients, respectively. The HbA1c level of the exercise therapy group was significantly lower than that in the non-exercise therapy group. The multivariate odds ratios (ORs) of possible factors affecting the exercise therapy group adjusted for age, gender, BMI and living area were as follows: frequency of exercise therapy guidance (OR = 1.89, 95% confidence interval =1.40 to 2.56; reference group (ref.): no exercise therapy guidance), detailed exercise prescription such as type (1.32, 1.08 to 1.61), frequency (1.60, 1.24 to 2.06) and duration (1.63, 1.32 to 2.01; ref.: no exercise prescription), patients who enjoy physical exercise (4.85, 2.97 to 7.93; ref.: patients who dislike physical exercise), high level of physical activity(2.31, 1.77 to 3.03; ref.: low level of physical activity).

Conclusion: The results of the current study showed that, concerning exercise therapy education, it is important to maintain the motivation of the patients to participate in exercise therapies, to increase the frequency of guidance, and to provide more detailed exercise prescription such as frequency and duration.

Key words: Exercise therapy, Nationwide survey, Type 2 diabetes, Physical exercise education, Logistic regression analysis

Introduction

It is well established that physical exercise therapy improves blood glucose control and can prevent or delay type 2 diabetes, along with positively impacting lipids, blood pressure, cardiovascular events, mortality, and quality of life [2]. Several studies have reported that introduction of type, frequency and duration of physical exercise therapy is necessary for patients with diabetes [3, 4]. Kodama et al. reported that increased physical activity was associated with larger reduction in future all-cause mortality and cardiovascular disease (CVD) risk in patients with diabetes [5]. In Japan, Sone et al. clearly indicated that the level of leisure-time physical activity is a significant predictor of stroke and total mortality in patients with type 2 diabetes [6]. In spite of these hopeful results suggesting potentially large effects of exercise in patients with diabetes, exercise is not adequately and sufficiently educated in daily clinical practice by medical institutions even compared with diet [7]. Thus, we undertook a nationwide survey to determine the current status of exercise therapy in Japan and to clarify the problems related to its implementation. To investigate the actual situation and problems of exercise therapy in Japan, a questionnaire was prepared and sent to diabetologists and non-specialist physicians; the rate of exercise guidance was significantly lower than that of dietary guidance [7].

This study was performed to investigate important factors of exercise therapies for the patients with diabetes, including the education system.

Methods

From July to October 2009, self-recording questionnaires were distributed and collected by the receptionists of out-patient clinics and medical institutions specialized in diabetes (20 hospitals, 16 clinics which are located from Hokkaido to Kyusyu). Responses were obtained from a total of 4,176 out of 5,100 the patients with diabetes patients (81.9% response rate). For the current study, data from 3,685 patients (88.2% effective answer rate) who answered the question whether they are performing exercise therapy or not were analyzed. Patients who responded “yes” were classified as exercise therapy group. This study was approved

by the Ethics Committee of the Japan Diabetes Society and review boards of the institutions involved.

The questionnaire contained items such as “do you know your HbA1c level?”, “what kind of treatment (oral hypoglycemic agents, insulin, diet and exercise only) are you receiving?” (multiple answer), “how many times do you receive exercise therapy guidance at medical consultations?”, “who carries out exercise therapy guidance?” (multiple answer), “what is the content of exercise therapy guidance” (multiple answer), “please describe your daily physical activity levels”, “please describe your leisure time activities” [8] (Table 1), “do you enjoy doing exercise?”, “do you enjoy watching sports?”.

