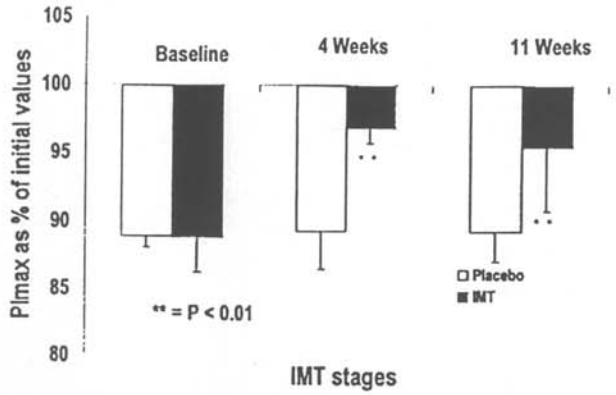

FIGURE 1—Decrement in inspiratory muscle strength after the 6-min all-out test, in percentage decrease from resting mouth pressure generating capacity, throughout the 11 wk of inspiratory muscle training in the training and placebo groups. Values are mean± SD ** $P < 0.01$ different from the placebo group. IMT, inspiratory muscle training group.

± 0.8% ($P < 0.05$) for the IMT and the placebo groups, respectively. After the first 4 wk of the training period the fatigue after the 6-min all-out effort in the IMT group decreased to 3.1 ± 1.1% ($P < 0.01$), whereas the placebo group remained at 10.7 ± 2.8%. Upon completion of the training period the fatigue for the IMT and the placebo groups did not change any further (4.5 ± 4.7%, $P < 0.01$ and 10.7 ± 2.2%, NS, respectively). Between-group differences in fatigue where also significant for both the 4 and 11 wk comparisons ($P < 0.05$; see Fig. 1).

Perception of Dyspnea

Significant improvements in the perception of respiratory effort during the incremental test were found in the IMT group throughout the training period (Fig. 2). However, no change was found in the dyspnea after the 6-min all-out effort. There were no significant changes in the control group either during the incremental test or the 6-min all-out effort (Fig. 2).

Ventilation and Breathing Pattern

After the completion of the training period, there were no significant changes in the ventilatory volumes at any stage of the incremental test, for either the IMT or the placebo group. However, during the 6-min all-out effort, minute ventilation increased for the placebo group, from a baseline of 120.3 ± 18.5 to 129.6 ± 13.4 L·min^{-1} ($P < 0.05$) The IMT group also increased minute ventilation from a baseline of 119.9 ± 12.8 to 122.5 ± 12.3 L·min^{-1}, a difference that just failed to reach significance ($P = 0.051$). The breathing pattern of the IMT group at the 6-min all-out effort changed after the completion of the training period. There was a shift to a significantly deeper breathing pattern with an increase of the tidal volume from 2.01 ± 0.16 to 2.16 ± 0.16 L ($P < 0.01$). Breathing frequency did not change significantly. The placebo group did not exhibit any significant changes in breathing pattern, but there was a tendency toward a more

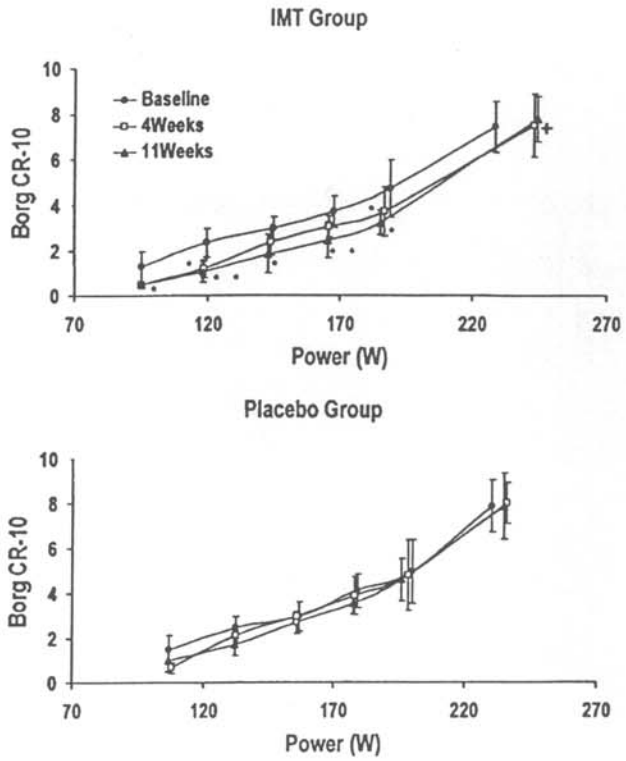

FIGURE 2—Dyspnea-power curves after 4 and 11 wk of inspiratory muscle training for the IMT (top) and placebo (bottom) groups. Values are means ± SD. * Significantly different ($P < 0.05$); ** significantly different ($P < 0.01$); + significantly different ($P < 0.05$) power output for the same dyspnea.

tachypneic pattern with an increase of 4.5% in their breathing frequency compared with only 1.5% of the IMT group (see Table 2).

DISCUSSION

The most important finding of this study is that inspiratory muscle training improved rowing performance to a greater extent than conventional training alone. To our knowledge, ours is the only study investigating the effect of inspiratory muscle training upon an index of sports performance rather than a marker of physiological capacity such as the time-limit test (Tlim). In the reports of Caine and McConnell (5) and Lisboa et al.(22), cycling time to ex-

TABLE 2. A summary of statistical significance for within- and between-group comparisons after 11 wk of IMT in selected parameters.

Parameter	IMT Group	Placebo Group	Between-Group Comparisons
Resting PI_{max}	Improved	No change	Yes
PI_{max} after exercise	Improved	No change	Yes
Lactate incremental test	Decreased	Decreased	No difference
Borg scale 6-min test	Decreased	No change	No difference
??E Incremental test	No change	No change	No difference
??E 6 min test	No change	Increased	No difference
??I 6 min test	Increased	No change	No difference
BI 6 min test	No change	No change	No difference
P_{ETCO_2}	No change	No change	No difference
P_{ETO_2}	Increased	No change	Yes
6-min test power	Improved	Improved	Yes
5000-m trial time	Improved	Improved	Yes