

Acute effect of beetroot juice supplements on aerobic performance of endurance in female athletes: a randomized controlled trial study

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INTRODUCTION & AIM

According to Senefeld et al. (2020), a meta-analysis on the potential ergogenic effects of NO supplementation included 80 studies with a total of 1179 male participants, whereas only six studies with a total of 156 women were included. This striking imbalance highlights the significant underrepresentation of women in NO supplementation studies, leaving a gap in understanding how NO may affect female athletes. The authors concluded that no ergogenic effects have been observed to date in studies involving only women; however, further research is needed to substantiate these findings adequately.

Studies suggest that dietary NO may affect skeletal muscle contraction in both sexes, but this effect may not be large enough to detect practically significant improvements (Wickham & Spriet, 2019). However, previous research has shown that after inorganic nitrate supplementation, plasma nitrite levels increased significantly more in women than in men, and pulse wave velocity decreased only in women (Kapil et al., 2018).

Benjamim et al. (2024) demonstrated that BRJ rich in nitrates led to significant reductions in systolic blood pressure and improvements in endothelial function in postmenopausal women with arterial hypertension. Despite these promising findings, the effects of BRJ supplementation on aerobic performance, cardiorespiratory fitness, and VO₂ max in healthy women athletes remain understudied.

Therefore, the aim of this study was to investigate the effects of beetroot juice supplementation on aerobic capacity, VO₂, and cardiorespiratory performance in adult women across different fitness levels in endurance sports.



METHOD

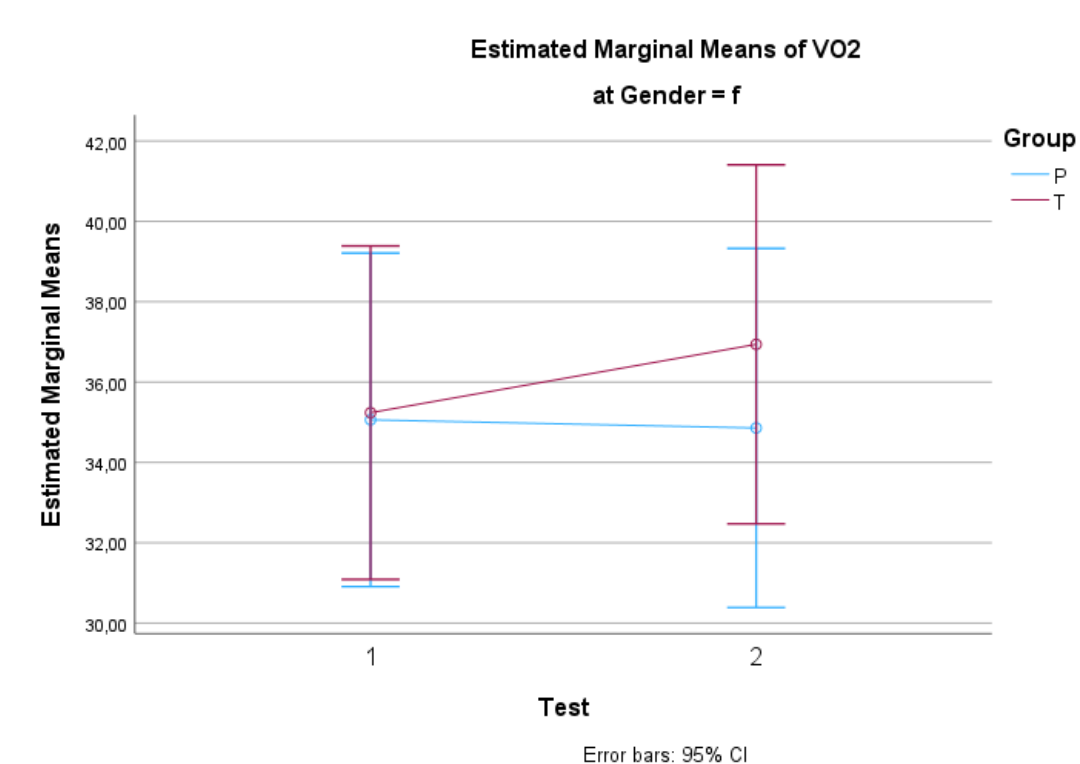
This study was a randomized placebo-controlled trial where participants (n=18), healthy, trained females (22.9 ± 5.6 years, 165.8 ± 7.14 cm, 64.0 ± 0.57 kg) were divided into two groups: placebo group (PLG; n=9), BRJ group n=9, BRJ concentrate 50ml (~8,2 mmol NO₃⁻, Hoon et al., 2014). Three hours after taking the supplement, participants completed cardiopulmonary exercise testing (CPET) test on a cycle ergometer at a constant work rate (W), gas exchange measurement, including the uptake of oxygen (V̇O₂) and exhaled carbon dioxide (V̇CO₂), with traditional exercise testing parameters.

