Evaluation of an Exercise Program for Diabetic Patients in Mongolia

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Abstract. [Purpose] The purpose of this study was to validate the effects of an exercise program developed for healthy Japanese young men. This program was established as a basis for an exercise program for diabetic patients in Mongolia. [Methods] Ten healthy young men underwent the exercise tolerance test. They participated in a light exercise program consisting of 10 stretching exercises and 11 light exercises. During the exercise tolerance test and exercise program, heart rate (HR), oxygen uptake (VO2), and rate of perceived exertion (RPE) were recorded. The intensity of the exercise program was determined by taking the average of the VO2 parameters during exercise and dividing it by the maximum value for VO2 (VO2max). Correlation coefficients for VO2, HR, and RPE were calculated during the exercise tolerance test and all exercises. [Results] During the exercise program, VO2 was approximately 20% of VO2max, HR was 85–100 bpm, and RPE was 10–11. A high correlation coefficient was observed during the exercise tolerance test, and a moderate correlation was observed during the exercise program. [Conclusion] The intensity of the exercise program in this study was low to moderate. Thus, the exercise program must be revised after validating it among diabetic patients in Mongolia.

Key words: Exercise tolerance test, Exercise prescription, Lifestyle-related disease

INTRODUCTION

The number of diabetic patients has increased substantially in many developing countries in recent decades because of changes in lifestyle and social environment resulting from rapid economic growth. This same tendency has been observed in Asian countries. For young people, researchers have advocated a preventative approach to counter lifestyle choices that may lead to type 2 diabetes1). In 2011, the International Diabetes Federation estimated that 2.3 million people (age, 20–79 years) will be affected by diabetes in 20302), which is a rapid increase. In Mongolia, hypertension, diabetes, hypercholesterolemia and overweight are thought to be high cerebrovascular disease risk factors3). Approximately one-third of diabetes patients were diagnosed prior to the survey4), and 15.9% of all diabetics were adequately controlled5). Especially, obese people are increasing in Mongolia, and it was reported that one-third of the diabetic people were obese6). It was reported that there were proportionally more people in Mongolia than in Japan who were overweight or had a lot of body fat7). Ten years ago, prevention and management of diabetes were first established as important national goals for Mongolians4). Diabetes is a preventable lifestyle-related disease. Exercise has been reported to be an effective means of decreasing blood sugar and controlling lipid metabolism, blood pressure, and weight. Exercise also enhances skeletal muscles, cardiopulmonary function, and psychological health; these benefits cannot be achieved by pharmacotherapy or dietary changes8,9). In diabetic patients, enhanced cardiopulmonary function because of exercise has been linked with prolonged life10). The benefits of exercise in the prevention of diabetes are well known11, 12). Therefore, physiotherapists and other exercise professionals provide support for diabetes care and implement prevention programs.

In Mongolia, physiotherapy was first registered as a recognized profession in May 2011. The clinical reasoning and techniques that physiotherapists provide will be essential in Mongolia13). Because physiotherapy is in the process of developing as a profession in Mongolia, effective exercise programs are currently lacking. Since the incidence of diabetes in Mongolia is increasing, effective exercise programs for diabetic patients must be devised and prescribed. Mongolian physiotherapists must play an active role in the treatment and prevention of diabetes.

We designed an exercise program in Japan called the Simple Exercise for Elderly People14), and we thought it might be suitable for Mongolia because it requires no special equipment. There are some differences (meals, culture, etc) between Japanese and Mongolians in their lifestyle, but there are also some common because of racial similarities. It was reported that proportion of people with metabolic abnormalities in Mongolia and Japan was not so different from Korea, but the proportion of people with of
Mongolian and Japanese people who do exercise more than twice a week was significantly less that of Korean people. Mongoloid populations were formerly considered to be relatively resistant to glucose intolerance. So, we thought it meaningful to validate an exercise program for Mongolian diabeties with Japanese in advance.

The purpose of this study was to validate the effects of an exercise program originally developed for healthy Japanese young men. And we believe that this result would help the physiotherapy for diabetes in Mongolia in future.

