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Response to task-specific sex differences in muscle fatigue: Is there a common underlying cause?

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Response

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Dear Editor-in-Chief:

I thank Mr. Dotan and Dr. Falk for their interest and comments on my article. They propose that sex differences in muscle fatigue are due to differences in the ability of men and women to recruit and use fast-contracting, Type II motor units. It is tempting and more simplistic to suggest one global mechanism to explain the difference in muscle fatigue between men and women for different tasks. Although men may have a larger proportional area of fast twitch fibers in their muscle than women for some muscles (see my previous article), the available evidence suggests that there is little sex difference in motor unit recruitment and rate coding during maximal and submaximal contractions in the absence of fatigue and also during an isometric fatiguing contraction.

Unlike children ([7]), for example, adult men and women have a similar ability to activate their available motor units during maximal strength contractions before a fatiguing task for various muscle groups within the upper and lower limbs ([1,3,5,8]). This is demonstrated with experiments that have quantified voluntary activation using a combination of stimulation of the nervous system and voluntary contractions. The reduction in voluntary activation that occurs with fatigue also is similar in men and women for the elbow flexor muscles ([1,8]) but greater

for men than women for muscles in the lower limb ([3,5]). For leg muscles, but not elbow flexor muscles, the greater fatigue of the men than women is in part due to a greater loss of neural drive to the muscle for the men. Thus, men seem more limited in their ability to recruit fast-contracting motor units with fatigue for some muscles compared with women.

Furthermore, single motor unit experiments that are used to quantify motor unit recruitment and rate coding also show no systematic sex differences that would explain the difference in muscle fatigue between men and women ([4,6]). For example, motor unit behavior of biceps brachii was examined during submaximal isometric contractions of the elbow flexor muscles sustained until failure in men and women ([4]). Although the women had a longer time to task failure than the men, the mean motor unit recruitment threshold, mean discharge rate, and the decline in discharge rate during the fatiguing contractions were similar for the men and women ([4]). In support of these findings, the transient recruitment of motor units that typically increases during a fatiguing contraction (and quantified as the bursting activity of the interference electromyography signal) shows no systematic sex difference in the increase during an isometric fatiguing contraction ([2]).

Collectively, these studies provide initial evidence that the sex difference in muscle fatigue for various muscle groups cannot be explained by one global mechanism under the umbrella of "neuromuscular activation." Further studies to understand single motor unit behavior of men and women during maximal contractions and various other types of fatiguing tasks would, however, complement the limited number of studies on isometric contractions that are highlighted.

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