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Maximal strength training does not improve double poling performance in well trained junior female cross country skiers

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1 • TREINO DESPORTIVO / SPORT TRAINING

**MAXIMAL STRENGTH TRAINING
DOES NOT IMPROVE DOUBLE-POLING
PERFORMANCE IN WELL-TRAINED JUNIOR
FEMALE CROSS-COUNTRY SKIERS**

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PURPOSE:

Performance in cross-country skiing is highly related to maximal aerobic capacity. Thus, a high volume of endurance training is a necessity. However, the introduction of sprint and mass start has increased the importance of generating high power outputs in parts of the races. Maximal strength and power output are closely related and maximal strength training has for decades been hypothesized to have a beneficial effect on endurance performance. Therefore, the present study investigated the effect of supplementing a high volume of endurance training with maximal strength training on performance and predictors of performance in female cross-country skiers.

METHODS:

Sixteen competitive female cross country skiers (17 ± 1 yrs, 60 ± 6 kg, 169 ± 6 cm, 59.6 ± 4.5 ml $\cdot$ kg⁻¹ $\cdot$ min⁻¹) were assigned either to an intervention group (INT; n=9) or a control group (CON; n=7). The intervention period was conducted in late preparation phase, lasted 10 weeks and consisted of two weekly maximal strength sessions on the upper-body muscles. Before pre and post testing, subjects conducted extensive familiarizations on equipment and protocols in which performance (poling ergometer) and 1 repetition maximum (RM) strength (seated pull-down) were tested. Measurements included submaximal O₂-cost, anaerobic power (AnP; 20sec all-out from rest), sprint abilities (SpA; 3min all-out from rest), finishing abilities (FiA; 3min all-out after a prolonged fatiguing load) and VO_{2-peak}.

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STATISTICS:

Data were log transformed before calculating relative changes, group-differences (mean $\pm$ 90% CI) and magnitude of difference (Cohen's *d* effect size (ES)). Pre- post and group interactions were respectively analyzed with Student's paired t-test and two-way repeated measures ANOVA.

RESULTS:

1RM-strength increased more in INT ($23.8 \pm 4.8\%$; $p < 0.01$; ES: 2.22) than in CON ($7.9 \pm 6.6\%$; $p < 0.05$; ES: 0.33) with a groups difference of $14.7 \pm 7.9\%$ ($p < 0.01$; ES: 0.90). The changes in AnP, SpA and FiA were similar for both groups (difference: -0.6 to -1.8%; $p > 0.6$; ES: -0.04 to -0.07). AnP increased $17.1 \pm 5.7\%$ ($p < 0.01$; ES: 1.13) in INT and $15.7 \pm 4.4\%$ ($p < 0.01$; ES: 0.46) in CON. SpA increased $17.1 \pm 6.9\%$ ($p < 0.01$; ES: 1.04) in INT and $16.2 \pm 3.0\%$ ($p < 0.01$; ES: 0.48) in CON. FiA increased $14.9 \pm 4.9\%$ ($p < 0.01$; ES: 1.06) in INT and $13.1 \pm 3.5\%$ ($p < 0.01$; ES: 0.33) in CON. Changes in $\text{VO}_{2\text{-peak}}$ showed a small group difference ($-3.9 \pm 4.8\%$; $p > 0.1$; ES: -0.42), with a trivial change in INT ($0.6 \pm 1.9\%$; $p > 0.5$; ES: 0.05) and a small increase in CON ($4.7 \pm 5.0\%$; $p > 0.1$; ES: 0.58). Relative O_2 -cost at three loads between 60 and 80 % of $\text{VO}_{2\text{-peak}}$ showed small group differences (-3.1 to -3.4% ; $p > 0.2$; ES: -0.29 to -0.34), with small decreases in INT (-6.3 to -4.2% ; $p < 0.05$ to $p = 0.15$; ES: -0.57 to -0.46) and trivial-small changes in CON (-3.3 to -1.1% ; $p > 0.2$; ES: -0.36 to -0.11).

CONCLUSIONS:

Supplementing an already high volume of endurance training with maximal strength training in the late preparatory period for top junior female athletes had trivial-small effects on O_2 -cost and short-lasting performance.

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