Short-term effects after a 3-month aerobic or anaerobic exercise program in Hong Kong Chinese

Short-running: 3-months exercise in Chinese

G.T.C. Ko*

*Department of Medicine, Alice HML Nethersole Hospital, Hong Kong

Correspondence:

Gary T.C. Ko, Department of Medicine, Alice HML Nethersole Hospital, 11 Chuen On Road, Tai Po, NT, Hong Kong

Tel: (852)26892255,

fax: (852)26656436

Email: gtc_ko@hotmail.com

Keywords: Exercise; Chinese; aerobic; anaerobic

ABSTRACT

Information on the beneficial effects of exercise in Chinese concerning weight reduction and fat loss is limited. We studied 18 young Chinese healthy volunteers and assessed the short-term effects of exercise on their anthropometric and biochemical parameters. They had no regular exercise before the study and were randomly assigned to aerobic or anaerobic exercise group (9 subjects in each group). Professional trainers on aerobic and anaerobic exercise were invited to teach and supervise the whole group on the exercise program. The study lasted for 3 months with exercise at least 3 sessions per week and 30 minutes per session. Of the 18 subjects, there were 7 (38.9%) men and 11 (61.1%) women. Their mean age was 28.9 ± 3.6 years (men: 29.6 ± 4.2 years, women: 28.5 ± 3.4 years, p-value: NS). After the 3-month exercise program, body weight and body mass index reduction was significant only in the aerobic group but not anaerobic group, while body fat percentage was improved in both groups. This suggests anaerobic exercise may increase the lean to fat body mass ratio. Plasma glucose was reduced in aerobic group but not anaerobic group. Plasma insulin level was, otherwise, similar before and after exercise in both groups. This is compatible to a blunted insulin hormonal response to endurance exercise and an improved tissue sensitivity to insulin.

INTRODUCTION

A decline in daily physical activity level is believed to be associated with the recent increase in obesity prevalence and impairment in physical fitness in the modern society. Ballor and Keesy in 1991 conducted a meta-analysis and confirmed a beneficial effect of exercise on weight reduction and fat loss [1]. Similar information in Chinese is, however, limited. We studied 18 young Chinese healthy volunteers and assessed the short-term effects of aerobic or anaerobic exercise on their anthropometric and biochemical parameters.

MATERIALS AND METHODS

Eighteen volunteers were recruited. All of them were healthy and had good past medical history. They had no regular exercise before the study. They were randomly assigned to aerobic or anaerobic exercise group (9 subjects in each group). The subjects were instructed to continue their previous diet pattern and no additional dietary consultation was given. Professional trainers on aerobic and anaerobic exercise were invited to teach and supervise the whole group on the exercise program. The study lasted for 3 months with supervised exercise 3 sessions per week and at least 30 minutes per session. Participants were encouraged to perform further assigned exercise if feasible. Aerobic exercise was provided with several options depending on subjects' own discretion that included swimming (n=2), biking (n=1), jogging (n=3), aerobic dance (n=2) and squash (n=1) while anaerobic exercise was weight lifting training (n=9).

Before and after the 3-month exercise, demographic data were documented and height and weight (BW) (measured to the nearest 0.1kg) were measured with the subject in light clothing without shoes. Body mass index (BMI) was calculated as the BW (kg) divided by the square of the height (m). Waist circumference was taken as the minimum circumference between the umbilicus and xiphoid process and measured to the nearest 0.5 cm. Hip circumference was measured as the maximum circumference around the buttocks posteriorly

and the symphysis pubis anteriorly and measured to the nearest 0.5 cm. Body fat percentage (BF%) was making use of bioelectrical impedance measurements with a bioelectrical impedance analyser (TBF-401; TANITA, Tokyo, Japan). Blood was taken after a 12 hour fast for measurement of plasma glucose (PG), urate, lipid profile and insulin level. Insulin resistance was calculated using a computer-solved homeostasis model assessment (HOMA) method: IR = fasting serum insulin/($22.5e^{-\ln \text{fasting plasma glucose}}$) [2].