Table 1. Classification of daily physical activities

Activities	Intensity (Mets)	Example activities	Duration
Work and housework (except commuting and shopping)	3-5	Walking to fast walking Farm work Transportation of light baggage, boxing Cleaning, hang the laundry out etc.	1. No activity 2. 30 minutes 3. 1 hour 4. More than 2 hours
	5	Running Baggage loading and Transportation of heavy	1. No activity 2. 15 minutes 3. 30 minutes 4. More than 1 hour
Leisure, exercise and moving (include commuting and shopping)	3-5	Walking to fast walking Take the dog for a walk Bicycle Gymnastics Gardening Play with a child Transportation of light	1. No activity 2. 30 minutes 3. 1 hour 4. More than 2 hours
	5	Jogging Running Swimming Sport activities Baggage loading and unloading Transportation of heavy baggage etc.	1. No activity 2. 15 minutes 3. 30 minutes 4. More than 1 hour

We used the Pearson’s Chi-square test to compare categorical data, and compared continuous data using the Student’s t test for parametric variables and the Mann-Whitney U test for non-parametric variables. In

addition, multiple regression analysis, in which the non-exercise therapy group was set as the criterion variable and the question items with a probability value (p) <0.25 in univariate analysis were set as independent variables, was performed to further extract relevant items adjusted for age, sex, BMI, and the living area. All statistical analyses were conducted using the IBM SPSS Statistics version19. A probability of less than 5% was considered significant.

Results

Characteristics of the subjects

The patients with diabetes were classified into exercise therapy group (1,926 patients, 52.3%) and non-exercise therapy group (1,759 patients, 47.7%). There was no significant gender difference between groups (men, exercise vs. non-exercise therapy group: 63.0% vs. 63.3%; p=0.838). The exercise therapy group was significantly older (p<0.001) and had lower BMI (p<0.001) than the non-exercise therapy group. The duration of diabetes in the exercise therapy group was significantly longer (p=0.001) and the HbA1c level was significantly lower (p<0.001) than those in the non-exercise therapy group. There was no significant difference in the frequency of medical consultation (p=0.508). There were significantly lower percentage of insulin users (p=0.001) and the proportion of patients receiving diet and exercise therapy only was significantly higher (p=0.001) in the exercise therapy group than in the non-exercise therapy group. The frequency of exercise guidance was higher in the exercise therapy group than that in the non-exercise therapy group (p<0.001). As for the exercise guidance counselor, the percentage of health fitness instructor was significantly higher in the exercise therapy group than that in the non-exercise therapy group (p<0.001). As for the content of exercise prescription, instructions concerning type, intensity, frequency and duration of exercise were significantly higher in the exercise therapy group (p<0.001) (Table 2).

Patients of the exercise therapy group performed higher levels of daily physical activity at both work/housework and leisure/exercise/moving (Table 3) (p<0.001) and enjoyed doing exercise and watching sports more than the patients of the non-exercise therapy group (Table 4) (p<0.001).

Table 2. Characteristics of the patients

	Effective answers n (%) (n=3,685)	Exercise therapy group n (%) (n=1,926)	Non-exercise therapy group n (%) (n=1,759)	p value*
Gender (male/female)	3,681 (99.9)	1,213 (63.0) / 713 (37.0)	1,111 (63.3) / 644 (36.7)	0.838
Age (years, mean ± SD)	3,682 (99.9)	61.0±11.5	58.8±12.9	<0.001
BMI (kg/m^2, mean ± SD)	3,633 (98.6)	24.0±4.0	24.7±4.4	<0.001
Duration of diabetes (years)	3,581 (97.2)			0.001
More than 10 years		952 (50.5)	774 (45.6)	
5 to 10 years		437 (23.2)	409 (24.1)	
Less than 5 years		493 (26.2)	516 (30.4)	
HbA1c (-6.8/6.9- %)	3,605 (97.8)	697 (38.6) / 1,110 (61.4)	538 (33.1) / 1,086 (66.9)	<0.001
Frequency of medical consultation	3,340 (90.6)			0.508
At least once a month		1,198 (68.6)	1,091 (68.4)	
Once per 2-3 months		535 (30.6)	490 (30.7)	
More than half a year		13 (0.8)	13 (0.8)	
Medication (multiple answer)				
OHA	3,566 (96.8)	1,213 (64.7)	1,065 (63.0)	0.288
Insulin	3,566 (96.8)	617 (32.9)	645 (38.1)	0.001
Diet and exercise therapy only	3,566 (96.8)	274 (14.6)	185 (10.9)	0.001
Exercise therapy guidance				
Frequency of exercise therapy	3,609 (97.9)			<0.001
Every medical consultation		258 (13.6)	154 (9.0)	
Once per 2-5 medical consultations		349 (18.4)	190 (11.1)	
Once per 6-10 medical consultations		397 (21.0)	300 (17.5)	
Once a year		456 (24.1)	465 (27.1)	
No guidance		432 (22.8)	608 (35.4)	
Exercise therapy guidance counselor (multiple answer)				
Medical doctor	2,618 (71.0)	979 (64.8)	733 (66.2)	0.483
Nurse	2,618 (71.0)	223 (14.8)	151 (13.6)	0.410
Dietitian or national-registered dietitian	2,618 (71.0)	260 (17.2)	161 (14.5)	0.064
Pharmacist	2,618 (71.0)	16 (1.1)	14 (1.3)	0.628
Physical therapist	2,618 (71.0)	56 (3.7)	44 (4.0)	0.729
Health fitness instructor	2,618 (71.0)	273 (18.1)	126 (11.4)	<0.001
Exercise prescription content (multiple answer)				
Type	2,419 (65.6)	667 (47.7)	404 (39.5)	<0.001
Intensity	2,420 (65.7)	258 (18.5)	124 (12.1)	<0.001
Frequency	2,420 (65.7)	335 (24.0)	160 (15.6)	<0.001
Duration	2,420 (65.7)	566 (40.5)	311 (30.4)	<0.001