SUBJECTS AND METHODS

Ten healthy young Japanese men (age, 23.1 ± 1.5 years; height, 172.9 ± 4.3 cm; weight, 66.8 ± 1.5 kg) with no significant medical history were recruited for this study. All subjects were informed about the purpose and procedure of the study and provided their written informed consent to participation in advance.

An exercise tolerance test was performed by all subjects. The subjects then participated in a light exercise program. The exercise tolerance test used a cycle ergometer (AEROBIKE 75XLIII, Combi Wellness, Tokyo, Japan). It began at 20 watts and increased by 10 watts/min (ramp-type incremental exercise protocol) to the symptom-limited maximum. A 3-min rest period (seated in the ergometer) and a 3-min warm-up preceded the test. The test was terminated when the cadence dropped to <40 revolutions/min, the subject requested termination of the test, or when the examiners judged that termination was best for safety reasons.

The light exercise program consisted of 10 stretching exercises and 11 light exercises, all of which can be easily performed at home. The required time was 20 min in total. A rubber tube and natural body weight were used in the resistance exercises. The stretching exercises of the exercise program are illustrated in Figure 1. Each stretch was performed twice for 20 s. The light exercise program is illustrated in Figure 2. Exercises included sit-ups (10 repetitions), bridge (10 repetitions), straight leg raise (10 repetitions, both legs), lateral leg raise (10 repetitions, both legs), down on all fours with opposite limbs raised (6 repetitions, both sides), pull-ups (using an elastic tube; 10 repetitions), toe and thigh raises (using an elastic tube; 10 repetitions, both legs), arm raises (using an elastic tube; anterior, lateral, posterior, 5 repetitions per side), squats (10 repetitions), calf raises (20 repetitions), and one-leg standing and leg swing (10 repetitions, both legs). All exercises were performed on a different day from the exercise tolerance test.

To examine the effects of the exercise program statistically, average VO2 values during stretching and light exercise were divided by VO2max values. The resulting values were used to determine the intensity of the exercise program. Correlations among VO2, HR, and rate of perceived exertion (RPE, determined using the Borg scale) were measured during stretching and light exercise. During the exercise tolerance test, all parameters were measured at rest, 1-min intervals during exercise, and maximal exercise. During the light exercise program, all parameters were measured after completion of each exercise.

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RESULTS

The average value of VO$_{2\text{max}}$ was 42.1 ± 0.6 mL/kg/min. VO$_2$ at the AT point was 25.9 ± 3.1 mL/kg/min, which was 61.5 ± 7.2% of VO$_{2\text{max}}$. During the stretching exercises, VO$_2$ was 7.6 ± 1.3 mL/kg/min (18.0 ± 2.9% of VO$_{2\text{max}}$), HR was 85.7 ± 6.4 bpm, and RPE was 8.1 ± 0.2. During light exercise, VO$_2$ was 9.7 ± 2.0 mL/kg/min (23.0 ± 4.6% of VO$_{2\text{max}}$), HR was 98.8 ± 9.2 bpm, and RPE was 11.7 ± 0.3. Over the entire exercise period, VO$_2$ was 8.7 ± 1.5 mL/kg/min (20.7 ± 3.4% of VO$_{2\text{max}}$), HR was 92.5 ± 10.3 bpm, and RPE was 10.0 ± 2.0. All results for VO$_2$, HR, and RPE are shown in Table 1.

Correlation coefficient values during the exercise tolerance test were 0.841 between VO$_2$, HR, and RPE, 0.842 between VO$_2$ and RPE, and 0.914 between HR and RPE. These values indicate high correlation. Correlation coefficient values during the exercise program were 0.496 between VO$_2$ and HR, 0.466 between VO$_2$ and RPE, and 0.645 between HR and RPE. These values also indicate high correlation. All results of the correlation analysis are shown in Table 2.

