Changed biomechanics after 4 weeks of running with increased step rate

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Introduction

- Running is a popular activity but the risk of running related injuries (RRI) caused by overuse is high
- The majority of RRI affects the lower extremities
- Increased experimental step rate (cadence) manipulation in laboratory settings reduce vertical ground reaction force (VGRF), but the long term effect on self-selected cadence and lower extremity load is unknown

Aim

To study the long-term effect of increased running cadence training on lower extremity muscle activity and maximal vertical ground reaction force (MVGRF) during running.

Hypotheses

Minimum 2 weekly running sessions with 10% increased cadence during 4 weeks results in decreased MVGRF, alters the late swing phase muscle activity in selected lower extremity muscles and increase the self-selected cadence.

Methods - procedure

Tibialis anterior (TA), Gastrocnemius lateralis (GL) and Gluteus Maximus (GM) muscle activity and VGRF in 16 (Fig. 1) injury free participants (age 24±3 years, height 174.3±6.7 cm, BMI 24.3±3.5) were measured before and after 4 weeks targeted running training with 10% increased step rate, supported by Setio ® accelerometer based sensors and mobile application.

Recruited N = 18 ⇨ Excluded N = 2 ⇨ Included N = 16

Fig. 1. The study group inclusion overview
18 participants met the inclusion criteria. Two participants completed less than two training sessions weekly during the intervention period and were excluded from the analyses.

Methods – analysis and statistics

- EMG were collected according to www.seniam.org guidelines with a wireless Noraxon® system during instrumented treadmill (Zebris® FDM-T) gait and running
- Pressure data defined early and late stance and swing-phases. Mean and peak Root-mean-Square (RMS)EMG during each phase was calculated across participants after the raw EMG data was filtered, full- wave rectified, smoothed and normalized to gait RMS-EMG
- Between baseline and re-test MVGRF was compared with t-test and RMS-EMG with Repeated measures ANOVA and post-hoc tested with t-tests (significance level P<0.05).

Results - resumed

At re-test significant difference was observed in MVGRF, self-selected cadence and late swing phase RMS-EMG:

- ⬆ Self-selected cadence (Fig. 2, P<0.01)
- ⬇ MVGRF (Fig. 3, P<0.01)

Muscle activity (Fig. 4) during late swing phase:

- ⬇ M. Tibialis anterior (TA): P<0,05)
- ⬆ M. Gastrocnemius lateralis (GL): (P<0,05)
- ⬆ M. Gluteus Maximus: (P<0,05)

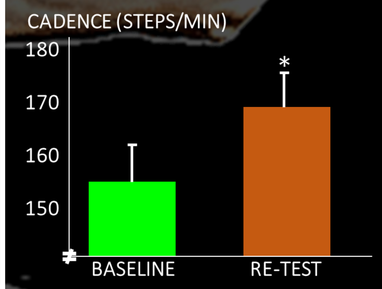

Fig. 2 Cadence
Compared with baseline, self-selected cadence increased significantly at retest.

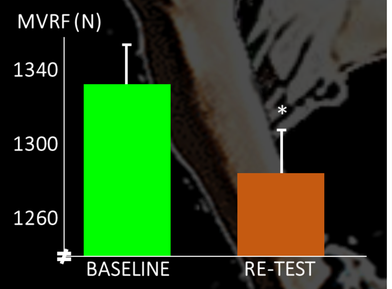

Fig. 3 MVGRF
Compared with baseline, MVGRF decreased significantly at retest.

Results – continued

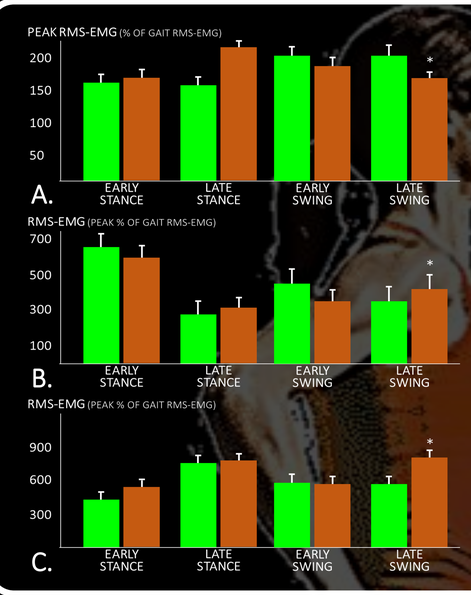

Fig. 4 RMS-EMG
Mean + SEM (N=16) Peak muscle activity (RMS-EMG) of A. TA, B. GL C. GM during early stance, late stance, early swing and late swing phases.
Significant changes were observed in the late swing phase in all three muscles (P<0.05)

Conclusion and discussion

Four weeks targeted step rate training supported by a sensor and mobile application system effectively and significantly

- Increased self-selected cadence and reduced MVGRF
- Increased Gastrocnemius lateralis and Gluteus Maximus and decreased Tibialis Anterior muscle activity during the late swing phase

The observed changes confirmed a sustained change in running biomechanics after four weeks of targeted training. These changes altered the lower extremity load and may be a potential strategy to decrease the risk of running-related injuries in some runners. More research in the underlying biomechanics is required and the long-term effect needs to be explored in prospective intervention studies.

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