The Effects Of Respiratory Muscle Training On Performance, Dyspnea, And Respiratory Muscle Fatigue In Intermittent Sprint Athletes

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ABSTRACT

The respiratory system has traditionally not been considered a limiting factor in aerobic performance. However, little is known regarding the potential influence of respiratory muscle training (RMT) during short-term, high-intensity intermittent exercise.

PURPOSE

To determine the effect of respiratory muscle training (RMT) on respiratory muscle strength (PImax), performance, dyspnea, and respiratory muscle fatigue (RMF) in intermittent sprint athletes.

METHODS

Collegiate soccer athletes (N = 27; 20 male, 7 female) were randomly divided into either a RMT or control condition. The RMT group received 5 weeks of RMT using a commercially available training device (PowerLung Inc.), while the control group received no intervention. Both groups continued to train under the supervision of their coaches throughout the intervention. The Yo-Yo Intermittent Recovery Test (IRT), designed for evaluating intermittent-sprint fitness, was used to assess performance. Dyspnea was assessed during and immediately following the IRT. RMF was assessed 2 minutes and 10 minutes after completion of the IRT.

RESULTS

Performance improved by (mean ± SD) 16.7% ± 17.2% in the RMT group ($p < .05$), while a non-significant increase (5.2% ± 7.8%) was observed in the control group. The RMT group also demonstrated a significant increase in PImax (20.5% ± 15.4%), whereas the control group exhibited little change in this variable (1.5% ± 4.7%). No statistically significant changes in dyspnea or RMF were detected in either group following RMT.

CONCLUSION

Results from this study indicate that RMT improves performance and respiratory muscle strength in intermittent sprint athletes.

INTRODUCTION

- Some controversy exists over the efficacy of respiratory muscle training (RMT). Studies in the area of RMT have produced equivocal results. However, several researchers have shown a potential ergogenic benefit to RMT[2].
- The majority of the research conducted in the area of RMT has focused on endurance activities (i.e. cycling, rowing, etc.). Increased time to exhaustion and improved time-trial performance has been found after RMT in cycling and rowing versus control and/or placebo conditions[4,5].
- Intermittent sprint sports (i.e. soccer, basketball, etc…) require participants to exert high intensity bouts of exercise, followed by short bouts of recovery. In one study, intermittent sprint athletes who completed RMT significantly reduced selected recovery time in a fitness test designed for intermittent exercise[3].
- More research is needed regarding the potential ergogenic effects of RMT, specifically in the area of intermittent sprint sports.
- The mechanisms by which RMT improves performance is still unclear. Delayed respiratory muscle fatigue and reduced dyspnea are two possible mechanisms by which RMT could impact performance.
- The purpose of this study was to determine the effect of respiratory training on performance, dyspnea, and respiratory muscle fatigue in intermittent sprint athletes.
- Since athletes reduced recovery time in a previous study[3], this study utilized a 10-second recovery time, which was held constant in between bouts of exercise (Yo Yo Intemittent Recovery Test)[1].

METHODOLOGY

- **Design**
  - 27 collegiate soccer athletes (20 males & 7 females) participated in the study from a small NCAA Division I institution.
  - Participants were randomly assigned to treatment (RMT) or control group.
  - The RMT group trained for 5 weeks using a commercially available device (Powerlung Inc., Sport Model, Houston, TX). Participants completed two training sessions per day, 5 days per week. Each training session consisted of 3 sets of 10 inhalation repetitions (estimated 30 RM). The control group received no RMT training for the 5 weeks.
  - Both groups continued off-season conditioning under the supervision of their coaches.
- **Pre-Intervention**
  - Height, weight, body fat, FVC, FEV1 were obtained.
  - PImax was obtained using a hand-held respiratory pressure meter.
  - Participants completed the IRT as a measurement of performance (test allows 10 second recovery time between bouts).
  - Dyspnea was assessed every 2 minutes during and immediately after the IRT (using modified Borg scale).
  - Respiratory muscle fatigue was assessed approximately 2 and 10 minutes post exercise (RMF2 & RMF10). A percentage reduction in PImax was used as the measurement for RMF2 and RMF10.

METHODOLOGY (con't)

Post-Intervention

- Participants were tested on two occasions within one week (order of testing sessions was counterbalanced).
- For one session, the participants were allowed to finish the IRT until volitational fatigue.
- For the other session, the participants were instructed to stop IRT at same level as they did during the pre-intervention session. Dyspnea, RMF2, & RMF10 were assessed during this session.