RESULTS

Of the 18 subjects, there were 7 (38.9%) men and 11 (61.1%) women. Their mean age was 28.9 ± 3.6 years (men: 29.6 ± 4.2 years, women: 28.5 ± 3.4 years, p-value=0.541). Table 1 summarises their baseline characteristics and outcomes after the 3-month exercise program. Despite a randomization assignment, the subjects in aerobic exercise group had higher BF% and fasting PG compared to those in anaerobic exercise group.

Overall speaking, there was reduction in anthropometric parameters after exercise including BW, BMI, waist and hip circumferences (Table 1). Abdominal muscular endurance was also improved. BW and BMI reduction were significant only in aerobic group but not anaerobic group while BF% was improved in both groups. PG was also reduced in aerobic group but not anaerobic group. Lipid profiles and plasma insulin levels were similar before and after exercise in both groups.

Table 2 summarizes the percentage changes on various parameters after exercise. Aerobic exercise, as compared to anaerobic exercise, gave rise to a better reduction in BMI and fasting PG but a higher insulin level. However, all these differences lost statistical significance after adjustment for baseline clinical and biochemical parameters.

DISCUSSION

It has been documented that low physical activity was a strong predictor of weight gain in Caucasians as well as Chinese [3,4]. Prospective studies of Chinese adults showed that exercise was associated with reduction in BMI, but which type of physical activity was most beneficial was not clear [5]. In particular, there is a lot of evidence in literature about the beneficial effects of aerobic exercise, whereas the role of anaerobic exercise is still debated [6]. In the present study, we found that it was aerobic exercise, but not anaerobic exercise, that was associated with weight reduction. However, after adjustment for baseline characteristics, percentage changes on BMI were similar no matter the type of exercise. The difference may probably be augmented with a larger sample of subjects.

Both types of exercise induced a reduction in BF% suggesting anaerobic exercise may alter body composition and increase the lean to fat body mass ratio [7]. This is in accord with previous studies that resistance training will reserve or increase fat free mass [1]. Fat is preferentially lost from the central region of the body after adequate physical activities [8]. We found that in Chinese after a 3-month exercise program, their waist circumference decreased by 3.8% (82.5 to 79.4 cm) while the hip circumference decreased by 1.9% (100.3 to 98.4 cm).

For those who perform aerobic exercise, their PG level decreased. However, the insulin

level showed no significant change (though the absolute value was increased). This may be due to the small number of studied subjects. However, the reduced PG level together with a steady insulin level after exercise may be due to improved insulin sensitivity and steady insulin hormone secretion. In accord to this, a seemingly blunted insulin hormonal response to exercise and an improved tissue sensitivity to insulin has previously been reported [9,10].

In conclusion, we have shown in Chinese young healthy subjects that a 3-month aerobic exercise program was associated with reduction in BW, BMI and BF% while after a 3-month anaerobic exercise program, BF% was reduced but the BMI was stable. Aerobic exercise was also associated with a reduction in PG suggesting an improvement in insulin sensitivity after the exercise program

ACKNOWLEDGEMENTS

The author would like to thank Alice SM Fung of the Next Magazine for her help in organizing the exercise program and data collection.

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Table 1. Clinical parameters of the 18 subjects before and after aerobic or anaerobic exercise

