Sex-Specific Mechanisms of Foot Numbness Associated to Cycling

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Summary

Foot numbness is a common problem for cyclists and can result from issues like nerve compression and vascular restriction, which can cause discomfort when cycling. However, there has been minimal research quantifying cyclists' numbness sensation, its underlying physiological and biomechanical mechanisms, and how they might differ between the sexes. The goal of this study is to analyze how cycling-induced foot swelling, blood oxygenation, muscle activity, and biological sex are associated with foot numbness sensation. Biomechanical and physiological measures are recorded in a laboratory-based cycling protocol. Preliminary results suggest that foot sensitivity decreases with cycling time. Larger sample sizes are needed to determine if these results are confirmed and whether they vary according to sex.

Introduction

A common complaint among cyclists is numbness in the feet, indicative of the diminished sensory function of the plantar nerves [1]. Numbness due to cycling is thought to result from nerve compression from applying pressure on pedals, and/or issues with vascular circulation [2,3]. Under loading, the plantar nerves help detect changes in body movement and external factors, therefore uninhibited sensory feedback is essential for efficient cycling [3]. However, it is unclear how cycling-induced numbness may affect biomechanics, motor control, and injury mechanisms during endurance cycling.

Semmes Weinstein (SW) monofilaments can help quantify plantar sensitivity [4]. Ultrasound, spectroscopy, and electromyography (EMG) can be used to examine changes in muscle swelling, oxygenation, and activation. Sex differences will also be examined since females are known to be more affected by both sensation loss and cycling injuries; however, whether these mechanisms are inter-related, and in a sex-specific way, is unclear [5].

Methods

28 cyclists (n=14 females) between the ages of 18 and 40 years are recruited to complete a fatiguing task on their personal bike attached to a bike trainer (Wahoo Kickr Core Zwift One, Wahoo Fitness, Atlanta, USA). EMG electrodes (Trigno, Delsys, Natick, USA) will be placed on the vastus medialis and lateralis, gastrocnemius, and semitendinosus, bilaterally. A near infrared spectroscopy probe (OxiplexTS, ISS, Champaign, USA) will be placed on the tibialis anterior muscle of the dominant leg. The bike task will consist of two 20-minute sections, the first at a moderate pace determined by a 10-12 rating on the Borg 6-20 scale, the second an all-out effort with a goal of averaging the highest watts possible during the 20 minutes. SW monofilaments (Fabrication Enterprises Inc., White Planes, USA) will be applied on the plantar surface of both feet before the task starts, and after each section [6]. Foot tissue thickness over the metatarsal heads will also be collected before and after the task using ultrasound (Logiq S7, GE©, Chicago, USA). EMG, SW monofilaments, ultrasound, and oxygenation data will be analyzed with a two-way ANOVA for time and sex.

Results and Discussion

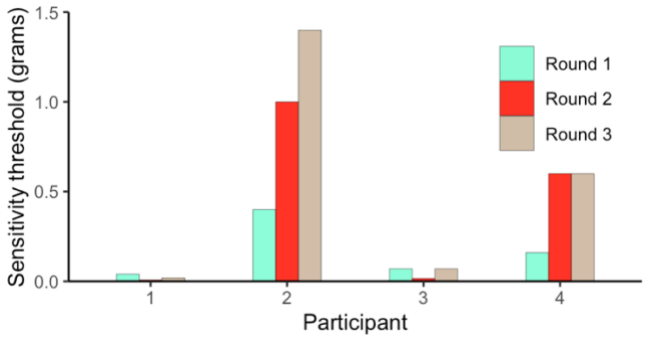

Figure 1: Sensory threshold from SW monofilaments for each round of testing. Participant 4 is female, participants 1, 2, 3 are male.

Initial results from pilot testing (fig. 1) on four participants do not suggest significant interactions for sex*time. However, the results do show differences in sensory thresholds with time, therefore we expect with a larger sample size there will be significant sex*time interactions on sensory thresholds, as well as changes in tissue thickness, oxygenation, and EMG data.

Conclusions

Quantifying changes in plantar sensitivity and associated changes in EMG, muscle oxygenation, and swelling can aid in understanding the consequences of foot numbness on cycling. With better understanding, cycling shoe design, and biomechanical technique and fit recommendations can be adjusted, to improve cycling performance.

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