Effect of Once a Week Endurance Exercise on Fitness Status in Sedentary Subjects

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Objective: *To study whether 3-months aerobic exercise training at moderate intensity once a week can increase fitness status in healthy sedentary young men.*
Material and Method: *Randomized controlled study was performed in 37 sedentary young men, 18 to 25 years old. The exercise group (19) was assigned to work on bicycle ergometry at 60% of maximal effort, once a week for 12 weeks. The control group (18) lived a normal life style. Before and after training, aerobic fitness (VO_{2max}), resting heart rate, lipid profile, and isokinetic power and strength of shoulder and knee were evaluated.*
Results: *In the exercise group, there was a significant increase in most fitness parameters compared with control, VO_{2max} (19.7%), isokinetic power and strength of shoulder and knee (14.9%), and resting heart rate decreased (7.4%).*
Conclusion: *Moderate-intensity training once a week for at least 12 weeks was sufficient to increase aerobic fitness in sedentary young men. This low frequency of exercise training may be used to encourage sedentary individuals for more compliance with physical activity.*

Keywords: *Endurance exercise, VO_{2max}, Strength, Frequency, Health status*

J Med Assoc Thai 2010; 93 (9): 1070-4
Full text. e-Journal: *http://www.mat.or.th/journal*

Physical activity can increase strength[1,2], aerobic fitness[3], and decrease risk of cardiovascular morbidity and mortality[4-6]. Although numerous studies have sought to determine the threshold exercise duration, intensity, and frequency necessary for different training adaptations, there is still a great deal of uncertainty about the threshold activity levels that can provide fitness status changes to young individuals. The current recommendation for all healthy adults aged 18 to 65 years old is to engage in moderate-intensity exercise for a minimum of 30 min on five days each week, or vigorous-intensity exercise for a minimum of 20 min on three days each week[7]. The great deal of latitude on alternative frequencies, durations, and intensities of these recommendations suggests that more information about the least amount of exercise, which provides beneficial effects, is needed.

Exercise effects are varied according to the age and baseline fitness of the individuals. Generally, benefits were noticeable among the younger and unfit individuals. The need to define a suitable exercise program to improve fitness is very necessary for developed countries because of the increasing prevalence of physical inactivity among adults[8]. They tend to have low compliance and adherence to the general recommended exercise training programs.

The present study aimed to examine the effects of 60% VO_{2max} at low frequency exercise training (one hour, once a week) on the fitness status in sedentary young men.

Material and Method

Thirty-seven healthy sedentary men aged between 18-25 years without cardiopulmonary, orthopedic, neurological, or metabolic diseases were recruited in the present study. Sedentary status was

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defined as individuals who participated in an exercise less than 1 hour per week for at least 12 months prior to the present study. Subjects were randomized into the exercise group (n = 19) and the control group (n = 18). They were asked to sign the written informed consent if decided to participate in the present study. The present study protocol was approved by the Khon Kaen University Ethics Committee for Human Experiments Research.

Study protocol

Preliminary measurements were performed on two occasions in all subjects. At the first visit, maximal oxygen consumption (VO_{2max}) and heart rate were assessed during graded work on a bicycle ergometer. At the second visit, baseline anthropometric measurements and isokinetic strength of left knee and shoulder were obtained. Randomization was performed by using simple random sampling into exercise and control groups. Subjects in the exercise group had to visit the exercise lab once a week for 14 weeks: the first two visits for exercise familiarization, and 12 visits for exercise training. Exercise training was carried out on a bicycle ergometer at 60% VO_{2max} for 60 minutes, including 5 minutes warm up and 5 minutes cool down. Subjects in the control group were allowed to continue their usual life-style. VO_{2max}, anthropometric measurements, and isokinetic strength were re-assessed at week 14 in both groups. High-density lipoprotein (HDL) was also evaluated before and at the end of the present study. All participants were asked to keep self-recorded diaries concerning their activities, stressful events, and food consumption.

Outcome measures

Body fat: Skinfold thickness was measured with Lange calipers (Beta Technology, USA) at seven standardized sites. Percent body fat (% BF), fat weight (kg), and fat free mass (kg) was calculated from body density (D_b), based on Jackson and Pollock[9] and Brozek's equations[10]. Isokinetic strength of knee and shoulder was measured with the Cybex 6000 dynamometer (Lumax Inc, NY, USA). For isokinetic test of the shoulder and knee, the subjects were performed at 90°/sec, 120°/sec, and 180°/sec. Peak torque and average power of left knee and shoulder were recorded. VO_{2max} was determined at week 0 and week 14 after training with a submaximal oxygen consumption test using a bicycle ergometer (818E, Monark, Sweden). The physical work capacity test (PWC) was used to estimate the maximal effort (VO_{2max}).

