

The Influence of Prior Activity Upon Inspiratory Muscle Strength in Rowers and Non-Rowers

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The aim of this study was to investigate whether a 'warm-up' phenomenon in the strength of the inspiratory muscles exists, and, under this assumption, whether whole body warm-up protocols or a specific respiratory warm-up is more effective in this respect. Eleven club level rowers performed a rowing warm-up, and twelve university students performed a general cycling warm-up. Both groups also performed a specific respiratory warm-up. Inspiratory muscle strength (Mueller manoeuvre) and lung function (flow-volume loops) were measured before and after the three conditions. Isokinetic strength during knee extension was measured before and after the rowing warm-up. The two whole body warm-up protocols had no effect on inspiratory muscle strength or any lung function parameter despite the significant ($3.8 \pm \text{SD } 1.4\%$; $p < 0.05$) increase in peak torque that the rowing warm-up elicited. The respiratory warm-up induced a significant increase in inspiratory mouth pressure ($8.5 \pm 1.8\%$; $p < 0.0001$) but not in any other lung function parameter. Following the rowing incremental test to exhaustion, maximum inspiratory pressure decreased by $7.0 \pm 2.0\%$, which is an indication of respiratory muscle fatigue. These data suggest that the inspiratory muscle strength can be enhanced with preliminary activity, a phenomenon similar to the one known to exist for other skeletal muscles. In addition, a specific respiratory warm-up is more effective in this respect than whole body protocols.

Key words: Warm-up, rowing, Mueller manoeuvre, inspiratory muscles, isokinetic strength.

Introduction

Warm-up may be defined as any preliminary activity that is used to enhance physical performance and to prevent sports-related injuries. There are various types of warm-up techniques that competitors use to prepare for their event. The most widely used methods are classified as *passive*, *general* and *specific warm-up* [28].

Competitive rowing is considered to be one of the most demanding sports, as rowers work near their maximal physical capacities and recruit a very large muscle mass. Open class rowers generate amongst the highest values of any athletes in selected physical fitness parameters, including those related to cardiorespiratory and muscular function [16]. Warm-up is an integral part of the preparation before the start of the race.

Most general warm-up protocols are of moderate intensity and characterised by a low ventilatory demand [13]. In competitive rowing, however, a higher intensity specific warm-up usually follows the general warm-up in an attempt to practise the racing pace [8]. The higher intensity of the specific warm-up, among other peripheral adaptations, elicits an elevated ventilatory response that may prepare the respiratory muscles for the demanding entrained breathing of rowing [20, 29]. The effect of warm-up upon locomotor muscle strength is well documented [2, 3, 7, 10] but very little scientific attention has been directed towards the effect of warm-up on pulmonary function and specifically inspiratory muscle strength.

The present study sought to address the following questions: a) Does a whole body warm-up influence inspiratory muscle strength? b) Does a specific respiratory warm-up affect the inspiratory muscle strength? Accordingly, we compared the effects of 3 warm-up protocols, a general cycling warm-up, a rowing warm-up, and a specific respiratory warm-up. Our hypothesis was that the inspiratory muscles will exhibit an improvement in performance similar to that observed in other skeletal muscles following at least one of these conditions.