SEX-DIFFERENCES IN MVC/CSA RATIO AND EMG ACTIVITY OF NECK MUSCLES DURING A SUSTAINED MAXIMAL ISOMETRIC CONTRACTION

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INTRODUCTION

Studies on muscle fatigue have shown that females exhibit greater fatigue resistance than males, most likely related to differences in muscle morphology, neuromuscular activation or substrate utilization [1,2]. The few studies available on submaximal neck muscle fatigue sustained this asumption but they did not explore neural activation patterns during fatigue or morphometric variations across gender [3,4].
Therefore, the aim of this study was to examine the sex-differences in MVC/CSA ratio and EMG activity of neck muscles during a sustained maximal isometric contraction.

METHODS

18 young healthy subjects, 8 females (F) and 10 males (M), performed a 15-s sustained maximal isometric neck flexion contraction on a specific ergometer. Force and surface EMG activity of sternocleidomastoid (SCM) and cervical paraspinal (PARA) muscles were recorded. The initial values and change of the average EMG (AEMG) and mean power frequency (MPF) were estimated over 0.5 s epoch. AEMG was normalized with values recorded during MVC before the test. Force and MPF shift was normalized with respect to initial value of the test. Linear regression was used to estimate the changes in variables with fatigue. Cross-sectional area (CSA) of muscles was estimated with MRI from C2 to C7 for MVC/CSA ratio calculation (figure 1).

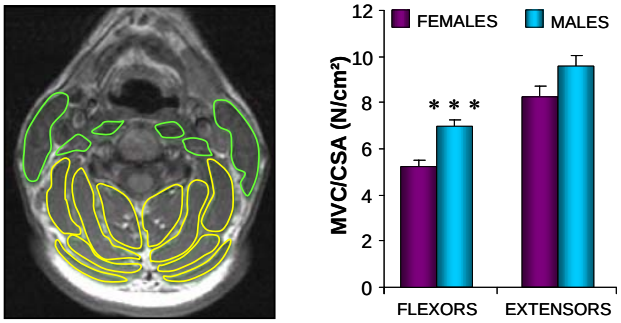

Figure 1: typical CSA of flexors (green) and extensors (yellow) at C4 level (left) and MVC/CSA ratio in males and females (right). Mean±SE, *** P<0.001.

RESULTS AND DISCUSSION

Males were stronger than females in terms of absolute MVC (P<0.01). Force at the beginning of the fatigue test was comparable with the MVC (90±2% MVC). Change in force (%init) with fatigue was similar among gender (-32±4%). MVC/CSA for neck flexors was 25% lower in F vs. M (P<0.001) but the extensors (-14%, P>0.05, figure 1). Normalized AEMG of SCM tended to increase through fatigue for F but quite constant for M (figure 2) although the difference was not significant due to a high inter-individual variability. In addition, MPF shift of both SCM and PARA muscles during fatigue was steeper for M vs. F (Figure 2).

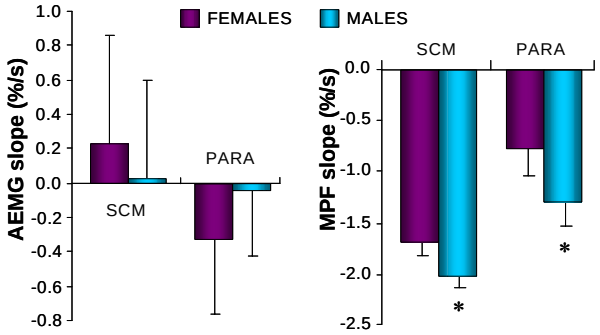

Figure 2: Changes in AEMG (%MVC) (left) and MPF (%init) (right) in males and females during 15-s sustained test. Mean±SE, * P<0.05, F>M for a given muscle.

Contrary to previous reports on other muscles groups [2], F were not more resistant to fatigue than M during a 15s-maximal sustained neck flexion. However, it has been stated that the likely sex-difference in fatigue is attenuated as the contraction level increases [1]. Therefore, in our study neck fatigability was not dependant upon absolute strength. The mechanical fatigue observed was not explained by the MPF shift of SCM that was lower in F, suggesting that this superficial muscle exhibited less peripheral fatigue in F vs. M likely related to a lower % of fast twitch in female [5]. Thus, neck flexors may have contributed differently to the net torque depending to gender. Alternatively, there was a trend to a sex-difference in pattern of neural recruitment of SCM muscles with fatigue, F exhibiting an increase in AEMG activity of this superficial muscle in contrast to M who displayed no change (figure 2). In addition, the MVC/CSA ratio was lower in F vs. M for flexion only (figure 1). sex differences in specific tension are equivocal among studies [6]. Our findings suggest that gender difference in MVC/CSA may be muscle-dependant. Collectively, these findings may indicate that F were unable to maximally recruit their neck flexors during a sustained maximal contraction. Future studies should examine other muscle activities during fatigue and calculate their lever arm for a better estimation of the specific tension.

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