

P18-Comparison of 2 field tests and a non-exercise test model to estimate $\dot{V}O_{2max}$ in the elderly: effect of two training programs.

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An interventional study compared $\dot{V}O_{2max}$ values estimated by 3 different submaximal or non-exercise model in older adults before and after two 5-month-training programs or a resting control period. Although the self-paced step test overestimated $\dot{V}O_{2max}$ by comparison to the 1-mile Rockport walk test and the non-exercise test model, it was the only to correctly discriminate gains in cardiorespiratory fitness between the 3 groups.

Key words: Cardiorespiratory fitness, Submaximal field test, Aerobic training, Elderly.

INTRODUCTION

Cardiorespiratory fitness (CF), often measured by maximal oxygen uptake ($\dot{V}O_{2max}$), is a marker of cardiovascular and general health, and is related to all-cause mortality and autonomy in the older population (ACSM, 2010). To assess $\dot{V}O_{2max}$ in the elderly for epidemiological or interventional studies, maximal exercise testing in laboratory is not always feasible (see ACSM, 2010) and for this reason, submaximal field tests have been developed.

The objective of the present study was to compare estimated $\dot{V}O_{2max}$ from two field tests: the Rockport 1-mile walking test (Kline et al., 1987) and the self-paced step test (Petrella et al., 1998), and one non-exercise test model (Jurca et al., 2005) and to examine the sensibility of the 2 field tests to detect $\dot{V}O_{2max}$ changes following two different exercise training programs in men and women aged 65 and older.

METHODS

Participants: Twenty-six (20 women, 6 men) sedentary older adults (71 ± 6 years), free of any cardiovascular or neurological disease and not taking any cardioactive medication were randomly assigned to an aerobic program (Aerobic), a stretching program (Stretching) or a resting control group (Control) for 5 months.

Measurement of $\dot{V}O_{2max}$: Before incorporating their group (pre-test), all the participants' $\dot{V}O_{2max}$ was estimated by the self-paced step test (ST, Petrella et al., 1998), the Rockport 1-mile walking test (RW, Kline et al., 1987) and Jurca et al.'s non-exercise test model (NE, 2005), on a one-week period. The participants only performed again the 2 field tests after 11 weeks (post-test 1) and at the end of the programs (post-test 2), because the NE model was not designed to detect changes in a short period of time. Using age, weight, heart rate, gender, height, time to complete the field tests and physical activity score permitted to derive estimated $\dot{V}O_{2max}$ from the appropriate regression equations.

Exercise training programs: The participants enrolled in the exercise training programs met three times a week (1 hour per session) for 23 consecutive weeks. The focus of the aerobic training program was to enhance CF. The intensity level was individualized at 60% of individual heart rate reserve (HRR). The focus of the stretching training program was to enhance flexibility, balance, and coordination, with intensity levels set under 40% of individual HRR.

Statistical analyses: A Cronbach alpha was calculated to assess internal consistency between the 3 different measures of $\dot{V}O_{2max}$ at pre-test. Bland-Altman plots were also used to evaluate bias between pairs of measurements. Subsequently, a 3 X 2 X 3 ANOVA with Group (Aerobic, Stretching, Control) as a between subject factor and Measurement (ST vs. RW) and Time (pre-test, post-test1, post-test2) as within subject factors with repeated measures was performed on the estimated $\dot{V}O_{2max}$ scores.

RESULTS

Comparison of the 3 models at baseline: The Cronbach α was equal to .933 indicating a very good reliability between the 3 models (all the bivariate correlations ranged from $r = .80$ to $r = .85$). Although there was no difference between the 3 groups at baseline, $\dot{V} O_{2max}$ estimated by the ST ($25.5 \pm 5.4 \text{ ml.kg}^{-1}.\text{min}^{-1}$) was significantly ($p < .0001$) higher than the one estimated by the RW test ($20.1 \pm 6 \text{ ml.kg}^{-1}.\text{min}^{-1}$) and the NE model ($19.5 \pm 5 \text{ ml.kg}^{-1}.\text{min}^{-1}$), which were not different.

Training programs effects on $\dot{V} O_{2max}$: The significant Group X Measurement X Time interaction ($p < .05$) indicated that the 2 field tests differed in their sensibility to detect $\dot{V} O_{2max}$ changes in the 3 groups. As shown in Table 1, for the RW test, $\dot{V} O_{2max}$ increased significantly from pre-test to post-test 1 and post-test 2 in the 3 groups (all $ps < .05$). However, for the ST, only the Aerobic group significantly improved $\dot{V} O_{2max}$ from pre-test to post-test2 ($p < .05$).

Table 1. Means (M) and Standard Deviations (SD) of estimated $\dot{V} O_{2max}$ ($\text{ml.kg}^{-1}.\text{min}^{-1}$) from the 2 field tests for the 3 groups at 3 different times.

		Step Test			Rockport Walking test		
		Pre-test	Post-test1	Post-test2	Pre-test	Post-test1	Post-test2
Aerobic	M	27,2	28,0	29,7 ^a	21,1	25,0 ^a	25,4 ^a
	SD	5,0	5,5	3,7	5,4	5,3	5,5
Stretching	M	25,1	25,0	24,9	21,7	23,1 ^a	23,9 ^a
	SD	6,4	6,5	6,2	5,9	6,6	6,2
Control	M	24,5	25,4	24,4	18,6	20,4 ^a	22,2 ^a
	SD	5,4	5,6	6,1	6,6	8,2	7,3

^a significantly ($p < .05$) different from pre-test.

DISCUSSION

Although we did not have a direct $\dot{V} O_{2max}$ measurement from a maximal test using spirometry in laboratory, we can speculate that the ST may overestimate $\dot{V} O_{2max}$ in comparison to the other models. The RW test and the NE model provided values closer than the ones reported for sedentary elderly people from the literature (Shvartz & Reibold, 1990, but see ACSM, 2010 for other norms). However, the RW test, although frequently used in interventional studies, seem sensitive to learning effects. It detected an increase in $\dot{V} O_{2max}$ even for people who remained sedentary. Moreover, this field test was unable to discriminate improvement differences between the 3 groups. On the other side, the ST was able to find differences between the 3 groups and reported significant gains in $\dot{V} O_{2max}$ only for the Aerobic group after a sufficient long training period, as expected. Caution has to be taken concerning the generalization of our results due to the small sample size and the great proportion of women. More work is still needed to clearly establish what kind of $\dot{V} O_{2max}$ estimation test is valuable for epidemiological or interventional studies involving older adults.

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