Some values in this table may not add up to the total number because of missing values
SD: standard deviation, OHA: oral hypoglycemic agents, BMI: body mass index
*Exercise therapy group vs. non-exercise therapy group

Table 3. Daily physical activity according to work/housework and leisure/exercise/moving

	Effective answers n (%) (n=3,685)	Exercise therapy group n (%) (n=1,926)	Non-exercise therapy group n (%) (n=1,759)	p value*
Work and housework (3-5 Mets)	3,451 (93.6)			<0.001
No activity		184 (10.2)	333 (20.3)	
30 minutes		471 (26.1)	476 (29.0)	
1 hour		641 (35.5)	403 (24.5)	
More than 2 hours		511 (28.3)	432 (26.3)	
Work and housework (above 5 Mets)	2,919 (79.2)			<0.001
No activity		802 (53.1)	850 (60.3)	
15 minutes		338 (22.4)	270 (19.1)	
30 minutes		196 (13.0)	137 (9.7)	
More than 1 hour		173 (11.5)	153 (10.9)	
Leisure, exercise and moving (3-5 Mets)	3,453 (93.7)			<0.001
No activity		133 (7.4)	456 (27.6)	
30 minutes		660 (36.6)	647 (39.2)	
1 hour		727 (40.3)	413 (25.0)	
More than 2 hours		283 (15.7)	134 (8.1)	
Leisure, exercise and moving (above 5 Mets)	3,111 (84.4)			<0.001
No activity		735 (45.0)	1,077 (72.9)	
15 minutes		160 (9.8)	135 (9.1)	
30 minutes		330 (20.2)	141 (9.5)	
More than 1 hour		409 (25.0)	124 (8.4)	

Some values in this table may not add up to the total number because of missing
*Exercise therapy group vs. non-exercise therapy group

Results of multiple logistic regression analysis

The odds ratios (ORs) of possible factors affecting the exercise therapy group in all patients adjusted for age, gender, BMI and living area, as assessed by multiple logistic regression analysis, were as follows: no insulin treatment (OR = 1.21, 95% confidence interval = 1.00 to 1.47; reference group (ref.): insulin treatment), frequency of exercise therapy guidance (1.89, 1.40 to 2.56; ref.: no exercise therapy guidance), detailed exercise prescription such as type (1.32, 1.08 to 1.61), frequency (1.60, 1.24 to 2.06) and duration (1.63, 1.32 to 2.01; ref.: no exercise prescription), patients who enjoy physical exercise (4.85, 2.97 to 7.93; ref.: patients who dislike physical exercise), high level of physical activity (1 hour per day) (2.31, 1.77 to 3.03; ref.: low level of physical activity) (Table 5).

