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The effects of Nordic hamstring exercise on pain and performance in elite rowers with lower back pain

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Abstract. The aim of the present study was to examine the effects of the Nordic hamstring exercise (NHE) on pain threshold, flexibility and 2000m rowing performance in elite rowers with lower back pain (LBP). Ten elite rowers (age 17.6 ± 2.12 years) with LBP participated in this study. Participants completed 6-weeks of NHE in addition to their usual training program. Pre- and post-training tests included measures of pain threshold of the lower back, flexibility (sit and reach test) and 2000 m rowing performance. The results demonstrated that an organized HNE caused a significant decrease in pain threshold from 4.8±2 to 3±1.4 (P = 0.03, ES = 0.9) and a non-significant but moderate improvement in rowing performance from 6.9±0.7 min to 6.3±0.9 min (P = 0.1, ES = 0.8). The sit and reach test revealed a non-significant change from 14.9±8.2 cm to 15.2±6.5 cm (P = 0.9, ES = 0.04). We conclude that the NHE may represent an effective method for reducing pain in elite rowers with moderate improvement in rowing performance.

Keywords. Eccentric training, flexibility, injury, strength.

Introduction

Rowing represents a modern Olympic sport that requires muscle strength, endurance and power (Lawton et al., 2013). It has been demonstrated that the most frequently injuries associated with rowing are injuries of the lower back, shoulders, knees, and wrists (Lawton et al., 2013). The chronic overuse syndrome, a low rowing technique, and poor flexibility and strength deficits are the most common mechanisms associated with pain and injury in rowers (Wilson et al., 2014). Additionally, low back pain (LBP) is a frequent complaint of rowers. In this context, Bahr et al. (2004) showed that 55% of the rowers reported LBP in the previous 12 months, which compared with 63% in skiing, and 47.5% in a matched control group.

Literature reported that inflexible hamstring muscles limit anterior pelvic tilt during trunk flexion which caused an increase in lumbar muscle and ligament tension, resulting in greater compressive stress on the lumbar spine (Gajdosik et al., 1994). Furthermore, it has been shown that the important factors associated with onset of LBP in rowers are history of injury and ergometer training volume (sessions longer than 30 min) (Wilson et al., 2014) .

It has been shown that the NHE as an eccentric exercise type represent an effective tool for improving eccentric hamstring strength and prevent injuries in athletes (Brooks et al., 2006; Van der Horst et al., 2015). To date, there is a paucity of information available regarding the effects of NHE on LBP and performance. Accordingly, the aim of this study was to investigate the effects of 6-weeks of NHE on pain, flexibility and 2000 rowing performance in elite rowers suffering from LBP. It was hypothesized that NHE reduce significantly pain and improve performance.

Methods

Procedure

To examine the change in pain, flexibility and 2000m rowing performance, 10 elite rowers with LBP were tested during 2 sessions, 6-week apart (pre-and post-tests). The testing sessions took place over a 2-day period at the same time of day to eradicate the potential effects of any circadian variation on the participants. After the pre-tests, athletes performed 6-week of NHE in addition to their normal training program. Informed consent was obtained from all the participants included in the study. All athletes were fully familiarized with testing procedure and the NHE before conducting the study. All procedures performed in the study were in accordance with the ethical standards of the national research committee and with the 1964 Helsinki Declaration.

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Participants

Ten elite rowers (7 male and 3 female) were recruited (17.6±2.12 years). To be included, all participants should be: 1) elite rowers competed in national and international competitions. 2) Athletes suffering from LBP. The rowers reported a moderate pain (4.8) according to the results obtained from the visual analog scale (VAS). The study was conducted according to the Declaration of Helsinki, and the protocol was fully approved by the National center of Sports medicine and Science Tunis. Each participant and the parents signed an informed consent form before the experimentation.

Athletes usually trained 5 to 6 sessions per week and including weight training, ergometer rowing, running or cycling, stretching exercises and cross-country skiing.

The Nordic hamstring exercise

The Nordic hamstring exercise is a partner exercise (see Figure 1). Athlete starts in kneeling position with torso held straight throughout the movement. The training partner applies pressure to the athlete's heels to ensure that the feet stay in contact with the ground. Athletes then lower their upper body to the ground, as slowly as possible to maximize loading in the eccentric phase (Van der Horst et al., 2015). Hands and arms are used to break his forward fall and to push him back up after the chest has touched the ground, to minimize loading in the concentric phase (Mjølsnes et al., 2004). Athletes trained 2 sessions per week for 6 weeks. Each session composed of 3 sets of 5 repetitions per set.

