The Effects of Hunger on Muscle Fatigue

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INTRODUCTION

Omitting food consumption creates feeling of fatigue and weakness. A lack of food consumption is closely linked to muscle fatigue and weakness and can lead to low blood sugar levels (hypoglycemia) and fatigue (Karlan and Cohn, 1946). Electromyography (EMG) is commonly used in measuring muscle activity (Kallenberg *et al.,* 2007). Fatigue affects muscle activity (Kallenberg *et al.,* 2007) by increasing amplitude and decreasing number of spikes in EMG recordings. Nevertheless, short-term hunger effects on muscle activity and sex difference have not been examined. The present study examined the relationship between muscle fatigue and hunger using EMG recordings. In addition, sex and age differences in muscle fatigue were compared during hunger versus non-hunger state. Females have shown a difference in exercise performance, female skeletal muscle is more resistant to fatigue elicited by equivalent dosages of high-intensity exercise (Ansdell et al., 2020).

Hypothesis 1: Muscle activity would decrease during a short-term hunger state, compared to non-hunger state, with a greater decrease during fatigue.

Hypothesis 2: Females will show a greater decrease in muscle activity during states of hunger and fatigue, compared to males.

Hypothesis 3: Age will affect muscle activity during states of hunger and fatigue.

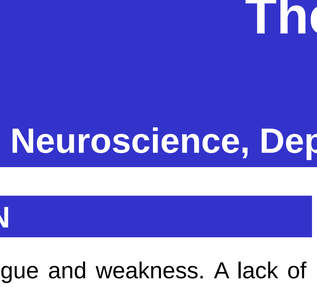
METHODS

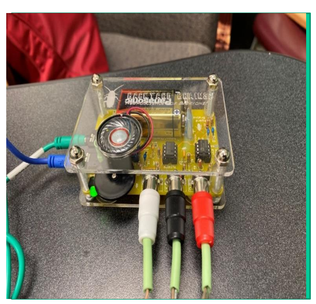
Subject. A total of 16 volunteers (6 males; 6 females), age 21-69, participated in the study.

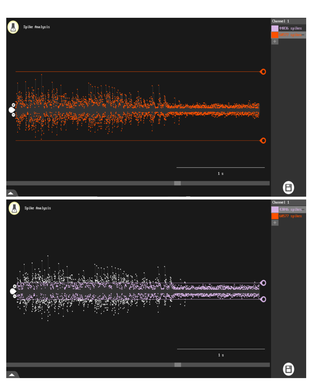
Isokinetic Exercise Task. Flexion-extension at the elbow with a 10lb dumbbell weight. Each subject will perform the task for 1 minute before and after food consumption.

Short-term Hunger State. Hunger state is defined as 4 to 6 hours (short-term) without eating food. Non-hunger state: within 30 minutes after food consumption

Hunger state: skipping meals decreases blood-sugar levels, causing fatigue, irritability, and faulty concentration (Witherby, 2012)







EMG recording

Recording done before and after task. EMG recordings from the bicep brachii of the subject's dominant hand were done using surface electrodes. The subjects flexed the arm and hold of a ten-pound dumbbell for 10 seconds. Then, subjects unflexed their arm for 10 seconds and repeat the same step. EMG recordings were done before flexing (1 min; non-fatigue or baseline) and after flexing (1 min; fatigue). Fatigue state was determined when subjects felt fatigue and weakness in their bicep and could no longer flex the dumbbell.

Data analysis

The Spike Recorder program (Backyard Brain) was used to count the number of spikes offline, with data files recorded during experiment. To quantify EMG signal, two threshold bars were set to detect the spikes above the threshold. The number of spike during baseline was compared under four experimental conditions.

RESULTS

1. Short-Term Hunger Effects on Muscle Activity

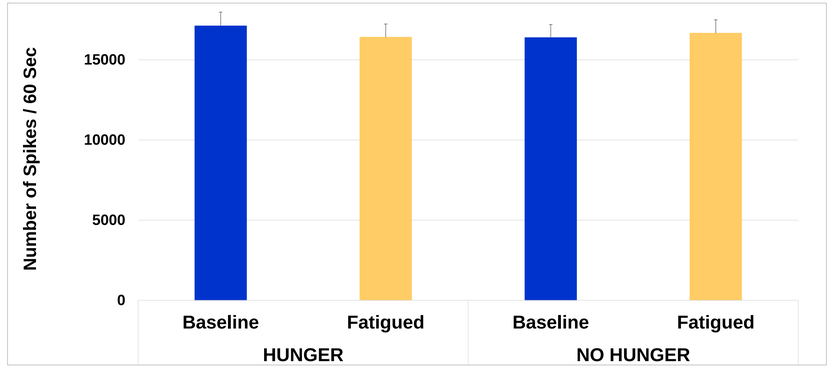


Figure 1. The effects hunger on muscle activity. Overall, there was no significant difference in muscle activity between hunger state and non-hunger state. There was a non-significant decrease in muscle activity when fatigued during hunger state.

