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Type 2 Diabetes Mellitus Exercise Management Therapy: Superior Monitor Efficacy over Polymeters

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Abstract – ***In comparison with the podemeter in the practise treatment of patients with type 2 diabetes, we compared the effectiveness of an activity monitor (that shows the strength and amount of steps of exercise). The topics were split into the community () and group of podometers of activity monitoring (). Improving haemoglobin A1c was the first objective (HbA1c). The goal was set at 8,000 steps/day and a mild intensity workout (altogether 3.5 caloric equivalents) for 20 minutes. The fitness monitor is designed to measure the time and length of the exercise, amount of steps, walking distance, calorie intake and overall calorie consumption with a three-axis accelerometer sensor. The podium metre measures the number of moves. During the visits, blood samples were taken for laboratory purposes. The thesis was started and repeated at 2 and 6 months. The first test took place. At 2 months, a major difference was found in both groups in the decrease in the amount of HbA1c. In addition to the amount of measures, the usage of activity level monitors that show details on exercise strength are helpful in exercise therapy so the exercise therapy principle is enhanced and the decrease in HbA1c in patients with diabetes is supported.***

Key Words – Diabetes Mellitus, Exercise Therapy, QOL

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1. INTRODUCTION

The management of diabetes mellitus of type 2 is based on diet and exercise therapy (T2DM). Both are popular for improving regulation of blood glucose. The therapy of practise has also been shown to improve blood glucose regulation and quality of life (QOL) efficiently. However, reducing fat and improving insulin tolerance through diet alone are reduced.

Thus, while we hear about the benefits of exercise therapy, in fact the number of the patients who are on exercise therapy is just about 40%, even though diet therapy is practised by almost all patients. The explanations for this low rate is that exercise therapy in patients without a history, time constraints and incapacity in keeping enthusiasm was not simple to enforce. A more explanation is that both the patient and the therapist are sometimes hard to grasp the actual procedures and aims of exercise therapy.

Exercise therapy target measures involve both the amount of steps which strengths and are seen as especially useful at low intensity training. While 3-6 metabolic equivalents (METs) are proposed for medium intensity exercise therapy, it is sometimes challenging to control the intensity level during preparation. The activity frequency can be sufficiently raised for optimal exercise therapy by monitoring and knowledge of the intensity of the workout. Developing an easy and practical method to boost T2DM care results will benefit. The aim of this research was to assess the results of exercise therapy with knowledge of exercise strength with regard to improvement of the blood glucose regulation using a standard instrument that measures the number of steps (pedometers) and an alternative that measures the number and speed and quantity of steps, exercise (activity monitor).

2. MATERIALS AND METHODS

2.1. Patients and Methods

Many who visited our division at the University of Tokai Hospital from March until April 2012 were 200 adult patients with T2DM and were assessed by doctors as suitable for exercise treatment. At the start of the project, more explanations were received both orally and written about procedures and the purposes of the analysis and the cooperative aspects of the collaboration and all patients agreed in writing. The thesis has been licenced as a Scientific Study (UMIN000018694) and the Clinical Review Board of Tokai University Hospital has been examined and approved.

A display with a triaxial speed sensor, Model MT-KT01, Terumo, Tokyo, Japan (model), which monitors the number of steps and time spent walking at a moderate intensity pace, records the number of steps and the quantity of physical exercise. As the pedal metre the amount of steps while walking/exercise was used as an additional instrument, a tweaked MT-KT01.

The pedometers set the goal for a moderately intensive walking workout (3 METs or more) for at least 20 minutes a day, and 8,000 steps, after allocating 100 subjects to the monitoring community and the pedopheter group at random. For the activity monitor category also a goal of 20 minutes of training and 8000 measures were set for the same aim of at least three METs (at or above a performance level predictor in the activity monitor; Figure 1(a)). During the waking hours, both the pedal and the console were hanged from a harness about the user's waist.

