

Nutritional Factors in Skeletal Muscle Insulin Resistance Development

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Abstract

Background. Diet composition ranks among etiological factors of insulin resistance (IR) and diabetes. Vegans, people consuming exclusively plant-based diet, have significantly lower prevalence of IR and thus represent a suitable model population for study of nutritional factors on IR development. Branched chain amino acids (BCAA) ranks among these factors.

Aims and hypothesis. Aim of the observational study was to prove that vegans have better glucoregulatory functions and thus to validate “vegan vs. omnivore” model. Aim of the consecutive interventional study was to prove in this model that dietary intervention with BCAA leads to a group specific changes in the insulin function measures.

Methods. 11 vegans and 10 omnivorous controls were recruited in the observational study. Hyperinsulinemic euglycemic clamp (HEC) and muscle (SM) biopsies (amount of intramyocellular lipids (IMCL), mtDNA and the activity of citrate synthase (CS)) were performed. 8 vegans and 8 omnivores were consequently subjected to the intervention with 15 or 20 g of BCAA respectively. The examination was performed at the baseline, after the intervention and after 6 months wash-out period: anthropometry, HEC, arginine test, SM biopsy (CS, activity of respiratory chain complexes, gene expression) and fat (AT) biopsy (gene expression) were performed.

Results. We proved in the observational study that vegans have higher glucose disposal in HEC (M-value vegan 8.11 ± 1.51 vs. omnivores 6.31 ± 1.57 mg.kg⁻¹.min⁻¹, $p = 0.014$). IMCL content as well as mtDNA and CS did not differ. In vegans the intervention resulted in a deterioration in the glucose disposal, that normalized after the wash-out period (M value: baseline 9.63 vs intervention 7.99 vs. washout 9.64 mg.kg⁻¹.min⁻¹, $p < 0.05$). In the omnivores this effect was not observed but we observed an increase in the expression of lipogenic genes (DGAT-2, FASN) in AT after the intervention.

Conclusion. Vegans have higher insulin sensitivity, which does not correlate with changes at the level of SM. Supplementation with BCAA leads to a deterioration in an insulin sensitivity in vegans. In omnivores the effect was not observed, but the intervention was associated with increased lipogenic activity of AT. Therefore it can be assumed that increasing the BCAA intake over the average omnivorous intake does not have a negative impact on whole-body glucose disposal, probably due to compensatory changes in the metabolism of AT.

Key words: *insulin, insulin resistance, branched chain amino acids, vegan*