	Overall (n=18)		Aerobic exercise (n=9)		Anaerobic exercise (n=9)	
Parameters	Before	After	Before	After	Before	After
Body weight, kg	67.6 ± 16.4	65.5 ± 15.3*	70.3 ± 21.6	67.1 ± 20.0*	64.9 ± 9.6	63.8 ± 9.4
Body mass index, kg/m2	25.1 ± 4.8	24.2 ± 4.3**	26.8 ± 6.0	25.4 ± 5.5**	23.3 ± 2.5	23.0 ± 2.5
Body fat percentage, %	30.2 ± 5.8	26.7 ± 6.1***	33.8 ± 2.8	28.8 ± 6.0*	#27.0 ± 6.1	24.6 ± 5.7*
Waist circumference, cm	82.5 ± 12.7	79.4 ± 11.4*	85.6 ± 14.4	81.5 ± 14.0	79.4 ± 10.6	77.3 ± 8.3
Hip circumference, cm	100.3 ± 8.0	98.4 ± 7.2*	101.9 ± 10.1	98.9 ± 9.5	98.7 ± 5.3	97.8 ± 4.3
Waist-hip ratio	0.82 ± 0.08	0.80 ± 0.07	0.84 ± 0.06	0.82 ± 0.08	0.80 ± 0.09	0.79 ± 0.06
Fasting plasma glucose, mmol/L	5.1 ± 0.6	4.9 ± 0.5	5.3 ± 0.06	4.9 ± 0.05*	#4.8 ± 0.04	5.0 ± 0.04
Urate, mmol/L	0.30 ± 0.08	0.31 ± 0.08	0.31 ± 0.10	0.33 ± 0.10	0.29 ± 0.07	0.29 ± 0.07
Total cholesterol, mmol/L	4.49 ± 1.13	4.62 ± 0.87	4.29 ± 0.72	4.59 ± 0.71	4.70 ± 1.45	4.66 ± 1.06
Fasting triglyceride, mmol/L	1.14 ± 0.69	0.95 ± 0.40	1.33 ± 0.78	1.03 ± 0.37	0.96 ± 0.57	0.87 ± 0.44
High-density lipoprotein, mmol/L	1.47 ± 0.51	1.45 ± 0.44	1.46 ± 0.65	1.50 ± 0.55	1.47 ± 0.34	1.41 ± 0.30
Low-density lipoprotein, mmol/L	2.51 ± 1.13	2.74 ± 0.83	2.21 ± 0.69	2.62 ± 0.65	2.80 ± 1.44	2.86 ± 1.01
Insulin, μU/mL	8.1 ± 4.8	8.8 ± 11.5	9.7 ± 6.2	13.1 ± 15.3	6.5 ± 2.3	4.5 ± 2.6
HOMA index	1.85 ± 1.22	2.02 ± 2.84	2.33 ± 1.55	3.01 ± 3.81	1.38 ± 0.47	1.03 ± 0.64
Stage-stepping, 3-min^{-1}	118 ± 14	119 ± 20	125 ± 14	115 ± 19	#110 ± 10	122 ± 22
Hand-grip dynamometry, kg	65.9 ± 24.4	69.2 ± 22.6	62.1 ± 26.1	67.6 ± 24.5*	69.8 ± 23.4	71.1 ± 21.7
Sit-up, min^{-1}	5.3 ± 7.7	7.2 ± 7.1*	0.8 ± 2.3	3.1 ± 6.0	##9.8 ± 8.6	11.8 ± 5.8*

p-value comparing before and after exercise: *<0.05, **<0.01, ***<0.001

p-value comparing aerobic exercise group and anaerobic exercise group at baseline: #<0.05, ##<0.01

Table 2. Percentage changes of various clinical and biochemical parameters of the 18 subjects after aerobic or anaerobic exercise.

Percentage changes	Aerobic exercise	Anaerobic exercise	p-value comparing the 2 exercise	p-value after adjustment*
Body weight	-4.5 ± 3.5	-1.5 ± 3.5	0.098	0.149
Body mass index	-5.2 ± 3.3	-1.3 ± 3.7	0.032	0.106
Body fat percentage	-9.9 ± 8.0	-8.5 ± 7.7	0.715	0.433
Waist circumference	-4.5 ± 8.9	-2.3 ± 3.0	0.492	0.804
Hip circumference	-2.8 ± 4.2	-0.9 ± 2.5	0.255	0.186
Waist-hip ratio	-1.9 ± 7.0	-1.4 ± 4.1	0.875	0.838
Fasting plasma glucose	-8.4 ± 10.2	4.3 ± 9.6	0.015	0.345
Urate	5.8 ± 7.4	0.2 ± 14.1	0.307	0.729
Total cholesterol	7.8 ± 13.0	1.0 ± 9.1	0.216	0.377
Fasting triglyceride	2.5 ± 67.8	1.3 ± 39.7	0.964	0.506
High-density lipoprotein	5.2 ± 15.3	-3.1 ± 12.9	0.232	0.488
Low-density lipoprotein	26.6 ± 44.6	8.8 ± 20.0	0.293	0.259
Insulin, μU/mL	36.6 ± 82.2	-27.9 ± 36.6	0.047	0.503
HOMA index	26.7 ± 79.3	-23.3 ± 43.9	0.118	0.712

*After adjustment for baseline body weight, body mass index, body fat percentages, waist and hip circumferences, waist-hip ratio, fasting plasma glucose, urate, lipid and insulin levels