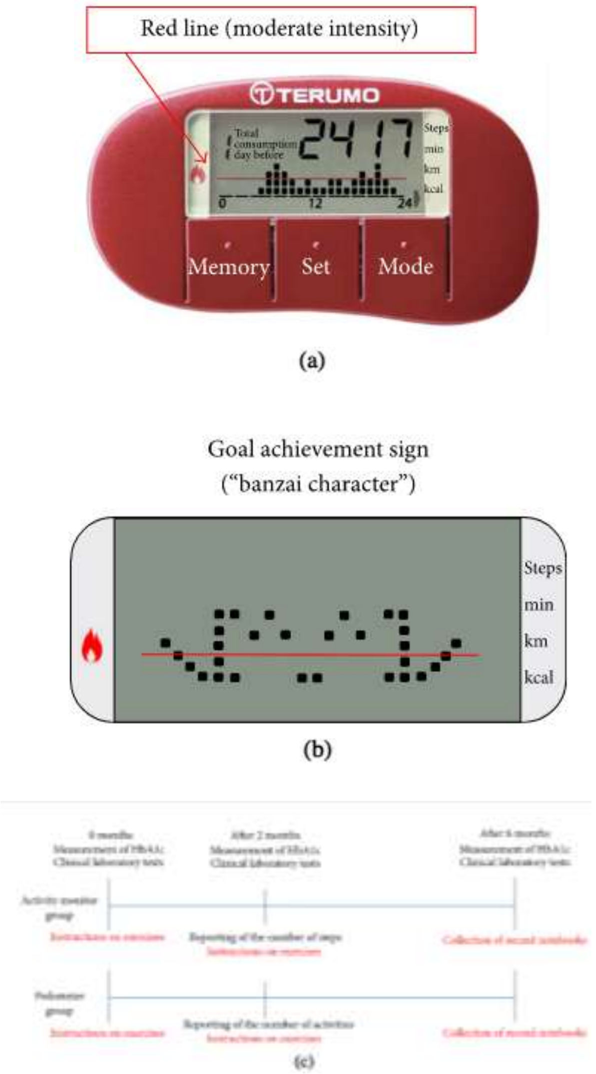

Figure 1: (a) On the activity monitor, for exercise of moderate intensity of 3 METs or higher, the intensity is displayed when the indicator exceeds the red line. (b) If the daily goal of moderate-intensity exercise of 20 minutes or longer and at least 8,000 steps is set and achieved, the user is notified that the goal has been achieved through a sign on the screen (a “banzai character”). (c) Study design.

A showing of the aim accomplishment symbol (Figure 1(b)) on the activity monitor indicated the achievement of the target exercise. In records that have been obtained during outpatient visits the patients were required to manual report the data on their monitor and paediatric measure. During the ambulatory visits, clinical data analyses were conducted including HbA1c levels, the amount of measures and the goal performance ratio of the second month were evaluated and finalised during the sixth month (Figure 1(c)).

Instructions for the pamphlet exercise delivered to each patient at the start of the studies were given (Figure 2). At 2 months after the training began, participants were required to indicate the number of steps and workout volume and whether the benchmarks have been met. Those who self-reported that they had accomplished the objectives had been advised to proceed whilst those who had not, without further action, were once more presented with details outlined in the brochure.

