Institute of Medical Physics
Friedrich-Alexander University of Erlangen – Nuremberg
Henkestrasse 91
D-91054 Erlangen
Germany

Influence of a 10 Week Walking Program with XCO-Trainers on Stamina and Additional Parameters of Physical Performance on Untrained Women between the Ages of 40 and 60.

By Stengel, S.[1], Brandt, A.[2], Kemmler, W.[1]

[1] Institute of Medical Physics, [2]Institute of Sport Science and Sport,
Friedrich-Alexander University of Erlangen-Nuremberg

Background
Stamina is a key component within all major tasks necessary for proper motor function. Particularly in individuals in the second half of their lifespan, there is a direct correlation between diminished stamina and increased morbidity and mortality rates. Currently, there are numerous studies validating the relationship between stamina and varying physical capabilities. In this context, a number of studies confirm the positive effect of a walking program to enhance stamina (as measured by the maximal oxygen intake [VO_2 max]), which in turn is also linked with a highly reduced probability of cardiovascular illness.
Frequent attempts have been made in the past to increase the effectiveness of stamina training by the addition of supplemental tools such as weighted wrist bands, dumbbells or walking poles.
The Xco-Trainer is such a new tool, which is intended to stimulate increased activity of the upper body musculature during walking. And indeed, a representative cross-over study by the Institute of Medical Physics (IMP) of the University of Erlangen-Nuremberg confirmed that walking at a constant speed with the Xco-Trainer yielded a significantly greater metabolic and cardiac response than walking at a similar pace without a weight. The study at hand, which was conducted within the framework of a diploma thesis under the auspices of the IMP, explores (by use of longitudinal sectional design) to what extent the tool's effectiveness, as previously verified by earlier studies, could be further improved with more refined adaptations geared specifically towards endurance performance, and other health-related goals.

Materials and Methods
29 untrained women between the ages of 40 and 60 were randomly divided into 2 groups: (1) walking group with no supplemental tool (WG; n=14); (2) walking group with

Xco-Trainers (WGX; n=15; Xco-Trainer (walking/running), Flexi-Sports Co., Munich, Germany). Both groups completed a twice-weekly hour-long walking training regimen over the course of 10 weeks under the direction of a trainer. The intensity of the training was guided subjectively by the Borg Scale of perceived exertion (standard: *somewhat hard).* The WG trained according to the Duration Method, while the WGX completed an interval training program, wherein Xco-Walking was interspersed by three 3-minute intervals consisting of four discrete strength-training exercises with Xco Trainers.

Prior to and directly following the intervening time frame, maximal oxygen intake (VO_2 max) (Oxycon mobile, Viasys Conshohocken, PA, USA) as well as maximal exertion endurance time were measured by use of a step test on a treadmill. As secondary endpoints, anthropometric and body structure measurements were taken both prior to and after completion of the program, specifically: body weight (Tanita TBF-305, Tokyo, Japan), body mass index (bioimpedance testing (Tanita TBF-305, see above), skinfold thickness at 11 points of measurement (Lange Skinfold Caliper, Beta Technology Inc., Cambridge , MD) and hip- and waist circumference. Additionally, blood pressure readings were taken (Sanitas, Hand Dinslage, Utterweiler, Germany). To get an idea of any changes in specific sports-related parameters the following were measured prior to and directly following the study: maximum isometric strength of the back muscles (Kraftmesstuhl Mechantronic, Hamm, Germany), endurance potential of the back musculature (Mattias Test with Spinal Mouse, Idiag, Volketswill, Switzerland) and shoulder region mobility (“shoulder stretch test” and “finger-to-finger test” with rod). All pre-and post-program measurements were taken by the same examiner.

Results

Three participants of the WG and two participants of the WGX did not complete due to personal reasons, which were not connected with the nature of the training. One participant of each respective group declined to complete the re-testing, so that in the final analysis, the data of 10 subjects of the WG and 12 of the WGX could be validly used.