DISCUSSION

VO$_{2\text{max}}$ values for the study subjects were similar to the average values for young Japanese men reported in a previous study. The intensity of the exercise program in this study was low, as indicated by the VO$_2$ values during the exercise program (approximately 20% of VO$_{2\text{max}}$). It was reported that the effective exercise intensity for diabetes mellitus is from 50% to 60%, or 30% to 40% for diabetic patients who do not exercise regularly. The exercise program in this study included exercises that are easy to implement, but individual tailoring of the intensity level was apparently insufficient to achieve adequate results. The program needs to be revised to increase the load during exercise. The program was developed considering that VO$_{2\text{max}}$ of diabetic patients is most probably lower, and the intensity of the exercise program would be higher for them than for the study subjects. Because diabetic patients are more often middle aged, overweight, and less physically active, their VO$_{2\text{max}}$ values are typically lower. Therefore, the exercise program in this study needs to be adapted for diabetic patients, and a revised version should be generated after validation among people with and at risk of diabetes in Mongolia. In this study, we designed the ramp slope as 10 watt/min on the basis of standards for diabetic patients, which is lower than the general indication. Because subjects in this study were healthy young men, we should have used a ramp slope of 20 to 30 watt/min. We think this explains why the intensity of the exercise program in this study was low.

The result of HR and RPE during light exercises shows that the exercises were moderate in intensity, which may be good for the target population. However, the effects of the program are still speculative because of the low correlation among the VO$_2$, HR, and RPE values. These results may be explained by the fact that many exercises in the program were effective not for the whole body but for specific muscles. Blood flow response to exercise for local muscles has been reported to differ from that to exercise for the whole body. Therefore, a more effective program would include exercises requiring use of the whole body.

In Mongolia, measurement of cardiopulmonary parameters such as VO$_2$ may be difficult because of the lack of sufficient equipment. The high correlations among VO$_2$, HR, and RPE in the exercise tolerance test demonstrate that HR and RPE measurement can be performed to determine the appropriate exercise intensity for diabetic patients in Mongolia.

REFERENCES


Table 1. Results of VO$_2$, HR, and RPE at each point or period

<table>
<thead>
<tr>
<th>VO$_2$/min</th>
<th>Max (ml/kg/min)</th>
<th>AT (ml/kg/min)</th>
<th>Total (ml/kg/min)</th>
<th>Stretching (ml/kg/min)</th>
<th>Exercise (ml/kg/min)</th>
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</thead>
<tbody>
<tr>
<td>Value</td>
<td>42.1 ± 0.6</td>
<td>25.9 ± 3.1</td>
<td>8.7 ± 1.5</td>
<td>7.6 ± 1.3</td>
<td>9.7 ± 2.0</td>
</tr>
<tr>
<td>/Max (%)</td>
<td>100</td>
<td>61.5 ± 7.2</td>
<td>20.7 ± 3.4</td>
<td>18.0 ± 2.9</td>
<td>23.0 ± 4.6</td>
</tr>
<tr>
<td>HR Value</td>
<td>92.5 ± 10.3</td>
<td>85.7 ± 6.4</td>
<td>98.8 ± 9.2</td>
<td>8.1 ± 0.2</td>
<td>11.7 ± 0.3</td>
</tr>
<tr>
<td>RPE Value</td>
<td>10.0 ± 2.0</td>
<td>8.1 ± 0.2</td>
<td>11.7 ± 0.3</td>
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</tr>
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</table>

Stretching: during stretching exercises; Exercise: during light exercises; Total: during all exercises. Values are expressed as means ± standard deviations.

Table 2. Correlation coefficients among VO$_2$/min, HR, and RPE (R)

<table>
<thead>
<tr>
<th></th>
<th>During exercise tolerance tests</th>
<th>during exercises</th>
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<tbody>
<tr>
<td>VO$_2$/min</td>
<td>HR 0.841</td>
<td>RPE 0.842</td>
</tr>
<tr>
<td>HR</td>
<td>0.914</td>
<td>0.496</td>
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<tr>
<td>RPE</td>
<td>0.645</td>
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