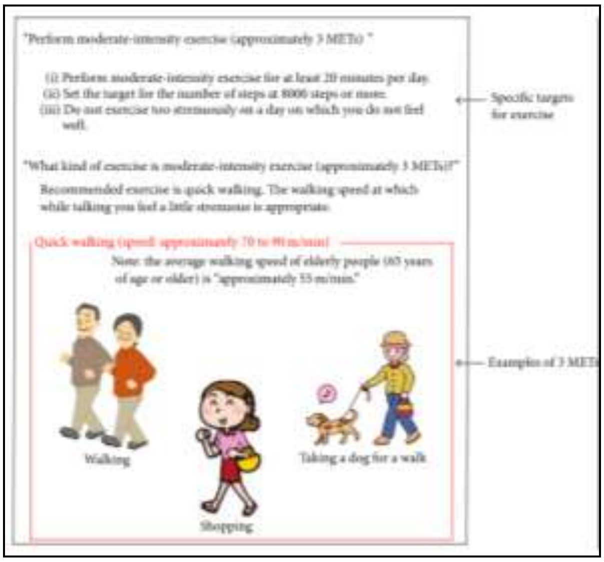

Figure 2: The explanatory pamphlet for exercise therapy. Examples of moderate-intensity exercises for the patients who participated in the study of both the activity monitor and the pedometer groups. The exercise goal of at least 20 minutes and 8,000 steps a day was based on the pamphlet.

2.2. Statistical Analysis

Instructions were provided for each patient's leaflet training at the beginning of the studies (Figure 2). At the beginning of training two months later learners had to show the amount of measures and the volume of training and whether the goals were reached. Those who indicated that they had achieved the goals had been recommended to continue, whilst those that had not been provided with information illustrated in the brochure without further intervention.

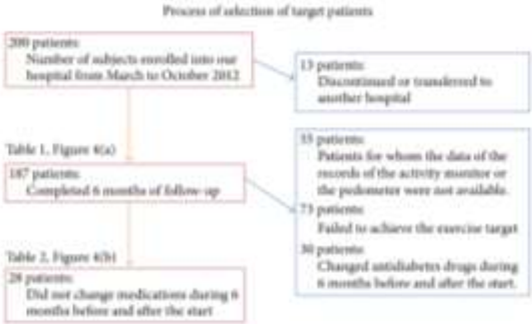

Figure 3: Patient selection process. After excluding those patients who cancelled, transferred to other hospitals, or dropped out, the data of 187 patients were subjected to analysis. After excluding patients with insufficient exercise therapy record data, unachieved exercise goals, and changes in medications in the 6 months before and after the start of the study period, data of 28 patients of each group were compared and studied.

HbA1c amounts were compared as key elements at the beginning of the analysis, both at 2 and 6 months later. For comparisons of variables between the two classes, the Pearson chi-square or Mann-Whitney test was used and the meaning amount was set at 5%. JMP Ver. 11.0.0 was the programme for statistical analysis (SAS Institute Japan, Tokyo).

3. RESULTS

3.1. Patients Background Characteristics and Changes in HbA1c Level

Table 1 summarises the clinical history results for 187 patients completing the 6-month follow-up and Figure 4 shows the improvements in the delta at the HbA1c stage during the trial (a).

Table 1: Clinical characteristics of the activity monitor group and pedometer group.

	Activity monitor group ()	Pedometer group ()	value
Age (years)	62.7 ± 9.2	62 ± 10.6	0.97
Male	78.3%	56.8%	<0.005
Height (m)	1.63 ± 0.08	1.62 ± 0.09	0.12
Weight (kg)	72.6 ± 15.7	69.1 ± 15.4	0.11
BMI	27.2 ± 5.1	26.4 ± 5.4	0.21
HbA1c (%)	7.1 ± 1.1	7.0 ± 1.2	0.53
Systolic BP (mmHg)	122.8 ± 11.1	123.0 ± 10.9	0.98
Diastolic BP (mmHg)	70.9 ± 9.3	71.9 ± 9.5	0.79
UA (mg/dL)	6.0 ± 1.5	5.3 ± 1.3	<0.005
HDL cholesterol (mg/dL)	59.9 ± 17.2	60.9 ± 19.7	0.85
LDL cholesterol (mg/dL)	108.7 ± 24.9	112.0 ± 23.9	0.60
Triglycerides (mg/dL)	151.1 ± 103.8	138.3 ± 75.9	0.49

