

Effect of 24 Weeks of Physical Activity Therapy on the Low Leg Muscular Strength

TAESUNG KO¹⁾, GUNSOO HAN²⁾, BYUNGJUN CHO³⁾

¹⁾ Department of Physical Therapy, Daewon University College

²⁾ Department of Sports and Leisure, College of Humanity, Daegu University

³⁾ Department of Emergency Medical Technology, Kangwon National University: Kuydong Samchuock City, Kangwondo, 245-711, South Korea. TEL: +82 33-570-6440, Email: cho6451@gmail.com

Abstract. [Purpose] The purpose of this study was to investigate the effects of physical activity on the muscular strength of the lower extremities of mentally retarded adults. [Subjects] The subjects were ten adults with mental retardation, residents of a special institution, who took part in an aerobic and strength exercise program and ten others who did not perform any exercise for 24 weeks. [Methods] Participants in the exercise group performed the combined exercise therapy at 55–69% HRmax for an hour 3–4 days a week for 24 weeks. Leg muscular strength was measured before and after the training. The paired t-test was used to analyze the difference between before and after training. [Results] The exercise group showed significantly improved leg muscular strength. [Conclusion] The findings imply that the physical activity over a long period has a significant effect on the muscular strength of the lower extremity of adults with mental retardation.

Key words: Physical activity, Muscular strength, Mental retardation

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INTRODUCTION

Teenagers with mental retardation have difficulty in communicating with friends, which leads them into fewer amounts of co-activity with normal companions^{1, 2)}. Measurements of muscle strength, endurance, agility, balance, running speed, flexibility and reaction time, for the comparison and study of the level of physical strength between mentally retarded children and normal peers, demonstrate that mentally retarded children consistently display lower levels of fitness than normal peers^{3, 4)}. Most teenagers with mental retardation show hypotonic muscular strength; therefore, physical activities are necessary for enhancing physical performance⁵⁾, and meaningful results can be obtained through physical training. It is reported that persons with mental retardation can not only improve cardiac output and muscular metabolic capability through aerobic exercises, but can also increase muscular strength and muscle endurance via standard muscle exercises of up to 20–50% HRmax⁶⁾ in general. Mentally retarded persons are reported to have lower levels of physical ability than normal persons.

Many studies have demonstrated that enhancing the physical strength, motor function and emotional capacity of mentally retarded subjects, promotes their social adaptation skills, helping them to integrate with normal persons as a member of a social group⁷⁾. Accordingly, the development and dissemination of exercise therapy for improving mentally retarded subjects' social adaptation skills are needed⁷⁾. Muscular strength is a fundamental health factor,

essential for all people, and it is an important factor in enabling mentally retarded subjects to gain employment as well as to enjoy their leisure time.

Regular muscle exercises reform individual motion ability and habitual behaviors⁸⁾. There are no reports of injury following low intensity isokinetic exercises, and repetitive isokinetic exercises enable adjustment of the body. Methods for performing isokinetic exercises rather than isotonic workouts have been presented which aim at avoiding injury of muscles⁹⁾. Maximum torque indicates muscle tension in a dynamic state, and it can be influenced by age, gender, angular velocity, test method, gravity, etc¹⁰⁾. It is also reported that muscular strength increased by up to 1.8 times more in isokinetic exercises than in isotonic exercises¹¹⁾. With regard to functional rehabilitation, as interest in the utilization of isokinetic exercises which are essential for strengthening muscles increases, needs for various types of research are emerging in regard to isokinetic exercises¹²⁾.

Studies of therapy programs for the mentally retarded and relations between factors of physical strength and motion ability have been restricted to children. Moreover, most studies of adults have made only simple comparison with normal persons participating in short-term exercise. Accordingly, there are few studies which have dealt with effects of participation in long-term exercise therapy on adult persons with mental retardation. Therefore, this study investigated the effects of a 24-week therapy program of combined exercises on muscular strength of adult persons with mental retardation in rehabilitation at a special facility.

SUBJECTS AND METHODS

The subjects of this study were 10 mentally retarded adult persons who were residents in a special facility with 3rd grade of disability, who had never participated in a regular combined exercise therapy program and were able to be educated. They were selected through a random sampling process. The subjects were fully informed of the purpose of this study and contents, and individually agreed to participation in the therapy program. The study was approved by the ethical committee of Health and Welfare at the Chungnam National University. Informed consent was obtained from all the subjects and their parents following an explanation of the content of the study. The physical characteristics of the participants are shown in Table 1. For this study, an isokinetic device (Cybex 770, USA) was used to measure the muscular strength of the flexors and the extensors of the knee joint. Subjects were given an explanation of the object of the study, the operation principle of the device, the measurement procedures and the procedure for producing of maximum muscular strength and rehearsed the procedure 3 times in advance before the actual measurement. For the measurement, muscular strength was measured 5 times at a loading rate of 60°/sec, which was focused on the knee joint. Twenty seconds were given to allow physiological adaptation of each muscle. The combined exercise therapy program was composed of aerobic exercise and muscular strengthening exercise. The workouts could be easily performed in subjects' daily lives. Before the combined exercise therapy program, a 10-min warm-up of stretching and walking was performed. The combined exercise therapy program consisting of aerobic exercises and muscular exercises took 30–60 min to perform. For cool-down, stretching was performed for 10 minutes. The combined exercise therapy program was conducted 1 hour a day, 3 times a week, for 24 weeks. Per-minute exercise strength was analyzed via cardiac rates which were checked during exercises, and a Polar heart rate tester (GBR 175015.A Finland) which automatically calculates heart rate during and after exercises was utilized to monitor the intensity relative to HRmax¹³⁾ which was calculated using Karvonen and Vuorimaa's equation¹⁴⁾.