Arithmetic mean and standard deviation were used to describe numerical variables. To analyze changes in variable values over time (between tests 1 and 2) in a randomized controlled trial, a one-way repeated-measures ANOVA test available in SPSS version 29 was used comparing 2 levels of repeated measures (test 1 and 2) considering belonging to the test or placebo group as an influencing factor. All measurements were subjected to a test of sphericity to adjust the reading of the results. The effect size was calculated as Cohen's d value for repeated (paired) measurements. Statistical significance was accepted at p<0.05.

RESULTS & DISCUSSION

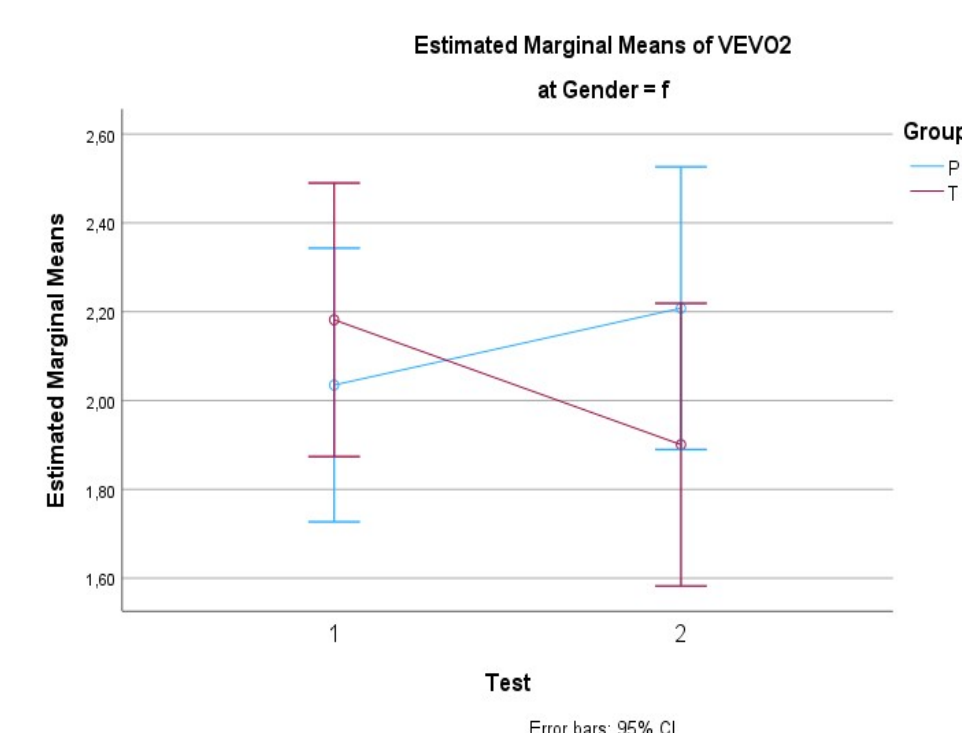
Results of maximal oxygen consumption in the BRJ group in the first test and in the second test after 50ml BRJ showed, significant (p<0.001) change after the second test. Maximal oxygen consumption (VO₂max) increased by 4.82% (from 35.24±5.07 to 36.94±4.91) in contrast with the PLG where results decreased by 0.57% between the first test and the second test (from 35.06±4.87 to 34.86±5.01).

Figure 1. VO₂ values in beetroot juice group and placebo group



Respiratory efficiency (VE/VO₂), increased by 0.84% in the PLG (from 34.53±2.67 to 34.79±3.38), decreased by 4,25% in the BRJ group (from 35.01±2.38 to 33.52±2.10).

Figure 2. Respiratory efficiency VE/VO₂ value in beetroot juice group and placebo group



This work presents data on the potential ergogenic properties of NO₃-supplementation. These data demonstrate that dietary supplementation with NO₃⁻ can be considered an ergogenic aid for high-intensity cycle training and may have therapeutic effects in hypoxic environments as well as on cardiovascular health in female athletes. The underlying mechanisms and parameters that may influence its effectiveness are not yet fully understood, so the use of supplements needs to be carefully considered and tailored to individuals and their specific needs.

CONCLUSION

This data demonstrates that dietary supplementation with NO₃⁻ can be considered an ergogenic aid and may have therapeutic effects in hypoxic environments as well as improve cardiovascular health in female athletes.

FUTURE WORK / REFERENCES

Future research should focus on a larger sample of female participants, considering the potential effects of the menstrual cycle and hormonal fluctuations on nitrate supplementation outcomes.

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