Statistical analysis

All data were presented as mean $\pm$ SD. Treatment differences were evaluated with an unpaired t-test for independent groups. A paired t-test was used to determine whether there were any statistically significant changes in dependent variables as a result of training, or 12 weeks of sedentary existence. The statistics were analyzed using SPSS program, version 10 (SPSS Inc., Illinois, USA). The level of significance was set at $p < 0.05$.

Results

Demographic data are shown in Table 1. There was no significant difference of all parameters between the exercise and control group at baseline.

At the end of the present study, the data no significant difference of mean weight, body mass index, and body fat of the exercise and control group was found (Table 2). However, the aerobic capacity was significantly increased in the exercise group (40.74 ± 5.99) compared with control (34.48 ± 7.59). The reduction of resting heart rate was significantly noted in the exercise group (78 ± 2.09) compared with control (93.00 ± 4.78). Knee extension was significantly increased in the exercise group, contradictory, the power of shoulder flexion/extension were significantly increased in the control group although, the peak torque revealed no difference between groups. Then, in the exercise group, there was significant increase in aerobic capacity, power, and strength of shoulder and knee after 12 weeks exercise (Table 2). The resting heart rate was also decreased after exercise.

Discussion

This was a randomized controlled study examining whether once-a-week moderate intensity exercise training for 3 months had influence on fitness and general health status in sedentary young men. The result showed that maximum oxygen consumption (VO_{2max}) of the exercise group was significantly increased (19.17%) and resting heart rate was significantly decreased (7.37%). This favorable improvement of physical fitness indicated that one hour of moderate intensity exercise performed once a week is sufficient to increase cardiorespiratory fitness in sedentary young men as suggested by several previous studies[11,12]. The magnitude of improvement varied based on training volume, type of training program, mode of activity, and baseline fitness level. In general, an average improvement between 5-25%

Table 1. Demographic data of the exercise and control group at baseline

Parameters	Exercise (n = 19)	Control (n = 18)
Age (yrs)	21.00 ± 2.00	20.00 ± 1.00
Weight (kg)	61.73 ± 10.94	65.72 ± 11.16
Height (m)	1.71 ± 0.05	1.71 ± 0.04
BMI (kg/m^2)	20.99 ± 3.35	21.35 ± 3.54
Percent fat	6.52 ± 4.34	7.89 ± 4.75
VO_{2max} (ml/kg/min)	32.93 ± 5.32	32.88 ± 5.13
Resting Heart rate (bpm)	88.00 ± 3.76	90.00 ± 4.24
HDL (mg/dL)	45.00 ± 12.75	45.72 ± 7.88
Shoulder flexion power (watts)	35.63 ± 10.73	36.61 ± 12.33
Shoulder extension power (watts)	53.42 ± 17.86	51.61 ± 14.20
Knee flexion power (watts)	66.63 ± 17.39	64.50 ± 27.09
Knee extension power (watts)	113.36 ± 27.03	114.83 ± 38.89
Shoulder flexion peak torque (deg/sec)	26.26 ± 7.91	28.32 ± 8.19
Shoulder extension peak torque (deg/sec)	39.37 ± 19.16	39.82 ± 11.08
Knee flexion peak torque (deg/sec)	49.10 ± 12.81	50.65 ± 15.16
Knee extension peak torque (deg/sec)	83.55 ± 19.52	82.77 ± 28.93

Table 2. Data parameters between the exercise and control group after 12 weeks

Parameters	Exercise (n = 19)	Control (n = 18)
Age (yrs)	21.00 ± 2.00	20.00 ± 1.00
Weight (kg)	61.73 ± 10.94	65.72 ± 11.16
Height (m)	1.71 ± 0.05	1.71 ± 0.04
BMI (kg/m^2)	21.35 ± 3.44	22.35 ± 3.44
Percent fat	6.57 ± 4.75	8.78 ± 4.75
VO_{2max} (ml/kg/min)	40.74 ± 5.99**	34.48 ± 7.59*
Resting Heart rate (bpm)	78.00 ± 2.09**	93.00 ± 4.78*
HDL (mg/dL)	46.47 ± 10.12	46.67 ± 12.14
Shoulder flexion power (watts)	44.63 ± 10.73**	52.61 ± 12.33*
Shoulder extension power (watts)	62.42 ± 17.86**	67.61 ± 14.20*
Knee flexion power (watts)	88.63 ± 17.39**	87.50 ± 27.09
Knee extension power (watts)	137.36 ± 27.03**	132.83 ± 38.89*
Shoulder flexion peak torque (deg/sec)	32.97 ± 8.35**	38.32 ± 8.19
Shoulder extension peak torque (deg/sec)	46.31 ± 13.06**	49.82 ± 11.08
Knee flexion peak torque (deg/sec)	65.51 ± 15.01**	64.65 ± 15.16
Knee extension peak torque (deg/sec)	101.00 ± 21.46**	97.77 ± 28.93

Data were presented as mean ± SD
* $p < 0.05$ was defined as statistically significant different from exercise group
** $p < 0.05$ was defined as statistically significant different from baseline

can be anticipated for college-age men or women following 8 to 12 weeks of training. All of them found that maximum oxygen consumption improved in a dose dependent fashion (1, 3 or 5 days/week) with a threshold exercise intensity of 60-80% VO_{2max} for 20 minutes. At a higher exercise intensity, improvement of cardiorespiratory fitness was achieved with lower training frequency and duration as demonstrated in the present study. In general, a 3-5 times/week training paradigm was recommended for improvements of VO_{2max} [13,14]. However, 5-day/week program also resulted in a significant increase in the incidence of injuries (39%), while the injuries were lowest (2-5%) in the 1-day/week group.

