Exercise training favors increased insulin-stimulated glucose uptake in skeletal muscle in contrast to adipose tissue: a randomized study using FDG PET imaging

Physical exercise increases peripheral insulin sensitivity, but regional differences are poorly elucidated in humans. We investigated the effect of aerobic exercise training on insulin-stimulated glucose uptake in five individual femoral muscle groups and four different adipose tissue regions, using dynamic (femoral region) and static (abdominal region) 2-deoxy-2-[18F]fluoro-d-glucose (FDG) PET/CT methodology during steady-state insulin infusion (40 mU·m−2·min−1). Body composition was measured by dual X-ray absorptiometry and MRI. Sixty-one healthy, sedentary (VO2max 36(5) ml·kg−1·min−1; mean(SD), moderately overweight (BMI 28.1(1.8) kg/m2), young (age: 30(6) yr) men were randomized to sedentary living (CON; n = 17 completers) or moderate (MOD; 300 kcal/day, n = 18) or high (HIGH; 600 kcal/day, n = 18) dose physical exercise for 11 wk. At baseline, insulin-stimulated glucose uptake was highest in femoral skeletal muscle followed by intraperitoneal visceral adipose tissue (VAT), retroperitoneal VAT, abdominal (anterior + posterior) subcutaneous adipose tissue (SAT), and femoral SAT (P <0.0001 between tissues). Metabolic rate of glucose increased similarly (~30%) in the two exercise groups in femoral skeletal muscle (MOD 24[9, 39] μmol·kg−1·min−1, P = 0.004; HIGH 22[9, 35] μmol·kg−1·min−1, P = 0.003) (mean[95% CI]) and in five individual femoral muscle groups but not in femoral SAT. Standardized uptake value of FDG decreased ~24% in anterior abdominal SAT and ~20% in posterior abdominal SAT compared with CON but not in either intra- or retroperitoneal VAT. Total adipose tissue mass decreased in both exercise groups, and the decrease was distributed equally among subcutaneous and intra-abdominal depots. In conclusion, aerobic exercise training increases insulin-stimulated glucose uptake in skeletal muscle but not in adipose tissue, which demonstrates some interregional differences.

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