



## Exercise Biochemistry Review

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### Endurance training, muscle fibre type composition and the maximal capacity for fat oxidation

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**Objective** A greater capacity for fat oxidation in endurance trained athletes is linked to greater utilisation of intramuscular lipid (IMCL). IMCL breakdown occurs only in type I muscle fibres yet little is known about the fibre type specific abundance of lipid regulatory proteins. We explored the impact of endurance training on the maximal rate fat oxidation, muscle fibre type and muscle fibre type specific abundance of proteins regulating IMCL metabolism.

**Methods** Endurance trained ( $n=7$ ,  $28 \pm 3$  years,  $VO_{2max}$   $62.6 \pm 1.6$  ml·min<sup>-1</sup>·kg<sup>-1</sup>) and untrained ( $n=8$ ,  $25 \pm 1$  years,  $VO_{2max}$   $44.9 \pm 1.9$  ml·min<sup>-1</sup>·kg<sup>-1</sup>) males performed an incremental exercise test to determine maximal fat oxidation rate. Muscle fibre type composition and fibre type-specific IMCL content was assessed with immunofluorescence microscopy and protein abundance was analysed with immunoblotting on pooled single muscle fibres and whole muscle.

**Results** Endurance trained individuals displayed a higher peak fat oxidation rate ( $0.49 \pm 0.05$  vs.  $0.20 \pm 0.03$  g·min<sup>-1</sup>,  $P < 0.05$ ), which correlated with type I fibre percentage ( $R = 0.83$ ,  $P < 0.01$ ) and  $VO_{2max}$  ( $R = 0.78$ ,  $P < 0.01$ ). Type I muscle fibres from endurance trained individuals had a greater abundance of ATGL. In whole muscle, the endurance trained group had greater abundance of PLIN2, PLIN5 and ATGL compared to the untrained group ( $P < 0.05$ ). Furthermore, autophagy flux measured as LC3-II/I ratio was higher in type I muscle fibres and LC3-II/I, lysosomal markers (LAMP2) and chaperone-mediated autophagy markers (LAMP2A) were all higher in whole muscle of endurance trained individuals ( $P < 0.05$ ).

**Conclusions** These results demonstrate that the maximal rate of fat oxidation is related to the proportion of type I muscle fibres. Furthermore, IMCL storage and the abundance of key proteins regulating lipid metabolism is fibre type specific and greater in endurance trained individuals. Muscle fibre type composition should be considered when investigating the regulation of IMCL utilisation and markers of autophagy.