The muscle power of both upper and lower extremities had significantly increased in the exercise group after bicycle training. These improvements may be due to changes in muscle fiber profile, metabolic adaptation, and neural recruitment in skeletal muscles[15-17]. The inclination of upper extremities during bicycle ergometry may cause muscle contraction and account for the observed increases in arm flexion and extension strength.

A trend of increasing HDL has been noted in the exercise group. Even without statistical significant, the present study demonstrated that endurance exercise may have a beneficial effect on HDL in sedentary young men. Longer duration of training would bring more significant finding as evidenced in previous reports[18- 20]. In addition, the participants had no adverse affect from the training.

There was no significant difference of BMI in both groups because activities, stressful event and food consumption was not restricted in the present study protocol to investigate the effect of once a week exercise in a normal life style sedentary person. Longer duration of exercise program may bring more obvious results.

Limitation of the present study related to the characteristic of study subjects and duration of exercise. The study subjects were sedentary volunteers with disfavor to participate in longer duration of exercise even only once a week. Activities, stressful events, and food consumption was not evaluated.

Conclusion

In summary, once a week modest intensity exercise program yields positive effects on aerobic capacity, power, and strength of muscle, and cardiovascular fitness in sedentary young men. This may be implied for health promotion campaign in a sedentary person who has low compliance and fewer adherences to exercise training programs. Further study should be worked out whether the beneficial effects are still demonstrated if more flexible exercise protocol is designed; moderate intensity and frequency (60% VO_{2max}, 30 minutes, 2 times/week).

Acknowledgements

The authors wish to thank all the subjects who volunteered for the study and greatly appreciate their time and cooperation. The authors thank Dr. Temduang Limpaiboon, Dr. Chanvit Leelayuwat, and Dr. Thyon Chintanez for their assistance.

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ผลของการฝึกการออกกำลังกายชนิดทนทานต่อสมรรถภาพทางกายในบุคคลที่ไม่ได้ออกกำลังกายเป็นประจำ

อชิระ หิรัญตระกูล, รัตนวดี ณ นคร, อลงกต เอมะสิทธิ์, แคทรีนา บอร์เรอ

วัตถุประสงค์: *เพื่อศึกษาถึงผลการออกกำลังแบบทนทานขนาดหนักปานกลาง 1 ครั้ง ต่อสัปดาห์ติดต่อกันนาน 3 เดือน สามารถเพิ่มสมรรถภาพทางกายในบุคคลเพศชายที่ไม่ได้ออกกำลังกายเป็นประจำ*

วัสดุและวิธีการ: *ศึกษาแบบสุ่มในชายที่ไม่ได้ออกกำลังกายเป็นประจำ อายุ 18-25 ปี จำนวน 37 คน โดย 19 คน ได้รับการออกกำลังโดยจักรยานอยู่กับที่ด้วยความหนัก 60% ของความสามารถสูงสุดเป็นเวลา 1 ชั่วโมง, 1 ครั้ง/สัปดาห์ ในระยะเวลา 3 เดือน และกลุ่มควบคุม 18 คน ใช้ชีวิตประจำวันตามปกติ ทั้ง 2 กลุ่ม ทำการวัดความสามารถการใช้ออกซิเจนสูงสุด, อัตราการเต้นของหัวใจขณะพัก, ระดับไขมัน และกำลังและความแข็งแรงของแขนและขา*

ผลการศึกษา: *พบว่าความสามารถการใช้ออกซิเจนสูงสุดเพิ่มขึ้น 19.7%, กำลัง และความแข็งแรงของแขนและขาเพิ่มขึ้น 14.9% และอัตราการเต้นของหัวใจขณะพักลดลง 7.4%*

สรุป: *การออกกำลังแบบทนทานขนาดหนักปานกลางเพียง 1 ครั้ง ต่อสัปดาห์อย่างน้อย 12 สัปดาห์ สามารถเพิ่มความสามารถการใช้ออกซิเจนสูงสุด และความแข็งแรงของร่างกาย รวมทั้งลดอัตราการเต้นของหัวใจขณะพัก ซึ่งบ่งบอก ถึงสมรรถภาพทางกายที่ดีขึ้น จึงเป็นอีกแนวทางในการส่งเสริมการออกกำลังกายในบุคคลที่ไม่ได้ออกกำลังกายเป็นประจำ*