THE EFFECT OF LOWER BODY POSITIVE PRESSURE ON MUSCLE ACTIVATION DURING RUNNING

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INTRODUCTION

Early mobilization after injury and surgery on the lower extremities are essential to reduce adverse effects of immobilization. Walking or running with reduced body weight in a lower body positive pressure treadmill chamber is potentially a new rehabilitation and training tool. A recent study found that runners can reduce peak vertical ground reaction forces while maintaining the aerobic stimulus [1]. Furthermore, no adverse impact on systemic and head cardiovascular parameters was found [2]. However, the effect of different levels of body support on the neuromuscular function has not yet been studied.

The main aim was to study the effect of running with reduced body weight on lower extremity muscle activation.

METHODS

Eight healthy experienced male runners (27.1 years, body weight (BW) 80 kg) performed two running sessions (8 km/h and 12 km/h) on a force treadmill with a lower body positive pressure chamber (G-trainer, Alter-G, USA) which allowed BW to be reduced gradually to 20%BW. The subjects were instructed to run normal at all levels of body support. The sessions were performed in random order and at least 20 min rest was allowed between sessions. Each session consisted of 6-min running trials at 100%BW, 80%BW, 60%BW, 40%BW and 20%BW.

Step frequencies were calculated. Heart rate (HR) was recorded and Perceived Exertion (RPE) was rated during steady state. Surface EMG (Logger Technology, Sweden) was recorded (3-6 min) from mm. vastus lateralis, vastus medialis, biceps femoris, gastrocnemius and soleus. EMG recorded during running was expressed relative to EMGmax obtained during maximum contractions. Mean RMS-EMG and peak EMG (90% percentile) were calculated.

RESULTS AND DISCUSSION

Reducing body weight from 100% to 20% decreased HR linearly from 119 bpm to 92 bpm at 8 km/h and from 143 bpm to 110 bpm at 12 km/h. Thus, a constant HR can be achieved by increasing running speed to compensate for the effect of reduced body weight on the cardiovascular system.
RPE changes were closely related to HR changes as expected during running. Step frequency at 8 km/h declined from 161 steps/min at 100%BW to 126 steps/min at 20%BW. The corresponding values at 12 km/t were 165 steps/min to 135 steps/min.

The activity (mean and peak activity) of the knee extensor muscles (m. vl and m. vm) and the ankle plantar flexor muscles (m. gas and m. sol) declined in parallel with decreasing body weight. However, the biceps femoris muscle remained largely at the same activity level independently on the body weight (Figure 1). Running at 12 km/h increased the activity levels in general but the muscle responses to reduced body weight were similar. Thus, the muscles primarily supporting the body weight in the stance phase responded differently from the biceps femoris muscle being active primarily during leg swing. Theoretically, reducing the weight in the treadmill chamber influence the component of the mechanical energy including the body weight only, i.e. ΔEpot and not ΔEkin which is dependent on body mass. Consequently, muscles primarily supporting the body weight reduce muscle activity with increasing lower body positive pressure while muscles primarily related to linear and rotational acceleration/deceleration remain at the same activity level assuming unchanged movement pattern.

Running with reduced body weight may be beneficial not only for early mobilization after injury and surgery but also for neuromuscular patient groups with reduced muscle strength or impaired motor function.

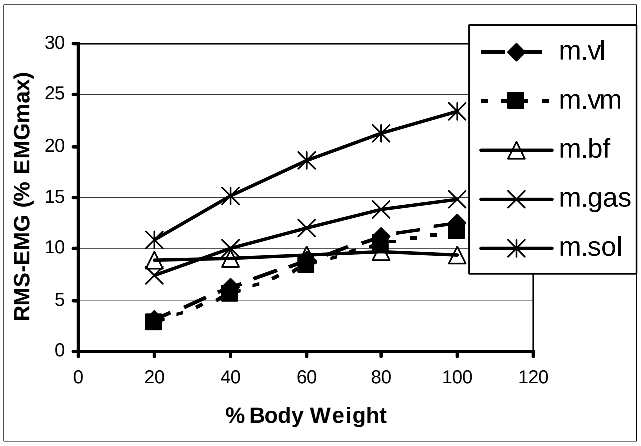

Figure 1: Mean EMG activity versus relative body weight during running at 8 km/t.

CONCLUSIONS

Running with reduced body weight in a lower body positive pressure treadmill chamber allow running with near normal movement pattern. The lower leg muscles adapt their activation levels to the new biomechanical conditions.

REFERENCES

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2. Cutuk A, et al., *J Appl Physiol.* **101**:771-777, 2006.