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Heat Shock Proteins in human single skeletal muscle fibres resist age associated alterations and differentially respond to high-intensity exercise training

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Objective Heat shock proteins (HSPs) are ubiquitously expressed proteins that help preserve cellular homeostasis. Within mammalian skeletal muscle three of the better characterised HSPs are HSP72, HSP27 and αB-crystallin. Among other roles, these three HSPs are involved in regulation of muscle mass and function and may be of importance in ageing. HSP's are fibre-type dependent in rat skeletal muscle and thus examining these proteins in humans should be completed on the single fibre level, particularly in ageing where maladaptations primarily occur in Type II fibres. High-Intensity Training (HIT) is a commonly used method to improve muscle health and function in the elderly, but HSP adaptability to training has not yet been investigated.
Methods This study examined isolated single muscle fibre segments collected from freeze-dried vastus lateralis muscle samples from young (25 ⍰/- 3 year old) and older (70 ⍰/- 4 year old) healthy individuals. A further sample was collected from the older individuals following 12 weeks of HIT, where they performed 4 x 4 min @ ~90-95% of peak heart rate (HR), with 4 min active recovery at 50-60% peak HR
Results Basal expression of HSP's in skeletal muscle: HSP70 tended to be higher in Type I fibres compared to Type II in young adults (p=0.08) and was higher in Type I compared to Type II fibres of older adults (p=0.03). HSP27 abundance was higher in Type I fibres compared to Type II in young adults (p=0.01) and tended to be higher in Type I compared to Type II fibres in older adults (p=0.07). The abundance of αβ-crystallin was more abundant in Type I fibres compared to Type II in both young and older adults (p<0.05). Preliminary data revealed that the abundance of pABCser59 and pHSP2782 displayed no fibre-type specific abundances in either young or older adults.
Age effects on HSP's: There was no difference in the abundance of HSP70, HSP27, ABC or pHSP2782 between young and older adults in either Type I or Type II fibres. There was an increase in the abundance of pABCser59 in Type I fibres in older adults compared to Type I fibres of young adults (p=0.03), with no difference in Type II fibres.
Effects of HIT on HSP's: HIT in the older individuals increased the abundance of HSP70 in Type I fibres (p<0.01) but not Type II. HIT tended to decrease the abundance of HSP27 in Type I fibres (0.92±0.66, p=0.06) and tended to increase the abundance of αβ-crystallin in Type I fibres (1.03±1.51 p=0.07).
Conclusions These results revealed that in healthy, older individuals, the basal levels of HSP27, ABC or pHSP2782 are not different to those in young adults in either Type I or Type II fibres. This could indicate that the muscle from the older individuals was not compromised. Interestingly, in response to HIT there were varying changes between these HSP's, and of note these occurred only in Type I fibres. Given that during HIT Type II fibres would be activated to a greater extent, it appears that the recovery phases of the HIT were most responsive to HSPs.