



Can exercise prevent the negative metabolic effects of sleep-loss?

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Introduction: Sleep-loss is emerging as an important risk factor for the development of impaired glucose tolerance, insulin resistance and, subsequently, type 2 diabetes mellitus. While the mechanisms underlying these changes remain to be fully elucidated, one plausible mechanism is a sleep-loss induced reduction in mitochondrial function – although this remains to be verified in well-controlled laboratory studies. The possible relationship between reduced mitochondrial function and glucose tolerance also suggests exercise could be used as a strategy to counteract some of the detrimental physiological changes induced by sleep-loss.

Aims: To investigate the effect of sleep-loss, with or without exercise, on skeletal muscle mitochondrial function and glucose tolerance.

Methods: Twenty-two healthy male participants were allocated into either a control group (CON, n=6) (8 h time in bed (TIB) for 5 nights), a sleep-restricted group (SR, n=8) (4 h TIB for 5 nights), and a sleep-restricted and exercise group (SR+EX, n=8) (4 h TIB for 5 nights and 3 x high-intensity interval exercise (HIIE) sessions). Oral glucose tolerance tests (OGTT) and muscle biopsies were performed pre- and post-intervention.

Results: Mitochondrial respiratory function (O_2 flux – pmol/s/mg tissue) was reduced in the SR group (87 ± 26 vs 71 ± 25 , $p < 0.05$), but remained unchanged in the CON (70 ± 6 vs 64 ± 12 , $p > 0.05$) and SR+EX (81 ± 18 vs 81 ± 24 , $p > 0.05$) group. OGTT total area under the curve increased post intervention in the SR group (678 ± 92 vs 827 ± 56 units, $p < 0.05$), but remained unchanged in the CON (714 ± 207 vs 634 ± 157 , $p > 0.05$) and SR+EX (638 ± 50 vs 705 ± 71 , $p > 0.05$) groups.

Conclusion: Sleep-loss was associated with a reduction in mitochondrial respiratory function and a decrease in glucose tolerance. However, these changes were mitigated by performing HIIE, demonstrating exercise as a potent and cost-effective strategy to alleviate some of the negative metabolic effects of sleep loss.