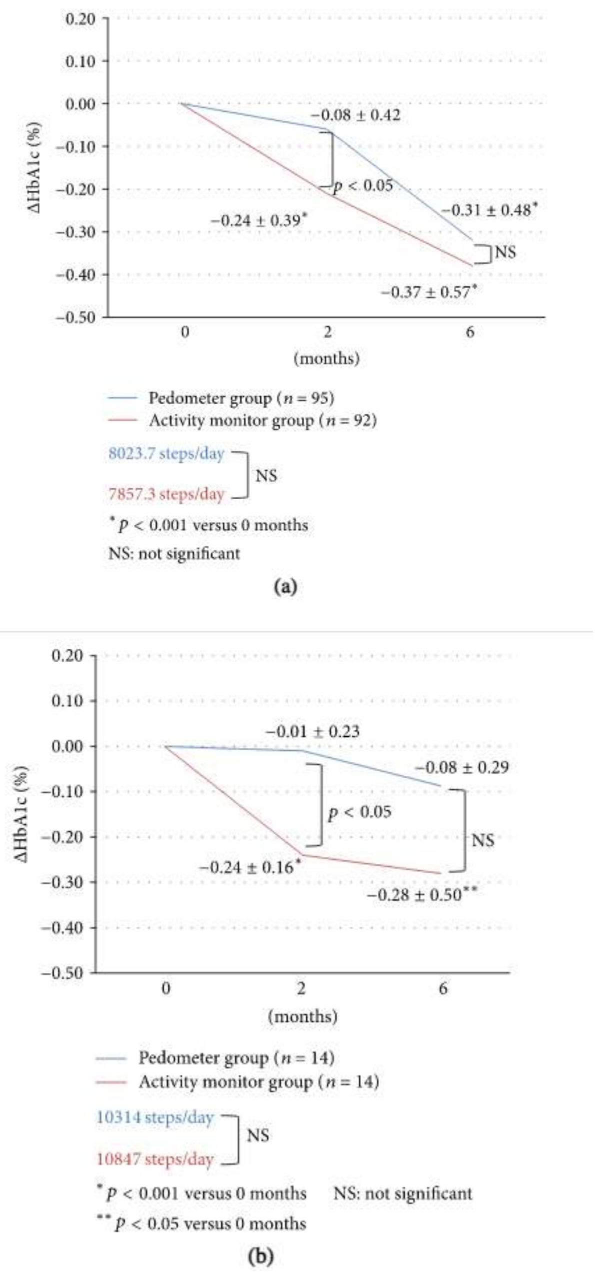

Figure 4: **(a) Changes in HbA1c level after daily walking exercise for 2 and 6 months in the pedometer and activity monitor groups and all 187 patients. (b) Changes in HbA1c level after daily walking exercise for 2 and 6 months in 28 patients of the pedometer and activity monitor groups who achieved their goals and recorded no changes in medications throughout the study.**

On a background basis, the values of uric acid in the blood were substantially low within the pedometer population and no clear distinction was identified between the two classes except a large prevalence of men in the activity monitor group (Table 1).

In the activity monitor community, major HbA1c decreases were observed at 2-6 months after the beginning of the research compared with prior to the start of the study with respect to improvements in the HbA1c stage. The two category system data comparison revealed a substantial gap between the pedometer and the watch group at the stage of HbA1c reduction at 2 months (pedometer group: percent , activity monitor group: percent). At 6 months, though, there was no major gap between the two classes.

HbA1c changes were also compared with the levels of sex and uric acid at two and six months. No substantial difference was observed among men and women in HbA1c (Figure 5). We saw little gap between the two classes after splitting the patients into the patients with high and low uric acid, using the median uric acid as the cut-off amount (Figure 5).

