

# 1.5T and 7T MR Spectroscopy of Tissue Specific Changes in Ectopic Fat Content in Response to Exercise Training in Type 2 Diabetes Mellitus Patients: The ATLAS-study

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## Introduction

Ectopic fat accumulation is common in type 2 diabetes and is associated with insulin resistance, lipid abnormalities and increased risk for cardiovascular disease. Ectopic fat deposition occurs in the heart, liver and skeletal muscle (1,2). Lifestyle changes are a pillar of therapy. Although changes in diet have beneficial effects on ectopic fat accumulation, this is less clear for effects of exercise training. It is also unclear how ectopic fat deposits in different organs relate to each other at baseline and during the exercise program.



## Purpose

To assess the effects of a 7-month exercise program on ectopic fat accumulation in heart, liver and skeletal muscle measured by <sup>1</sup>H-MRS at 1.5T and 7T.

## Methods

We included 12 patients with type 2 diabetes mellitus. The training program consisted of 7 months of cardio training and ended with climbing the Toubkal mountain (the highest peak in the Atlas Mountains). Before training and again after climbing the mountain, patients were studied. Myocardial and hepatic triglyceride content (TG) were measured <sup>1</sup>H-MRS at an 1.5 Tesla scanner (Philips Healthcare, Best, the Netherlands). Skeletal muscle spectroscopy measurements were performed on a 7T whole-body MRI system (Philips Healthcare, Best, the Netherlands) using a custom-built partial volume coil and volume selective power optimization (3). Localized <sup>1</sup>H-MRS was performed in the left tibialis anterior muscle after imaging based shimming (STEAM, TR=3s, TE=22 ms, TM=28ms, voxel 10x10x10 mm). Ratios of intramyocellular lipids (IMCL) with respect to creatine were determined from the (CH<sub>2</sub>) signals of IMCL at 1.3, and the sum of the triplet creatine signal at 3.0 ppm.

## Results

A 7-month exercise program in patients with type 2 diabetes mellitus, significantly reduced hepatic TG content from 6.8±2.3% (mean±SEM) to 4.6±1.6% (P<0.01). Myocardial TG content did not change during training (0.61±0.13% to 0.60±0.13%, P>0.05). Skeletal muscle IMCL/creatine ratio was 3.17±0.67 (mean±SEM) at baseline and 4.11±0.76 (p>0.05) at follow up.

## Conclusion

A 7 month exercise intervention in patients with type 2 diabetes mellitus decreases hepatic TG content. Myocardial and myocellular lipid content remained unchanged. Therefore, exercise intervention in patients with type 2 diabetes mellitus induces tissue-specific changes in ectopic fat distribution.

## References

1. Rijzewijk et al. JACC 2010.
2. Boesch et al. NMR Biomed 2006.
3. Versluis et al. MRM 2010.