After 10 weeks of training, a substantial improvement in stamina, as measured by increased levels of VO_2max was observed in the WGX group, which compared to the WG group was significant. Maximum exertion time during the step test was seen to increase significantly only in the WGX group; however, the difference between the groups for this parameter could not be deemed to be significant. Moreover, a significant improvement in the WGX group in terms of shoulder mobility was also observed, as was a reduction in BMI, whereas the differences as compared to the WG group were not significant.

No significant changes or differences between the groups were established in terms of the secondary endpoints of isometric back strength, back endurance strength, body fat, blood pressure or body circumferences.

Discussion

A walking endurance training program with the Xco-Trainer was proven to be more effective than a comparable program without the added tool in terms of raised maximal oxygen intake as the gross criterion of stamina. The increased effectiveness can be explained by the additional muscles being stimulated by the Xco-Trainer, thus leading to an intensified training routine. In earlier cross-sectional studies under laboratory conditions, it was confirmed that heightened cardiac (heart frequency) and metabolic (oxygen intake, energy expenditure) responses with the same energy sources (as measured by RER and lactate) occurs while walking with the Xco-Trainer as compared to walking without the tool. Given these data as background, one can surmise that the walking exercises of healthy, non-adipose middle-aged individuals is often practiced at levels of intensity inadequate to improve cardiovascular activity, and that through the use of supplemental tools – such as Xco-Trainers – a more effective workout can be achieved.

Detailed Presentation of the Results

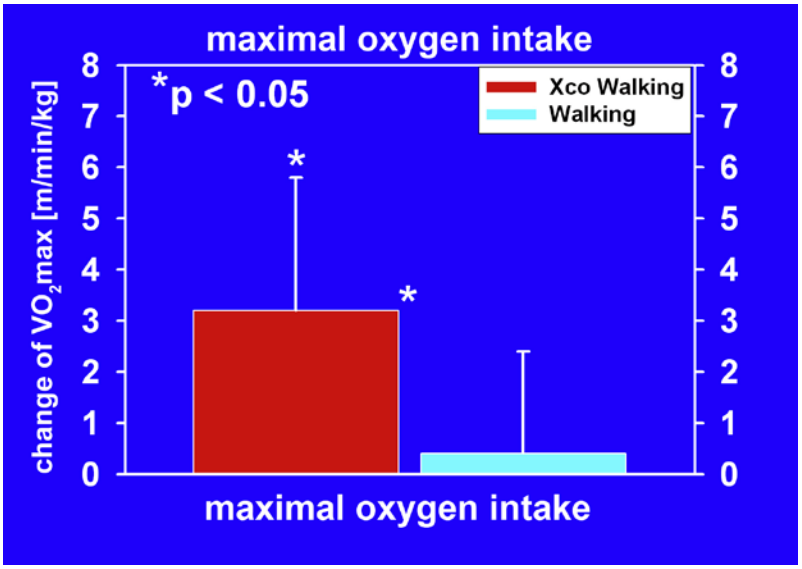
The following depicts detailed presentations of only those parameters for which statistically significant changes could be observed.

1. Stamina

Table 1: Maximal oxygen intake (VO_{2max}) (as gross criterion of stamina) in the WGX and WG at outset of study and after 10 week training interval, changes, differences between groups, p-value and effect size.

	WGX MV± SD	WG MV± SD	Absolute Difference (95% CI)	P	Effect Size Cohen's d
Basal	29.1 ± 3.2	29.0 ± 3.1			
10 weeks	32.3 ± 2.1	29.4 ± 3.7			
Difference	3.2 ± 2.6	0.4 ± 2.0	2.9 (0.8 / 5.0)	.009	1.21

The WGX were able to increase their maximal oxygen intake by +11%. With p=.001, this change is highly significant. In the WG, a non-significant increase (+1.4%) was observed. The difference between the groups with p=.009 is highly significant, the effect size with d+1.21 high.