Table 4. Preference of exercise and watching sports

	Effective answers n (%) (n=3,685)	Exercise therapy group n (%) (n=1,926)	Non-exercise therapy group n (%) (n=1,759)	p value*
Patients who enjoy doing exercise	3,624 (98.3)			<0.001
Enjoy		708 (37.3)	348 (20.2)	
Somewhat enjoy		501 (26.4)	417 (24.1)	
Neither enjoy nor dislike		405 (21.3)	476 (27.6)	
Somewhat dislike		248 (13.1)	367 (21.3)	
Dislike		35 (1.8)	119 (6.9)	
Patients who enjoy watching sports	3,625 (98.4)			<0.001
Enjoy		1,001 (52.7)	756 (43.8)	
Somewhat enjoy		455 (24.0)	417 (24.2)	
Neither enjoy nor dislike		288 (15.2)	322 (18.7)	
Somewhat dislike		109 (5.7)	140 (8.1)	
Dislike		46 (2.4)	91 (5.3)	

Some values in this table may not add up to the total number because of missing values

*Exercise therapy group vs. non-exercise therapy group

Discussion

Previously, to clarify the actual situation of exercise therapy for the patients with diabetes, we conducted a written questionnaire-based survey of 570 the patients with diabetes outpatients. The results revealed that approximately 30% of the patients did not carry out prescribed exercise regimens. However, that study was performed in a local, restricted area and the number of subjects was somewhat low [9]. The present study was the first national survey to investigate important factors of exercise guidance for the patients with diabetes in Japan, including the education system, conducted by the Research Committee for the Establishment of Therapeutic Exercise for the Patients with Diabetes of the Japan Diabetes Society.

Although dietary intervention in combination with physical exercise is effective for the prevention and treatment of type 2 diabetes, lifestyle improvements based on diet and exercise are, in practice, difficult. The Diabetes Prevention Program (DPP) [10] showed that 50% of the patients in the lifestyle-intervention group achieved the goal weight loss of 7% or more by the end of the 24-week curriculum, and that 38% of them had

weight loss of at least 7% at the time of the most recent visit to the clinic; the proportion of participants who met the goal of performing at least 150 minutes of physical activity per week, assessed on the basis of logs kept by the participants, was 74% at 24 weeks, and 58% at the most recent visit to the clinic. Similar to the results of the DPP, in the current study the exercise therapy implementation rate was 52.3%.

The BMI was lower and glycemic control was better in the exercise therapy group than those in the non-exercise therapy group. In addition, compared with the non-exercise therapy group, there was lower percentage of insulin users in the exercise therapy group. Therefore, the effectiveness of physical exercise for the patients with diabetes was confirmed.

As expected, the frequency of exercise guidance was higher in the exercise therapy group than that in the non-exercise therapy group. The present study also showed that the relative number of health fitness instructors providing exercise guidance was higher in the exercise therapy group than that in the non-exercise therapy group, and thus patients in the exercise therapy group received more concrete exercise prescription. In the DPP study, the curriculum, taught by case managers on a one-to-one basis during the first 24 weeks after enrollment, was flexible, culturally sensitive, and individualized [10]. The DPP and its outcome study showed that, from the perspective of a payer and compared with placebo, lifestyle intervention over 10 years was cost-effective and metformin was marginally cost-saving [11]. Both the Finnish Diabetes Prevention Study and the Da Qing Diabetes Prevention Study also showed that lifestyle intervention for people at high risk of type 2 diabetes induces sustained lifestyle change and results in long-term prevention of type 2 diabetes development [12, 13]. These results suggested that lifestyle guidance conducted by exercise specialists is of most importance.