Figure 1. The Nordic hamstring exercise.

Pain thresholds: LBP was assessed using the VAS (see figure 2). The VAS consists of a 10- cm line, with the left extremity indicating "no pain" and the right extremity indicating "unbearable pain." Participants were asked to use the scale to indicate their current level of pain. Higher values suggest more intense pain. This instrument showed good reproducibility in the assessment of pain (Dixon & Bird, 1981).

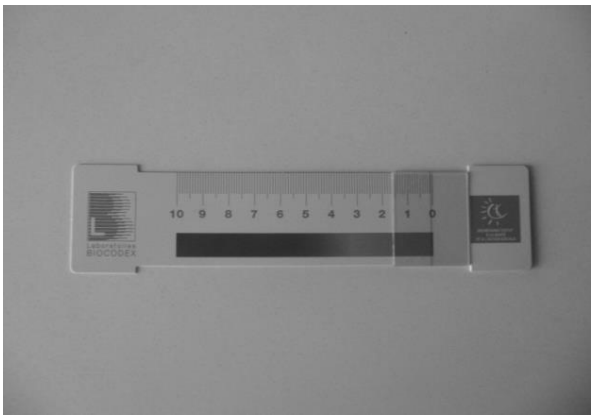

Figure 2. The visual analogue scale used in this study to assess pain thresholds.

Flexibility: Flexibility was assessed using the sit-and-reach test (see figure 3). Participants sat with leg straight (extended) and feet flat against the sit and reach device. They exhaled and stretched forward as far as possible with one hand over the other and finger tips in line and held the end point for 2 seconds. This process was repeated 2 times with the greatest performance used for analysis. This test demonstrate an acceptable reliability (ICC =0.92) (Ayala et al., 2012).

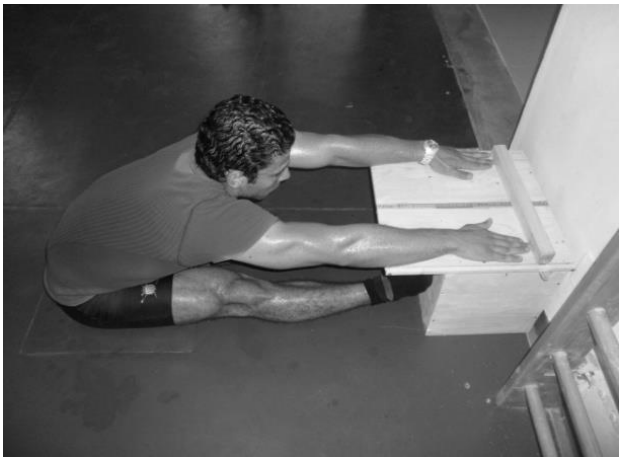

Figure 3. The sit and reach test used in this study.

2000m rowing performance

After a standardized warm-up, all athletes performed the 2000m rowing performance using an air-braked rowing ergometer (Model D; Concept 2, Inc., Morrisville, VT, USA). Rowing performance in the present study was the 2000-m time trail measured in min.

Statistics

Data are expressed as mean ± SD. The normal distribution of the data was checked using the Kolmogorov-Smirnov test. After confirming normal distribution, paired sample t-test was used to compare the difference between pre- and post-test. Significant level was defined as $p = 0.05$.

