

Institute of Medical Physics

Friedrich-Alexander University of Erlangen-Nuremberg
Henkestrasse 91
D-90154 Erlangen
Germany

Influence of XCO-Trainers on Energy Expenditure, Oxygen Intake and Heart Rate During Walking and Running

Von Stengel, S., K. Kalender, W.A., Kemmler W.

Background and goals:

Numerous attempts have been made in the past to supplement walking and running exercise with training devices which, by means of integrating additional upper-body muscle groups into the exercise, seek to increase the overall effectiveness of the training in terms of increased cardiovascular and metabolic activity. In this current study we examine the influence of the Xco-Trainer (Flexi-Sports, Munich, Germany) on heart rate as well as spirometric and calorimetric parameters, when added to walking and running exercise.

Materials and Methods:

Five female sports students (ages 25.2 ± 2.8 years) of the University of Erlangen-Nuremberg participated as subjects in this study. The subjects completed two test runs respectively on a treadmill (Uno Fitness LTX 5 Pro, Bonn, Germany) on two separate days. One test was carried out with Xco-Trainers, the other without, whereby half of the subjects completed the first test with, and the second without Xco-Trainers. The following exercise challenge protocol was applied to both tests: warm-up: 5 min. walking at 6 km/hr; test phase: 15 min. walking at 6 km/hr, 15 min. running at 9 km/hr. During the challenge tests, heart rate and spirometric and calorimetric parameters were recorded by use of the Oxycon Mobile Spirometry System by Viasys (Conschohocken, PA).

To establish the effect of the Xco-Trainer, group mean values of the test runs with and without Xco's were analyzed by means of t-tests for distinct reference points to establish the significant differences. A level of 5% was established as the level of significance for this study.

Results and Observations:

The addition of Xco-Trainers to walking and running led to a significant increase in heart rate in both cases. Heart rates increased on an average of 23 beats with Xco-Walking and 20 beats with Xco-Running (fig. 1). Oxygen intake increased by 32% when Xco was used with walking, and by 13% with running (fig. 1). Through the addition of the Xco-Trainers to walking, calorie expenditure was increased by an average of 33%, from 332 Kcal/hr to 444.7 Kcal/hr. With regard to the biological energy carriers, significantly increased rates of carbohydrate as well as fat burning with Xco-Walking were observed (fig. 2). With Xco-Running, energy expenditure was raised by 13.2%, whereby carbohydrate burning was increased, while fat burning was reduced (fig. 2).

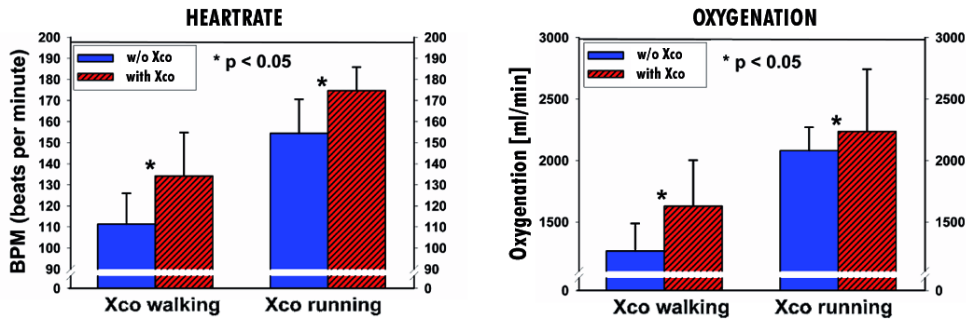
Practical Conclusions:

The use of the Xco-Trainers while walking and running led to significant increases in heart rate and oxygen intake. The tools proved themselves to be well-suited to raise training intensity by increasing activation of the arm and upper-body musculature, which is highly meaningful as a proper stimulus setting for the production of an effective cardiovascular workout, especially when applied to walking. Collectively, the use of Xco-Trainers during walking heightened the intensity from a very low level (111 bpm), in which only few training-induced adaptations are to be expected, to a much more effective level of intensity (134 bpm). Within this context it can be surmised that the effectiveness of cardiovascular training during walking can be markedly raised by the use of Xco-Trainers, particularly for young athletic females. Marked advantages are also seen in the use of Xco-Trainers during walking for the achievement of weight loss fitness goals. Calorie burning could be increased up to 33%, which resulted in raised levels of carbohydrate as well as fat burning. Although the total energy expenditure was also increased during Xco-Running, there was however a reduction in fat burning. The respiratory quotient increased significantly from .84 to .90. Also the pulmonary function test, as a representative measure of maximum exertion, increased significantly from 22.8 to 25.3. As these parameters and also the average pulse of 174.7 bpm clearly indicate, the intensity of running was increased by the addition of Xco-Trainers to the activity, by which the augmented energy demands had to be compensated for primarily with carbohydrates. In order to apply the results regarding the effects of Xco-Running to well-trained endurance athletes, further study will be required. Studies of individual cases of male athletes who, in addition to the prescribed protocol also completed a classic step test, demonstrate that with the addition of Xco-Trainers at slower running speeds (9km/hr), the oxygen intake and calorie expenditure was increased by amounts equivalent to a running speed increase of 2 additional km/hr.

In summary it can be determined that that the Xco-Trainer constitutes a device which can raise the effectiveness of the athletic training activity, particularly with walking. This plays an important role especially for recreational athletes, who generally do not attain levels of training intensity sufficient to attain cardiovascular and weight-loss-related fitness goals.

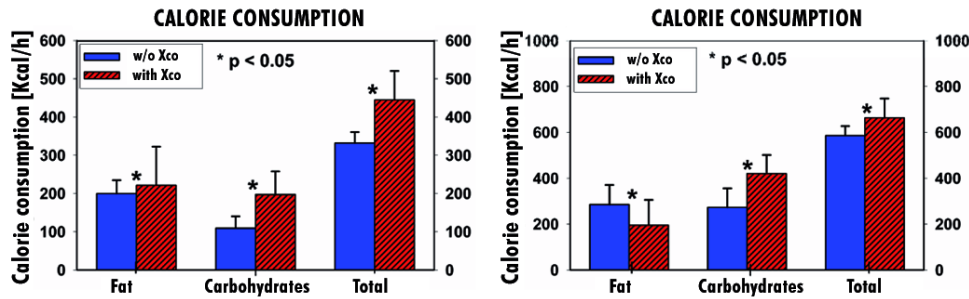
Parameter	Walking		Running	
	without XCO	with XCO	without XCO	with XCO
Heart rate [bpm]	111.4 ± 14.6	134.12 ± 20.7*	154.4 ± 16.1	174.7 ± 11.11*
Pulmonary function	23.2 ± 1.6	22.8 ± 2.7	22.9 ± 1.4	25.3 ± 1.3*
Respiratory quotient	0.80 ± .04	.84 ± .05	0.84 ± .04	0.90 ± .05*
Energy expenditur [Kcal/hr]	332.0 ± 28.7	444.7 ± 75.7*	585.7 ± 41.6	663.2 ± 84.4*
Carbohydrates [Kcal/hr]	109.27 ± 30.7	197.1 ± 60.5*	273.0 ± 82.7	419.7 ± 81.4*
Fats [Kcal/hr]	199.7 ± 32.8	221.5 ± 101.5*	284.7 ± 85.5	195.3 ± 109.9*

Fig. 1: Elevated spiroergometric parameters during walking and running with and without Xco-Trainers. Significant changes ($p < 0.05$) are marked with an asterisk.



Heartrate (left) and oxygenation (right) during the XCO[®] WALKING & RUNNING workout and without the XCO-TRAINER[®]. The significant differences (<0,05) are marked with a star.

Fig. 1: Heart rate (left) and oxygen intake (right) during walking and running with and without Xco-Trainers. Significant changes ($p < 0.05$) are marked with an asterisk.



Calorie consumption during Walking (left) and during Running (right), with and without the XCO-TRAINER[®]. Significant differences (<0,05) are marked with a star.

Fig. 2: Energy expenditure during walking (left) and running (right) with and without Xco-Trainers. Significant changes ($p < 0.05$) are marked with an asterisk.