Effect of Diet and Exercise on Skeletal Muscle Morphology Following Radiation Exposure

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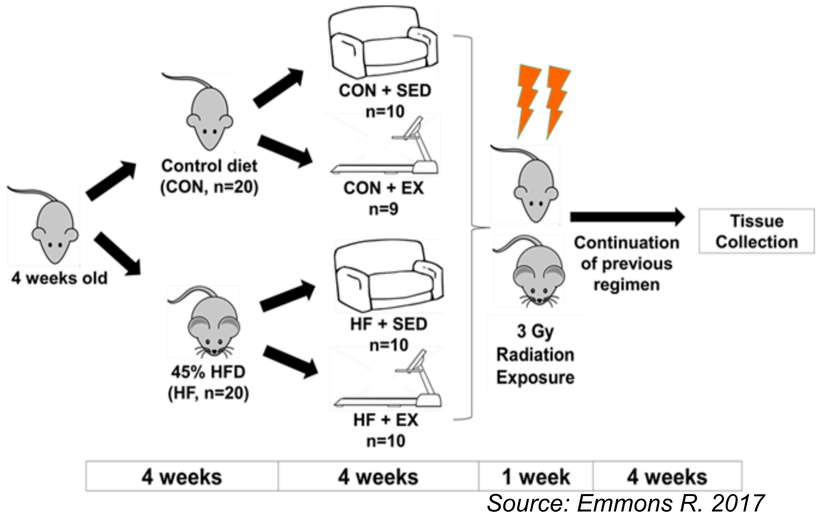
Introduction

- Radiation therapy is commonly used during cancer treatment, yet the long-term effects on health remain a clinical concern.
- Late effects are particularly harmful in skeletal muscle as muscle wasting and fibrosis induced by radiation exposure could decrease strength, metabolic function, and overall quality of life.
- Two physiological factors of health that are common in cancer survivors and influence skeletal muscle morphology are obesity and physical inactivity.
- It remains unknown; however, if obesity exacerbates the late effects of radiation exposure on skeletal muscle, and if exercise training is an effective strategy for improving these effects.

Purpose: To investigate the influence of a high fat diet-induced obesity and exercise on skeletal muscle morphology following radiation therapy using a preclinical model.

Hypothesis: We hypothesized that exercise will increase muscle cross-sectional area and number of myonuclei per myofibre.

Methods



Source: Emmons R. 2017

Figure 1. Mice were randomized into: control diet + sedentary (CS), control diet + exercise (CEx), high fat diet + sedentary (HFS), and high fat diet + exercise (HFEx). All mice were exposed to a high dose of radiation (3 Gy) at 13 weeks of age.

Following Tissue Collection:

- Immunofluorescence staining of the basal lamina (Laminin) and nuclei (DAPI) was completed to determine changes to muscle cross-sectional area (CSA).
- ImageJ was used to manually circle and quantify the area of at least 150 myofibres per muscle section.
- Myonuclei were counted within the circled myofibres.

Results

CSA was greater following exercise training for both control and high fat groups ($p<0.05$) with the largest increase observed in the combined HFEx ($p<0.05$). Myonuclei/fibre was higher in the HFEx group compared to HFS and CEx ($p<0.05$).