In the current investigation, we collected data related to the level of daily physical activity. Comparatively, the exercise therapy group showed higher level of physical activity in all four items considered (Table 1). In addition, multivariate analyses indicated that the exercise therapy group had higher physical activity level at 3-5 Mets. Several studies have reported that television viewing time is associated with increased risk of all-cause and CVD mortality [14-16]. Bankoski et al. showed that older people may benefit from reducing total inactive time and avoiding prolonged sedentary periods by increasing the number of breaks during

inactivity [17]. Wennberg et al. indicated that, in addition to regular physical activity, reduced television viewing in adolescence may positively contribute to cardiometabolic health later in life [18]. Wilmot et al. also demonstrated by meta-analysis that the length of inactivity is associated with increased risk of diabetes and cardiovascular disease and cardiovascular and all-cause mortality; the strength of the association was most consistent for diabetes [19]. A Japanese study also showed that higher level of leisure-time physical activity was associated with significantly reduced total mortality in the patients with diabetes [6]. Therefore, we believe that high quality exercise guidance including exercise type, frequency and duration should be performed. Particularly, an active lifestyle is essential in the management of diabetes, which is a typical lifestyle-related disease [2].

Table 5. Odds ratios of possible factors affecting the "exercise therapy group" in all participants by multiple logistic regression analysis

Independent variable	Odds ratios (95% confidence interval)	p value
No insulin treatment (ref.: insulin treatment)	1.21 (1.00-1.47)	0.011
Frequency of exercise therapy guidance (ref.: no exercise guidance)		
Every medical consultation	1.79 (1.28-2.51)	0.001
Once per 2-5 medical consultations	1.89 (1.40-2.56)	<0.001
Once per 6-10 medical consultations	1.24 (0.95-1.63)	0.118
Once a year	1.23 (0.97-1.55)	0.086
Received exercise guidance including type (ref.: no exercise prescription)	1.32 (1.08-1.61)	0.008
Received exercise guidance including frequency (ref.: no exercise prescription)	1.60 (1.24-2.06)	<0.001
Received exercise guidance including duration (ref.: no exercise prescription)	1.63 (1.32-2.01)	<0.001
Patients who enjoy doing exercise (ref.: dislike physical exercise)		
Enjoy	4.85 (2.97-7.93)	<0.001
Somewhat enjoy	2.81 (1.72-4.61)	<0.001
Neither enjoy nor dislike	2.18 (1.33-3.58)	0.002
Somewhat dislike	1.77 (1.07-2.93)	0.025
Work and housework of 3-5 Mets (ref.: no activity)		
30 minutes	1.50 (1.14-1.96)	0.003
1 hour	2.31 (1.77-3.03)	<0.001
More than 2 hours	1.70 (1.29-2.25)	<0.001

Dependent variables: non-exercise therapy group=0, exercise therapy group=1
ref: reference group

Multivariate analyses showed that patients who enjoyed doing exercise had higher odds ratios in the exercise therapy group. Physical exercise instruction should be provided so as to maintain the motivation of patients. In recent years, much attention has been paid to interventions for patients with diabetes following the transtheoretical model (TTM) [20] and behavioral approaches [21]. Jackson et al. reported that specialist-conducted motivational interviewing and behavioral change training can successfully provide a TTM intervention to people with diabetes, which results in an increase in physical activity and change levels. The TTM approach appears useful for working with people with type 2 diabetes [22].

Two strengths of our study are that it was a large-scale, nationwide survey that included 20 hospitals and 16 clinics located in whole Japan from Hokkaido to Kyusyu, and its recovery rate was very high (4,176 out of 5,100 patients; 81.9%). On the other hand, the limitation of this study is that a cross-sectional design only allows assessment of the association between exposure and outcome; it is not possible to establish a causal relationship between exposure and outcome. Therefore a prospective study design is required to validate the findings of the current study.

Conclusion

The results of the current study showed that, concerning exercise therapy education, it is important to maintain the motivation of the patients to participate in exercise therapies, to increase the frequency of guidance, and to provide more detailed exercise prescription such as frequency and duration. Exercise guidance should be performed by exercise specialists such as health fitness instructors.

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Appendix

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Conflict of interest

The authors declare no conflict of interest.

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