



III CONGRESSO INTERNACIONAL DE NUTROLOGIA

What is the Role of Reducing Inflammation in Improving Glucose Metabolism in Older Adults Undergoing Exercise Training? A Systematic Review and Meta-Analysis

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ABSTRACT

Chronic low-grade inflammation (“inflammageing”) contributes to insulin resistance and metabolic dysfunction in older adults. This systematic review and meta-analysis investigated whether exercise-induced reductions in inflammatory markers are associated with improvements in glucose metabolism. Controlled exercise trials reporting changes in fasting glucose, fasting insulin, and cytokines were included. Subgroup analyses compared studies that improved inflammatory markers with those that did not. Reductions in CRP were associated with greater decreases in fasting glucose and insulin. Decreases in IL-6, TNF- α , and leptin, and increases in adiponectin were significantly associated with greater reductions in fasting insulin, whereas fasting glucose showed no consistent associations with

cytokine changes. Overall, improvements in inflammatory profile were more strongly linked to insulin reductions than to glucose changes. These findings suggest that anti-inflammatory adaptations contribute to exercise-induced improvements in insulin sensitivity in older adults, although glycemic responses may involve additional mechanisms.

Ageing; Exercise training; Inflammation; Insulin resistance; Cytokines; Glucose metabolism.

BACKGROUND

Chronic low-grade inflammation in older adults (“inflammageing”) contributes to insulin resistance and metabolic dysfunction, increasing the risk of type 2 diabetes (T2D). Although exercise training reduces inflammation and improves metabolic health, the extent to which cytokine modulation mediates improvements in glucose metabolism remains unclear. To determine whether reductions in inflammatory markers are associated with improvements in fasting glucose and insulin in older adults undergoing exercise training.

METHODS

A systematic review and subgroup meta-analysis were conducted including controlled exercise trials in older adults reporting changes in fasting glucose, fasting insulin, and inflammatory markers. Databases were screened, and study selection, data extraction, and quality assessment were independently performed by two reviewers using Covidence and Excel. Studies were categorized according to whether exercise significantly improved cytokine profiles (CRP, IL-6, TNF- α , leptin, adiponectin). Subgroup meta-analyses (Q-test) were performed to compare glucose and insulin responses between studies that did and did not improve inflammatory markers.

RESULTS

Fasting glucose and insulin showed significantly greater reductions in trials reporting a decrease in CRP ($p=0.02$ and $p<0.001$, respectively). Reductions in fasting insulin were significantly greater in studies decreasing IL-6 ($p=0.04$), TNF- α ($p=0.03$), and leptin ($p=0.01$), and in those increasing adiponectin ($p<0.001$). Improvements in adiponectin and leptin appeared necessary for reductions in fasting insulin. In contrast, fasting glucose was not significantly associated with changes in IL-6, TNF- α , leptin, or adiponectin. Overall, insulin reductions were more consistently linked to improvements in inflammatory profile than glucose reductions.

CONCLUSION

Exercise-induced improvements in inflammatory profile support reductions in fasting insulin in older adults, suggesting that anti-inflammatory adaptations contribute to enhanced insulin sensitivity. However, fasting glucose changes appear independent of these cytokines. Future analyses considering diabetes status, exercise modality, and body composition changes are needed to clarify underlying mechanisms. These findings reinforce the role of systemic inflammation modulation in exercise-mediated metabolic adaptations during ageing.