A single resistance exercise session reduces skeletal muscle lipid and glycogen content in healthy males

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Introduction
Resistance training is an effective tool to increase skeletal muscle mass, which improves glucose disposal capacity on a whole-body level. In addition, resistance training also improves muscle strength, power and functional capacity, which helps to adopt a more active healthy lifestyle. Recently, we have shown that even a single resistance exercise session can substantially improve whole-body insulin sensitivity for up to 24 h after cessation of exercise. Although the exact mechanism for these short-term effects of resistance exercise on skeletal muscle insulin sensitivity remain to be resolved, they are unlikely to be any different from the reported effects of endurance exercise on skeletal muscle insulin sensitivity. As such, substrate use and more specifically the depletion of intramyocellular lipid and glycogen stores are likely to play a key role in the process. However, the metabolic demands of resistance exercise on skeletal muscle substrate stores have not been studied extensively. Therefore, in the present study, we investigated the net changes in skeletal muscle substrate content before and after a single resistance exercise session.

Methods
Eight healthy male volunteers (age: 22±1 y, BMI: 23.3±0.7 kg.m⁻², 1RM leg press: 198±7 kg, 1RM leg extension 105±3 kg) performed a ~40 min resistance exercise session, mainly consisting of 16 sets of leg-exercise using 75% of the individual 1RM. Before and immediately after exercise, as well as after 30 min and 2 h of post exercise recovery, muscle biopsies were collected from the m. vastus lateralis. Serial muscle cross-sections (5µm) were stained to quantify muscle fibre type specific lipid and glycogen content using optimised oil red O and PAS staining procedures. All sections were examined using a NIKON E800 fluorescence microscope coupled to a Basler A101C progressive scan colour CCD camera. Digitally captured images were processed and analysed using LUCIA G/F 4.81 software.

Results
Following the resistance exercise session, intramyocellular glycogen content had declined 23±6 % in the type I fibres, 40±7 % in the type IIA fibres, and 44±7 % in the type IIB fibres compared to pre-exercise values (P<0.01; Fig 1A). Intramyocellular glycogen content decreased to a greater extent in the type IIB fibres compared to the type I muscle fibres (P<0.05). No significant changes in glycogen content were observed over time in the type I, IIA and IIB muscle fibres during post-exercise recovery. Muscle tissue analysis for intramyocellular lipid content, using fluorescence microscopy on oil red O stained muscle cross-sections, showed a substantial ~30 % net decline in muscle fibre lipid content in the type I fibres (P<0.05), with IMTG content in the type I muscle fibres being significantly lower both immediately post-exercise as well as following 30 min of post-exercise recovery compared to pre-exercise values (Fig 1B). After 2 h of post-exercise recovery, IMTG content had returned to values similar to pre-exercise values. No significant changes were observed in intramyocellular lipid content in the type IIA or IIB muscle fibres.

Discussion/Conclusion
We conclude that intramyocellular lipid and glycogen represent important substrate sources that are used during resistance exercise. A single resistance exercise session leads to a substantial reduction in muscle glycogen content in type I, IIA and IIB fibres, whereas intramyocellular lipid content is substantially reduced in the type I fibres only.

References