Circulating myostatin is reduced with ageing in humans but not altered by short-term, high intensity training

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Introduction

The aging process involves a loss of muscle strength, quality and mass, and a general increase in frailty. Losses occurs at a predictable rate from ~30 years of age[1]. Whilst aging and muscle loss is intrinsic to the human condition, excessive loss of muscle mass (sarcopenia) affects 5 – 13 % of people 60 – 70 years of age and up to 50 % of those > 80 years of age, greatly decreasing quality of life and increasing mortality[2]. Chronic exercisers show successful aging, i.e. a maintenance of physical function [3].

In both healthy individuals and chronic disease states, muscle mass is controlled by the peptide hormone myostatin[4]. Disagreement exists in the literature as to the role of myostatin in aging and frailty[5,6].

We aimed to explore the role of myostatin in aging, hypothesising a) myostatin would be increased with age, and b) lifelong exercisers would show reduced myostatin relative to non-exercisers. Here we present preliminary results of this investigation.

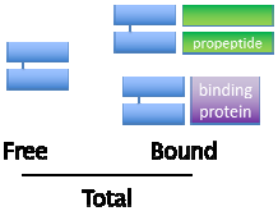


Figure 1: Myostatin is found in plasma as a bioactive peptide (free) or inactive (bound), attached to several binding proteins.

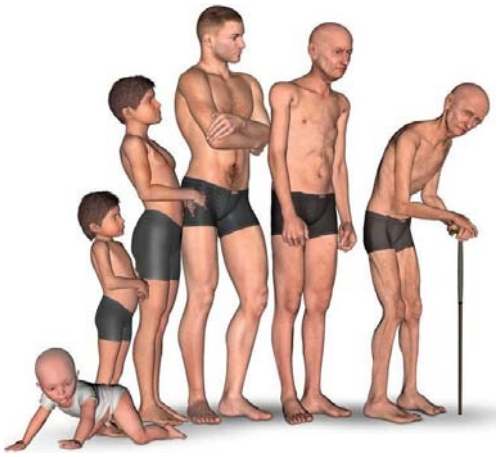
Methods

Experiment 1 – Healthy participants (n = 83, 18 – 75 years; 36 male) were recruited. After an overnight fast, resting metabolic rate, resting heart rate and blood pressure, fat free mass (BodPod), anthropometry, grip strength and six minute walk time was recorded.

Experiment 2 – Sedentary ([SED]; n=14; 64±6 years) and lifelong exercisers ([LEX]; n=10, 61±6 years) completed 6 weeks of high intensity interval training (HIIT), with venous serum collected pre- and post-training.

Circulating total myostatin, free myostatin, and follistatin-related gene (FLRG) were quantified by ELISA.

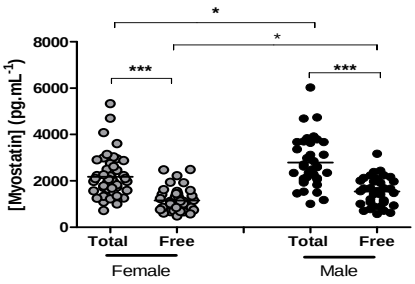
For both experiment 1 and 2, here we present preliminary results, with data analysis ongoing.



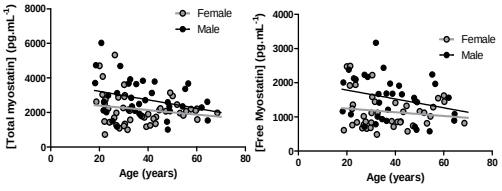
Results

Experiment 1

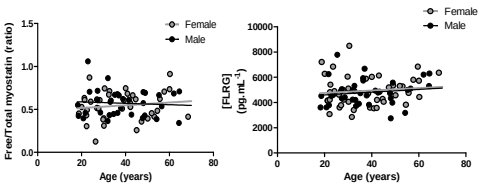
Total & free plasma myostatin was lower in females than in males (total p = 0.027), free p = 0.015). An effect of gender is removed if myostatin concentration is normalised to fat free mass.



Total myostatin decreases with age, independent of gender (p = 0.046). Free myostatin does not (p = 0.134).



Total / free myostatin ratio and FLRG concentration show no gender difference or relationship to age.



Stepwise regression indicated age was best predicted by systolic blood pressure, resting metabolic rate and total myostatin (r^2 = 0.362, p = 0.015), and not improved by the addition of any other measures (table 1).

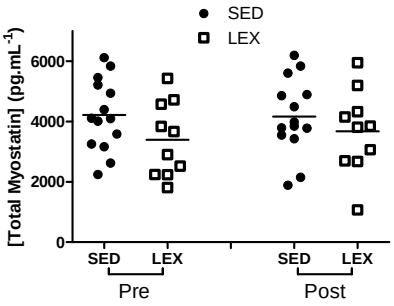
Table 1: Unforced stepwise regression for age.

Order	Variable	R^2	p value
1	Systolic blood pressure	0.204	< 0.001
2	... + Resting metabolic rate	0.296	0.012
3	... + Total myostatin	0.362	0.015

No additional predictive efficacy – Blood pressure (diastolic), resting heart rate, height, weight, body mass index, lean mass (%), lean mass (kg) fat free mass index, thigh diameter, thigh subcutaneous fat thickness, grip strength (dominant hand) six minute walk time, FLRG (pg.mL^{-1}), free myostatin (pg.mL^{-1}).

Experiment 2

No group (SED, LEX) × time (pre, post) interaction on serum total myostatin concentration (p = 0.649), nor a main effect of time (p = 0.757) was noted. The main effect of group (SED vs LEX) on total myostatin was p = 0.083.



Discussion

Here we show three key results;

1) Decreased total myostatin peptide in healthy individuals as age increases.
2) Total myostatin aids prediction of chronical age.
3) Acute HIIT training does not alter total myostatin in older individuals.

A counterintuitive decrease in total & free myostatin is seen as individuals age. Total myostatin may better reflect muscle mass; the addition of other variables (FLRG, free myostatin) do not contribute towards a prediction of age.

No effect of an acute HIIT protocol was seen on either group. Previous reports[7] have demonstrated resistance training reduces plasma myostatin in young individuals. Either the HITT protocol is not optimal for alterations in myostatin & thus muscle mass, or the age of participants is key. We are currently completing 3 year follow up data on the SED and LEX individuals to establish longitudinal changes in this cohort.

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