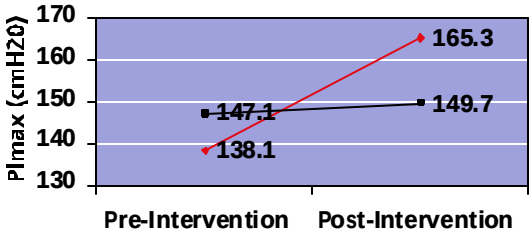
Data Analysis

- 2 x 2 repeated measures ANOVA used to test within group effects due to time & between group effects due to treatment on each dependent variable
- A Bonferroni adjustment was utilized to maintain family-wise alpha at .05 per ANOVA

RESULTS

Treatment
Control

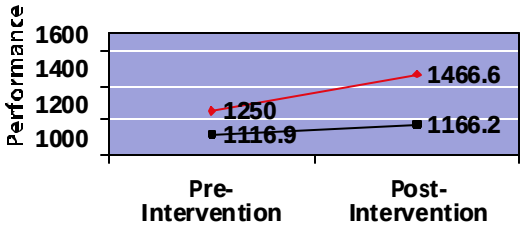
Change in PImax*



PImax

- Statistical interaction between time and group was significant (p<.001).
- Improvement by RMT group was significant, with a (mean±SD) 20.6%±15.5% increase in PImax., p<.001 (d = 1.5) compared to a non-significant 1.5%±4.7% improvement experienced by the control group (d = .45).

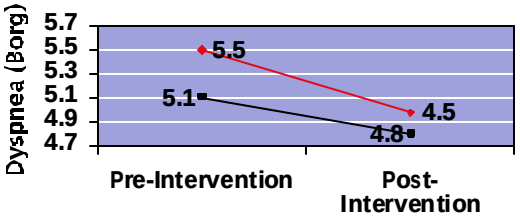
Change in Performance*



Performance*

- Statistical interaction between time and group was significant (p =.021).
- RMT group significantly improved performance (mean±SD) 16.7%±17.2%, p = 008, (d = .94) compared to a non-significant 5.2%±7.8% improvement in the control group (d = 66).

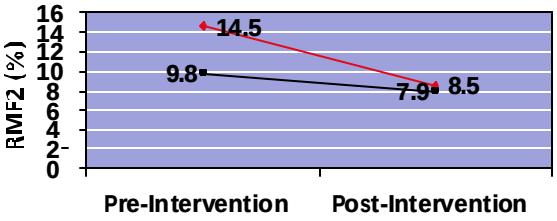
Change in Dyspnea



Performance*

- No statistically significant interaction found between time and group (p = .514).
- RMT group experienced a (mean±SD) .52 ± .73 decrease in dyspnea (d = .71) compared to a .33 ±.74 decrease in the control group.

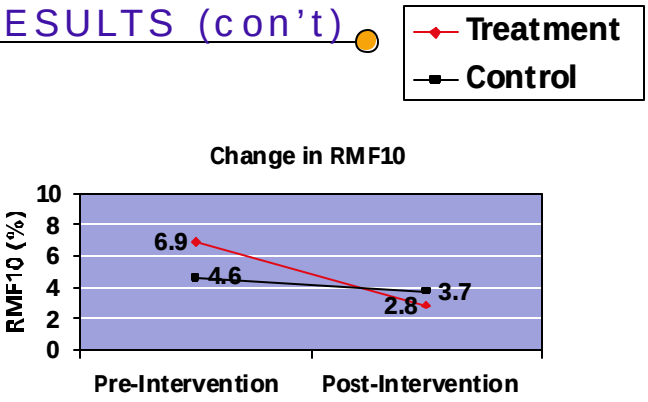
Change in RMF2



RMF2

- No statistically significant interaction found between time and group (p =.206).
- RMT experienced a (mean±SD) 6.0%±9.5% reduction in RMF2 (d = .63) compared to a 1.9%±6.2% reduction in the control group (d = .30).

RESULTS (con't)



RMF10

- No statistically significant interaction found between time and group (p =.158).
- RMT experienced a (mean±SD) 4.0%±5.8% reduction in RMF10 (d = .70) compared to a 0.9%±5.2% (d = .17) reduction in the control group.

SUMMARY / CONCLUSIONS

- The results of this study support existing evidence that RMT has an ergogenic effect in athletic populations.
- More specifically, RMT can improve performance in intermittent sprint athletes after 5 weeks of training (16.7% improvement). The 5.2% improvement in the control group was expected, as participants continued to train throughout the duration of the study.
- PImax can improve after 5 weeks of RMT (with an estimated 30 RM training protocol) using a commercially available RMT device.
- Within the parameters of this study, RMT did not significantly decrease perceived ratings of dyspnea (recorded as an average during and immediately following the IRT).
- While the RMT group experienced reductions in RMF2 and RMF10, these reductions were not significantly different than the reductions experienced by the control group.
- The significant improvement in performance experienced by RMT group may be due to other factors not measured in the investigation.
- Further research is needed to determine the efficacy of RMT training and performance.
- The mechanisms by which RMT improves performance also warrant further study.

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