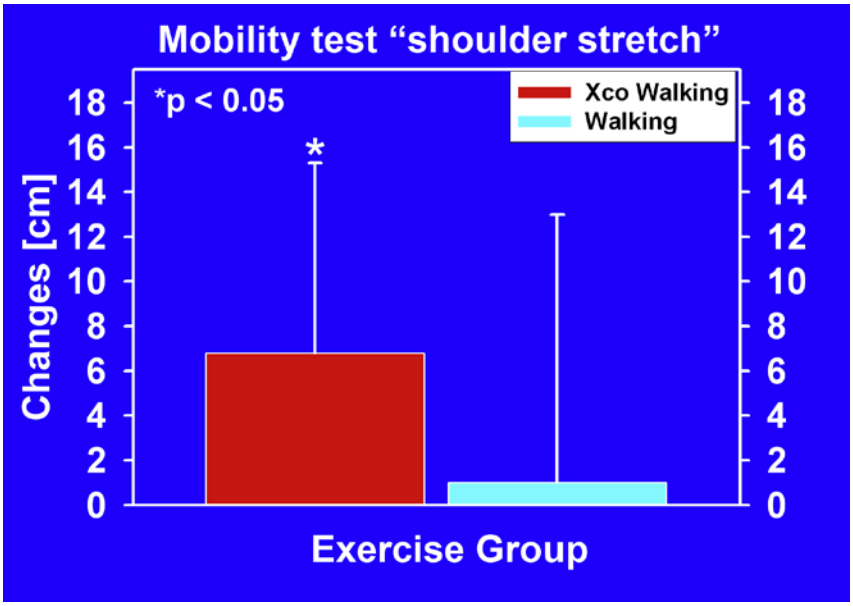
Illus. 1: Change in VO_2max in the WGX and the WG after a 10 week training interval. Significant changes within the WGX and the significant difference between the groups are marked with an asterisk.

2. Mobility

Table 2: minimal possible grip width measured in cm by "Shoulder stretch with rod" test in the WGX and WG at start of study and after 10 week training interval, changes, difference between groups, p-value and effect size.

	WGX MV± SD	WG MV± SD	Absolute Difference (95% CI)	P	Effect Size Cohen's d
Basal	102.8 ± 16.3	101.2 ± 12.2			
10 weeks	96.0 ± 14.5	100.2 ±13.0			
Difference	6.8 ± 8.5	1.0 ± 12.0	-5.8 (-15.0/3.3)	.197	.557

The WGX showed improvements of flexibility of 6.8 cm during the "shoulder stretch" test. With p=.017, this is a highly significant difference. The WG showed non-significant improvements of 1 cm. The difference between the groups is not significant with p=.197, the effect size is medium-high.

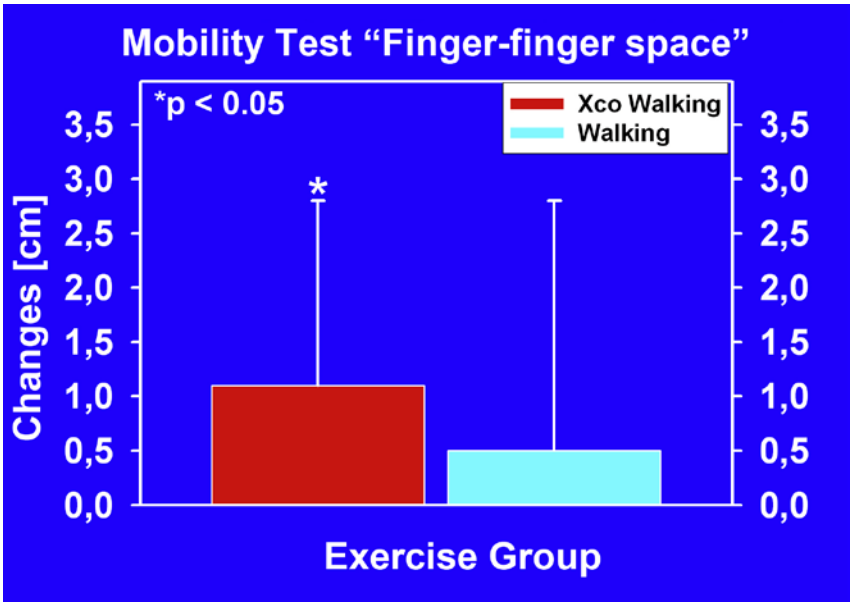


Illustr. 2: Changes in mobility as defined by the minimal grip width, measured in cm by “shoulder stretch” test in the WGX and WG after a 10 week training interval. The significant change within the WGX group is marked with an asterisk.