Muscle Morphology

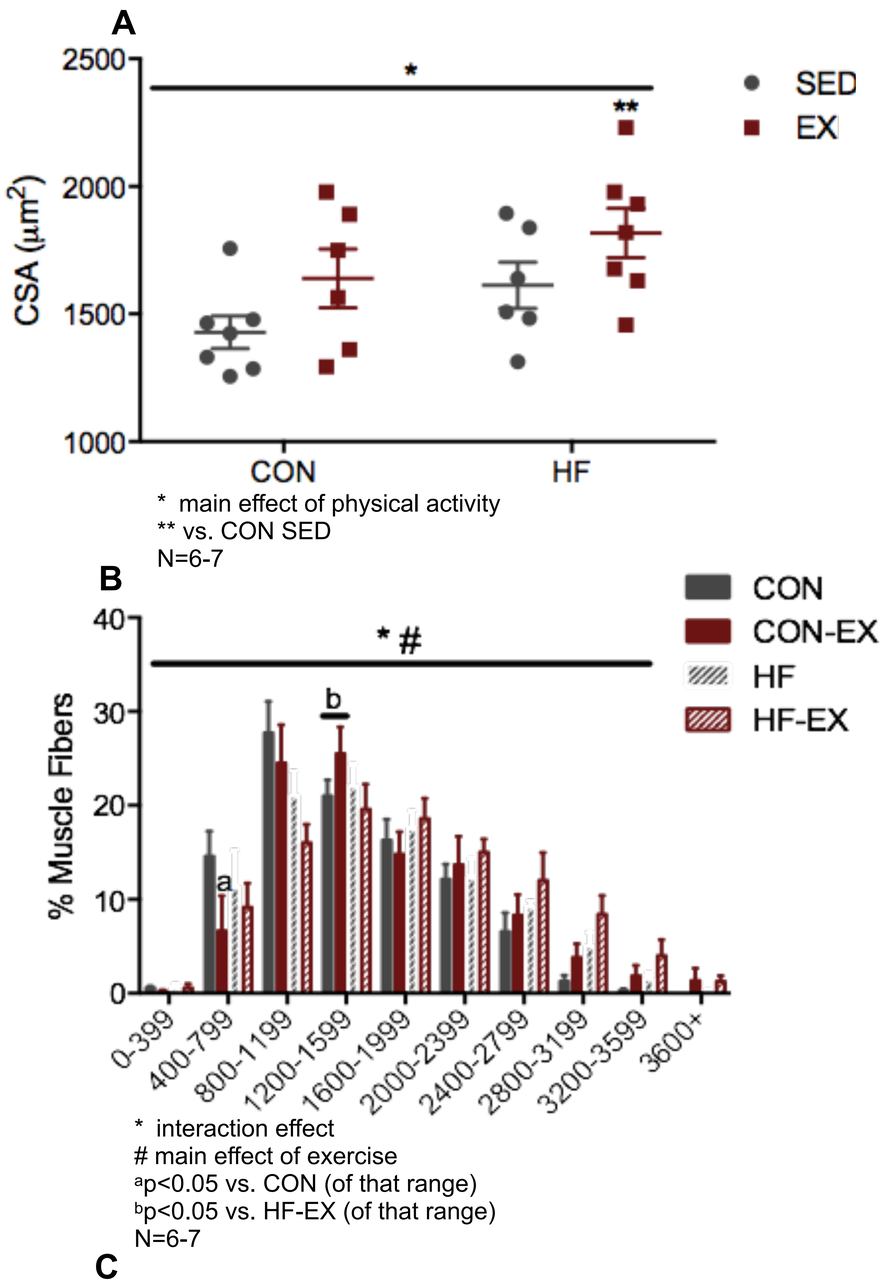


Figure 2. Muscle morphology for CS, CEx, HFS, and HFEx, where A) represents the average CSA measured in μm², B) represents % of muscle fibres distributed across size intervals and C) represents myonuclei per fibre.

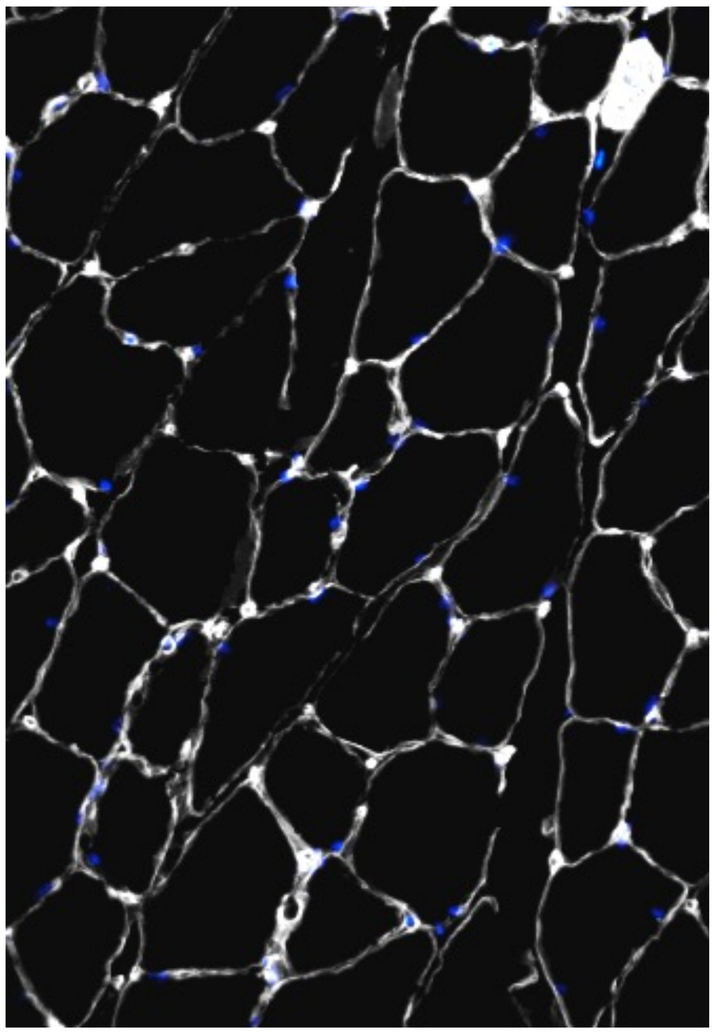


Figure 3. Immunofluorescence staining of the basal lamina (white) and nuclei (blue).

Conclusions

In summary, following radiation therapy we found that exercise influenced muscle morphology by increasing CSA and myonuclei/fibre, particularly in high fat fed mice. Based on these data, further studies will evaluate changes to key populations of muscle stem cells that affect muscle morphology, to further elucidate the mechanisms responsible for the effects of obesity and exercise on muscle morphology following radiation therapy.

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