A research assistant checked exercise therapy times and cardiac rate, and kept records on a work log to record the exercise therapy.

Data are shown as mean \pm SD, Student's t-test was used for statistical analyses of the data. Statistical significance was accepted for p values of less than 0.05.

RESULTS

With respect to the muscular strength of the musculus membri inferioris of the right foot at 60°/sec in the exercise group, shown in Table 2, the Peak Torque (PT) value of hamstring muscle strength was 76.9 \pm 4.3 Nm before the exercises intervention and 79.1 \pm 2.6 Nm afterwards, showing no significant difference. The PT value of the quadriceps muscle strength was 137.6 \pm 3.5 Nm before the intervention and 159.2 \pm 2.3 Nm afterwards showing a significant

Table 1. Baseline characteristics of the subjects

Group	Age (yrs)	Height (cm)	Weight (kg)
Exercise (n=10)	45.2 \pm 2.5	158.2 \pm 2.4	64.2 \pm 1.9
Control (n=10)	49.8 \pm 3.0	154.9 \pm 5.3	64.4 \pm 9.0

difference in statistics. Considering the muscular strength of the musculus membri inferioris of the left foot at 60°/sec in the exercise group, the PT value of hamstring muscle strength was 74.5 \pm 3.5 Nm before the intervention and 81.1 \pm 2.4 Nm afterwards, showing a significant difference. The PT value of the quadriceps muscle strength Quadriceps was 132.1 \pm 2.5 Nm before the intervention and 148.1 \pm 3.3 Nm after exercise, showing a significant difference.

DISCUSSION

This study was conducted to verify the effect of participation in a combined exercise therapy program for 24 weeks on the muscular strength of the musculus membri inferioris of adults with mental retardation who were residents of a special facility. A distinct difference and effect between before and after the 24-week combined exercise therapy program were found in the muscular strength of the musculus membri inferioris, which indicates that a long-lasting exercise therapy can have a positive effect on the musculus membri inferioris of persons with mental retardation. Isokinetic is related to producing strength and motion angles according to velocity generated by muscle groups, and an isokinetic muscle strength test serves to find the maximum potential of muscles through the total range of joint motion (Perrin, 1993). The maximum torque in an isokinetic muscle strength test is a highly useful value for evaluating muscle training effects, and can be used to scientifically measure workload^{15, 16)}. In this study, the results of all the isokinetic muscles of the knee joint showed higher values for the hamstrings than for the quadriceps. The reason why the quadriceps strength is higher than the hamstrings at each angular velocity of 60°/sec is because the quadriceps femoris muscle as an extensor has more muscles than the hamstring tendon muscle as the flexor, and because the fatigue in the large muscle group appears slowly. In this study, the exercise group attained higher performance than the control group, and the maximum torque of the exercise group became significantly different from that of the control group, indicating that the combined exercise therapy program for the mentally retarded has a positive effect on the maximum torque of the knee joint. This suggests that the difficulty mentally retarded subjects have with exercises which need muscle strength, due to hypotonic muscles, can be resolved through muscle training⁵⁾. An improvement in the muscle ratio and the difference between left and right muscle strength was Ref. showing the efficacy of the intervention for preventing injury through muscular imbalance. In the comparison of isokinetic muscular functions according to participation in the exercises revealed the superiority of the exercise group was shown, indicating that the combined exercise therapy had a satisfactory effect on muscular

Table 2. The results of 60°/sec peak torque of Low leg muscular strength

Group			Baseline	24 Weeks
Right leg	H	Exercise	76.9 ± 4.3	79.1 ± 2.6
		Control	75.4 ± 3.2	73.7 ± 2.4
	Q	Exercise	137.6 ± 3.5	159.2 ± 2.3**
		Control	135.2 ± 4.3	136.9 ± 4.8
Left leg	H	Exercise	74.5 ± 3.6	81.1 ± 2.4*
		Control	72.1 ± 2.3	75.9 ± 4.1
	Q	Exercise	132.1 ± 2.5	148.1 ± 3.3**
		Control	135.2 ± 3.1	137.2 ± 2.4

** Significantly different from the baseline (*p<0.05, **p<0.01).

H: Hamstring, Q: Quadriceps

function, and the development of various types of exercise therapy programs is necessary. In general, a mentally retarded person has lower physical strength than a normal person and the difference grows depending on the degree of retardation. In addition, mentally retarded subjects showed lower levels of muscle strength, muscle endurance, agility, balance, running, velocity, flexibility and reaction^{3, 4, 17}. In this context, in a comparison of physical strength between adult mentally retarded persons and healthy persons^{4, 18}, the adult persons with mental retardation showed much lower levels of muscle strength, muscle endurance and flexibility than the normal persons. A special physical education program was suggested in order to give solution to physical and mental deterioration and to improve the adaptation of adults with mental retardation. Mentally retarded subjects can improve motion and physical functions, and make harmonious social interaction with ordinary people through exercise therapy activities, and the acquisition of motion function by a mentally-retarded person can remarkably enhance the self-confidence of that person. Thus, regular participation in exercise therapy can promote or maintain Mentally retarded subjects' health, consequently contributing to their enjoyment of daily life. It is also mentionable that the combined exercise therapy in a group rather than individually is a more effective therapy. As described above, the implementation of combined exercise therapy programs with long-term aerobic exercises and muscular exercises for the health promotion of adults with mental retardation. It

is not easy for subjects with mental retardation to draw the benefit of the training effect of muscle exercises due to their cognitive characteristics and hypotonic muscles. However, the results of this study demonstrate that a systematic training program is able to enhance their muscular strength.

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