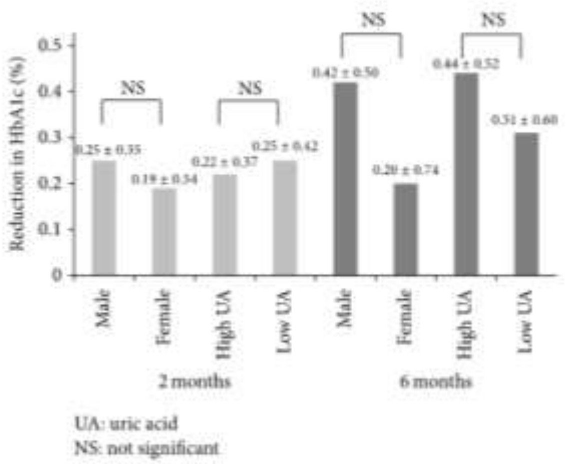

Figure 5: Comparison of the levels of reduction in HbA1c at 2 and 6 months according to sex and serum uric acid.

Next, we omitted data from 55 individuals with data for physical activity less than 80 percent of those in 6 months, and from 73 individuals with data for physical activity less than 80 percent of the goal rate of performance. Therefore, for 6 months 59 participants, including 36 from the activity monitor and 23 from the pedometer community, continued workout therapy. The percentage of continuation was respectively 37.9% and 25.0%. The activity monitor community's levels of workout therapy continuation was slightly higher than the pedometer group ().

Since no restriction on the usage of and improvements in medicines was enforced in the present review, the drugs' results were omitted. For meaningful research, however, we chose patients with 6 months before and after the start of the trial (i.e. for 1 year) of which no improvements in medicines were made and reviewed the results only for the consequences of exercise therapy. The findings revealed that HbA1c differences were observed in 14 individuals in each category solely because of exercise (Figure 4(b)).

The activity control category but not the pedometer group, both at 2 and at 6 months, had significant decreases in HbA1c from the period prior to the time after the analysis began. The 2-month decline in HbA1c in the activity monitor community (percent) was substantially bigger relative to the pedometer group (percent). At 6 months, there was a similar pattern, but the gap was not substantial.

4. DISCUSSION

As an effective fitness treatment, the U.S. Recommendations prescribe 150 minutes a week. But a new analysis has shown that 90 minutes of low-to-moderate practise per month are good for Asians. Thus, quick walking is considered moderately vigorous workout in Asia and can be easily reached on a daily basis. This research was carried out by choosing the walking exercise as the most simple exercise treatment. The aim of this research was to hypothesise that adjusting the physical routine itself to a degree of medium intensity is an adequate fitness therapy to resolve the question "I don't have time to practise," even though one can just take time to exercise, and that activity monitors are doing more effectively than pedometers.

In the current research, the goal behaviour was set at three METs, while moderately intense practise in T2DM patients was successful. In either case, the workout burden can also be calibrated according to age for low intensity exercises. The 3-MET standard is known to be moderate in patients aged at 65 years (which comprises the bulk of our patients and the majority in Japan who are T2DM). Therefore, the aim activity in this analysis is 3 METs and higher.

Our findings revealed that both patients exercised the amount of HbA1c while knowing of the 3-MET goal in both categories. These findings indicate that exercise therapy has improved HbA1c in patients with T2DM for at least 6 months. In addition, HbA1c levels were reduced, considerably better than the pedometer community, to patients who wear the activity monitor, who got data on their exercise speed. The incentive for exercising at a reasonable stage, along with input from the control speed of the exercise, resulted in more positive results for the activity monitor community than the pedometer group, was believed to be this discrepancy. These findings together indicate that the usage of the activity monitor seems to improve the decrease in HbA1c level.

As shown in Figure 4 (b), the decline in HBA1c levels in the behaviour monitor population at both 2 and 6 months was significantly higher in the sample that omitted the impact of drugs. This result shows the use of an activity monitor is useful in practise therapy, since it offers guidance on exercise strength and that such a monitor is especially helpful while walking as part of everyday activities is basic exercise therapy.