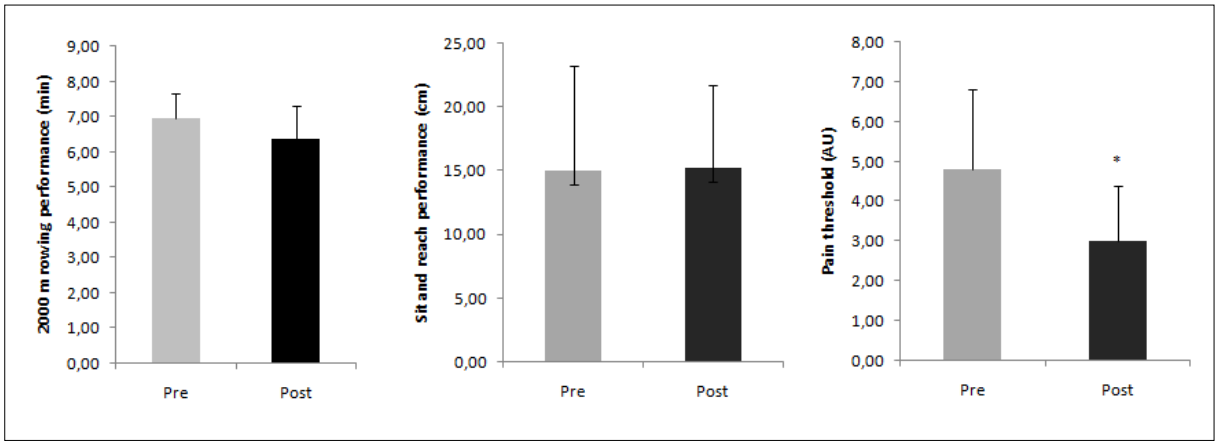

Figure 4. The effects and changes of pain thresholds, rowing and flexibility performance after 6-weeks of NHE.

The magnitude of changes was interpreted using the effects size (ES) according to Cohen's d. ES was classified according to Cohen's d as follows: < 0.2 was defined as trivial; 0.2– 0.6 was defined as small; >0.6–1.2 was defined as moderate; >1.2–2.0 was defined as large; > 2.0-4.0 was defined as very large; and >4.0 was defined as extremely large.

Results

The results of the effects of NHE on pain, rowing performance and flexibility were presented in Figure 4. The results demonstrated that an organized HNE caused a significant decrease in perceived pain threshold from 4.8±2 to 3±1.4 (p = 0.03, ES = 0.9) and a moderate improvement in rowing performance from 6.9±0.7 min to 6.3±0.9 min (P = 0.1, ES = 0.8). The sit and reach test revealed a non-significant change from 14.9±8.2 cm to 15.2±6.5 cm (P = 0.9, ES = 0.04).

Discussion

To the authors 'knowledge, the present study is the first to analyze the effects of 6 weeks of NHE on pain and performance in elite rower with LBP. The results demonstrated that NHE reduced significantly pain thresholds and produced a moderate improvement in rowing performance without effects on flexibility. It has been shown that LBP is highly prevalent in athletic and nonathletic populations, and is a common cause of pain and disability (Hebert et al., 2008). Some of the alternatives and treatments interventions for athletes with LBP consist of various forms of exercise, stabilization training, manual therapy, traction, and the use of physical modalities (Khadilkar et al., 2005; Hebert et al., 2008). The evidence showing the effectiveness of exercise intervention as a treatment of LBP is generally lacking or inconclusive (Hebert et al., 2008).

In the present study, we hypothesized that the NHE as an eccentric training mode will be an effective method for reducing LBP and improving flexibility in rowers. The results demonstrated that the NHE reduced significantly LBP without effects of flexibility that are in conjunction with Stutchfield & Coleman (2006), who demonstrated that LBP was not associated with hamstring inflexibility in university rowers. Moreover, literature showed that the NHE, as a bodyweight only exercise, was an effective tool to increase eccentric hamstring strength (Mjølsnes et al., 2004) and recommended for hamstring injury prevention especially in soccer players (Van der Horst et al., 2015). Indeed, it has been shown that female athletes with LBP were observed to have greater differences in hip strength, than females without LBP and males with or without LBP (Nadler et al., 2000). Concerning the possible influences of muscular strength on LBP, the hip musculature plays a significant role in transferring forces from the lower extremity up toward the spine during upright activities and thus theoretically may influence the development of LBP (Lyons et al., 1983; Nadler et al., 2002). This interpretation may explain in part the positive effects of NHE on reducing pain thresholds in rower with LBP in addition to the moderate improvement in rowing performance.

The absence of changes in flexibility in the present results may depend on the sport practiced. Indeed, rower generally has a high level of hamstring and back flexibility and this may explain in part the results founded. Future studies are needed to explore the possible effects of NHE on muscular strength and pain thresholds in athletes from different sports suffering from LBP using randomized controlled trials.

In conclusion; this article demonstrated that conducting a regular NHE in addition to usual training in elite rowers with LBP contribute significantly in the decrease of pain with a moderate improvement in rowing performance and without effects on flexibility.

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