2. Sex Differences in Muscle Activity

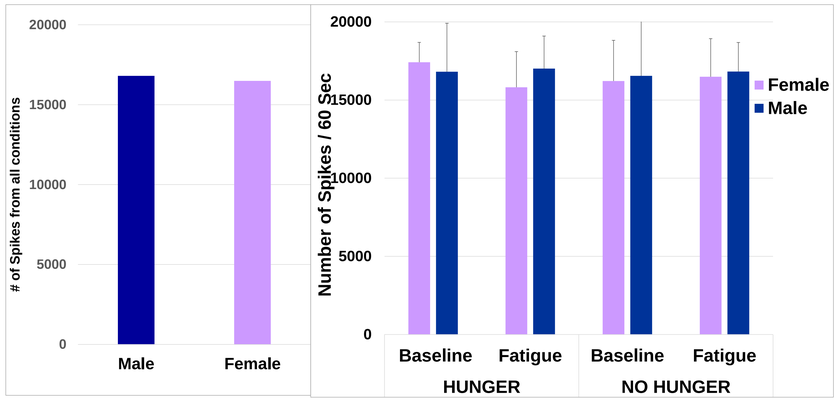


Figure 2. Sex difference in muscle activity. Overall, there was no sex differences in muscle activity (Left). Similarly, males and females showed comparable muscle activity during hunger and non-hunger state in the non hunger condition. Females showed a slight decrease in muscle activity when fatigued during hunger state.

3. Age Differences in Muscle Activity

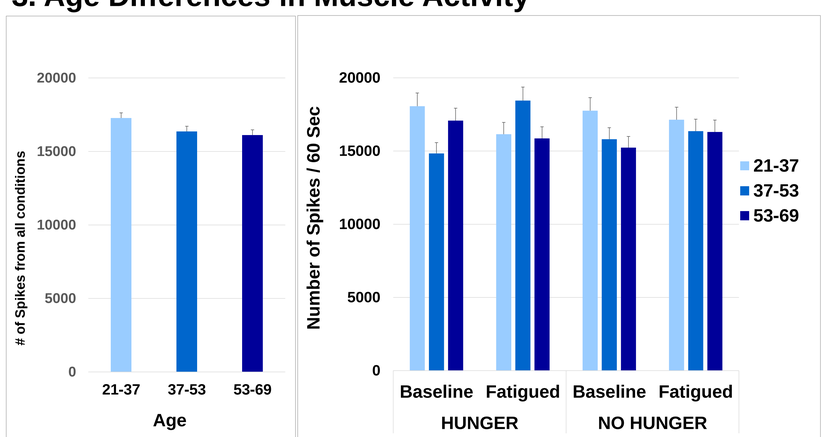


Figure 3. Age differences in muscle activity. Overall, muscle activity decreased as a function of age, with a greater decrease in older subjects (Left). Such decrease in muscle activity in older subjects were greater when fatigued during hunger state.

SUMMARY AND CONCLUSION

Overall, no significant difference in muscle activity was shown between a hunger state and a non-hunger state. During a short-term hunger state, there was a non-significant trend with decreased muscle activity, particularly during a fatigue state.

Similarly, there was no sex difference in overall muscle activity. During a hunger state females showed slight decreased muscle activity, particularly when fatigued.

Overall, muscle activity decreased as a function of age, with a greater decrease in oldest group. Such decrease in muscle activity was greater when fatigued during a hunger state.

The present findings suggest that a longer-term hunger state will produce a greater decrease in muscle activity, leading to greater fatigue and weakness. Omitting food consumption will affect muscle activity of females and older people more, leading to suboptimal motor activity.

Future Direction

- Effects of a long-term hunger state on muscle activity
- Increase in subjects in all age groups

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