In addition, it was the hardness of maintaining the therapy over the six month trial that was the most notable finding of this study. Thus, in all categories, the number of patients who pursued exercise therapy for 6 months at 80% of the drug therapy was fewer than 40%: 37.9% of the behaviour monitor group and 25.0% of the drug control group showed the problem of continued exercise therapy itself. We stress the need to motivate T2DM patients to pursue their training on the basis of these outcomes.

As regards providing patients with instructions or guide to exercise therapy, it is useful to check if the 3 MET goal was achieved on walking by means of an ability to recognise the levels of exercise intensity, including in patients who received instructions only via the brochure. This is also achievable not only by a doctor, but also by other medical personnel. This shows that the very act of introducing participants to fitness targets before using behaviour monitoring and integrating low to high levels of movement into their everyday lives appeared to add to the effectiveness of exercise treatment.

There are certain shortcomings in this report. The 6-month decrease in HbA1c was the same as in summer (from the fourth month after the start of the study). For causes like avoiding heatstrokes, people prefer to sit less indoors. Because of the possible decrease of physical exercise and the impact of an elevated consumption of high-glucose sports beverages, more long-term research, including seasonal variations, are required. Table 1 indicates that in the exercise control category the number of men was even higher than in the pedometer monitor community. This can lead to the preference for variety. Therefore, we contrasted the level of HbA1c reduction between males and females and between high and low uric acid patients at 2 and 6 months (Figure 5). In 28 patients who did not alter their prescription over the 6 months, we also studied history features and improvements in HbA1c (Table 2). The present research also has a drawback that it compares not the number of steps that should be used to determine whether exercise monitor use actually increases the overall amount of physical activity (e.g., walking time, walking distance and total calorie costs) in the two classes. Unfortunately, the pedometer system cannot retain such info.

Table 2: Clinical background of patients in whom medications were not changed throughout the study.

	Activity monitor group ()	Pedometer group ()	value
Age (years)	65.8 ± 6.7	62.4 ± 9.9	0.58
Male	78.6%	71.4%	0.66
Height (m)	1.61 ± 0.08	1.63 ± 0.09	0.46
Weight (kg)	62.4 ± 12.7	68.3 ± 9.5	0.08
BMI	24.1 ± 4.0	25.9 ± 4.3	0.24
HbA1c (%)	6.6 ± 0.6	6.4 ± 0.9	0.27
Systolic BP (mmHg)	121.1 ± 10.8	121.6 ± 6.8	0.89
Diastolic BP (mmHg)	67.8 ± 8.1	73.5 ± 9.0	0.09
UA (mg/dL)	5.5 ± 1.6	5.6 ± 1.6	0.80
HDL cholesterol (mg/dL)	66.6 ± 18.7	60.3 ± 11.6	0.72
LDL cholesterol (mg/dL)	111.4 ± 34.9	103 ± 10.8	0.09
Triglycerides (mg/dL)	107.6 ± 59.7	127.1 ± 90.8	0.68

Values are mean ± SD.

BMI: body mass index; BP: blood pressure; UA: uric acid; HDL: high-density lipoprotein; LDL: low-density lipoprotein

The second interpretation of the pamphlet given during the consulting in the second month is the only explanation for continuing training of patients after achieving the practise goals. It is therefore impossible to conclude that this is entirely identical to the guidance provided in regular clinical consultation on exercise therapy. Further experiments should be carried out to determine the optimal follow-up regimen and its connection to exercise objectives in T2DM patients.

5. CONCLUSIONS

In this research, we have shown that exercise therapy is essential for patients with T2DM. Results found that knowledge of the exercise frequency was increased in the initial exercise cycle by using an activity monitor that gives details on the exercise intensity, not a pedometer. The findings show that the usage of instruments with functions to verify the accomplishment of the goal in a concrete manner helps to continue the practise of patient therapy.

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