Table 3: minimal possible grip measured in cm during the “Finger-finger-space” test behind the back in the WGX and WG groups at outset of study and after a 10 week interval, changes, differences between groups, p-value and effect size. Positive values indicate that the participants were able to touch their fingers behind their backs and could move them past one another.

	WGX MV± SD	WG MV± SD	Absolute Difference (95% CI)	P	Effect Size Cohen’s d
Basal	1.5 ± 8.0	2.4 ± 6.4			
10 weeks	2.7 ± 7.6	2.9 ± 6.4			
Difference	1.1 ± 1.7	0.5 ± 2.3	0.6 (-1.2/2.4)	.474	0.296

The WGX group showed significant improvements (p =.042) from 1.5 to 2.7 cm, while the WG group’s improvement was incidental, increased only from 2.4 to 2.9 cm. The difference between groups is not significant, the effect size is low.



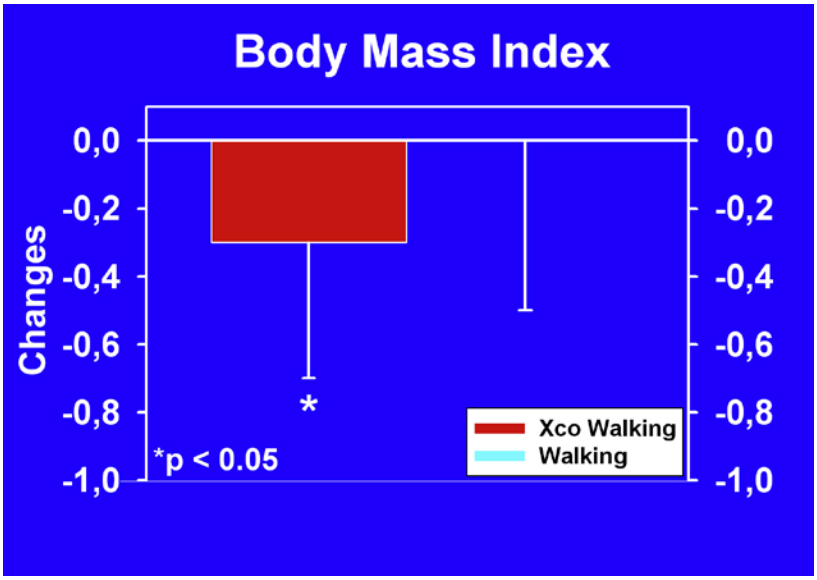
Illus. 3: Difference of the minimal possible grip measured in cm during the "Finger-finger space" test in the WGX and WG groups after a 10 week training interval. The significant change within the Xco group is marked with an asterisk.

3. Body-Mass-Index (BMI)

Table 4: BMI in the WGX and WG at start of study and after a 10 week training interval, changes, differences between groups, p-value and effect size.

	WGX MV± SD	WG MV± SD	Absolute Difference (95% CI)	P	Effect Size Cohen's d
Basal	24.4 ± 2.0	27.0 ± 3.0			
10 weeks	24.0 ± 2.0	27.0 ± 2.6			
Difference	0.3 ± 0.4	0.0 ± 0.5	-0.3 (-0.7 /0.1)	.135	0.658

The BMI showed a significant reduction of -1.6% in the WGX group (p=.012), while no difference was noted in the WG group. The difference between the groups is not significant, the effect size of d=0.658 is however medium high.



Illus. 4: changes in BMI in the WGX and WG groups after 10 week training interval. Significant changes within the WGX group are marked with an asterisk.