Carbohydrate and lipid disorders and relevant considerations in persons with spinal cord injury

Wilt TJ, Carlson KF, Goldish GD, MacDonald R, Niewoehner C, Rutks I, Shamliyan T, Tacklind J, Taylor BC, Kane RL

CRD summary
This review evaluated exercise, pharmacologic and dietary interventions in adults with chronic spinal cord injury. The authors concluded that evidence for carbohydrate, lipid and cardiovascular outcomes was inconclusive. Given the poor quality and variability of the included studies, the authors' conclusion is justified. Methodological concerns within the review process suggest the extent to which this conclusion is reliable is unclear.

Authors' objectives
To evaluate the effectiveness of exercise, pharmacologic and dietary interventions for the prevention or treatment of carbohydrate and lipid metabolism disorders in adults with chronic spinal cord injury.

Searching
MEDLINE and The Cochrane Library were searched to identify relevant articles for inclusion in the review. Search terms were reported. Further studies were identified from reference lists of reviews and articles, by searching the authors' own citation library and through contact with other researchers. Search dates ranged from 1996 to 2007. Articles were limited to those published in English.

Study selection
All studies of exercise, dietary or pharmacologic interventions were considered for inclusion, provided they reported carbohydrate, lipid or cardiovascular outcomes in adults with chronic spinal cord injury (sustained for one year or more in studies of dietary or pharmacologic interventions). Studies that reported only improvements in lipid or glucose were excluded, as were pharmacologic interventions that included omega-III fatty acids. Randomised controlled trials (RCTs), or systematic reviews of RCTs were eligible for inclusion to evaluate the preventive effects of dietary or pharmacologic interventions on cardiovascular disease, mortality and diabetes in able-bodied adults.

A range of aerobic and weight resistance programmes and non-specified activity were included, containing various frequencies and intensities, and many with short duration (eight weeks to one year). A variety of outcome measures were used; many were self-reported. Able- and non able-bodied participants were included. Those with spinal cord injury had varying degrees of severity and time since injury. Participants were often hospital-based and predominantly male. The age range of all included participants spanned 16 to 71 years. Studies of dietary interventions were based on recommendations from the American Heart and Dietetic Associations, or part of a multicomponent package. There were no studies of pharmacological interventions.

The authors stated neither how the papers were selected for the review nor how many reviewers performed the selection.

Assessment of study quality
The authors state that levels of evidence were used to evaluate study quality. This did not constitute a formal assessment.

Data extraction
Data were extracted for the outcomes of interest on percentage change from baseline or between groups, or to indicate an association with the intervention. Significance levels and 95% confidence intervals (CI) were reported, where appropriate.

Data were checked by a second reviewer and disagreements were resolved by discussion.
Methods of synthesis
The authors stated that studies were too heterogeneous to permit statistical pooling. The results were presented as a narrative synthesis and in tables according to the outcomes of interest and type of intervention.

Results of the review
Twenty studies were included in the review (n=631): 14 case series (n=132) and five survey designs (n=261) reported on exercise interventions; one of the case series (n=16) and an additional controlled clinical trial (n=222) also reported on dietary interventions. Overall, study quality was considered to be low (details were not reported). Evidence was mixed and inconclusive.

Exercise interventions with carbohydrate-related outcomes (10 study arms, n=101):
Statistically significant glucose-related changes were reported as follows: post-training reduction in glucose level (one study; p=0.014); post-training reduction in glucose tolerance (one study; p<0.05); increased glucose disposal (one study; p<0.05); and post-training increase in insulin-stimulated glucose uptake (p<0.05).

Inverse correlations were reported between self-reported physical activity and plasma glucose (one study: p<0.05), and two-hour post-load glucose levels (one study; p<0.01). Significant changes were reported for reduced insulin concentration (one study; p<0.01), post-training increase in insulin sensitivity index (p<0.05) and an inverse correlation between self-reported physical activity and post-load insulin (one study; p<0.01).

Exercise interventions with lipid-related or cardiovascular-related outcomes (13 study arms, n=292):
Statistically significant improvements of 8% to 10% post-training were reported for total cholesterol reductions (two studies; p<0.04, p=0.021). This increased to 31% for high-intensity exercise (one study; no p value). Statistically significant inverse correlations were noted between physical activity and total cholesterol levels (two studies; p=0.008, p<0.05). High density lipoprotein cholesterol (HDL-C) was increased in another study (p<0.05), but further results were mixed in the remaining studies that measured this outcome.

Results for total cholesterol/HDL-C were similarly inconsistent. Low density lipoprotein cholesterol (LDL-C) was significantly decreased post-training by 15% to 25% in two studies (p=0.05). Significant inverse correlations were found between self-reported physical activity and LDL-C (two studies; p=0.003, p<0.01).

Dietary interventions with lipid-related outcomes (two study arms, n=246):
Statistically significant reductions from baseline in total cholesterol (p<0.001) and LDL-C (p=0.004) were noted in one controlled clinical trial. HDL-C was significantly reduced (p=0.03) after 12 weeks, but this was no longer significant at 24 weeks.

Authors' conclusions
Evidence that exercise, dietary or pharmacologic interventions can change carbohydrate, lipid or cardiovascular outcomes was inconclusive.

CRD commentary
The research question was clear and supported by appropriately detailed inclusion criteria. There was no justification offered for apparent limitations in the search strategy (such as predominant reliance on two electronic databases, the 11-year search range and restriction to published English-language articles), which meant that relevant studies may have been missed and language and publication biases could not be ruled out. There was no formal assessment of study quality. Given the reported included study designs, it was reasonable to assume that the authors’ conclusion about overall poor quality was justified. There were no apparent attempts to minimise reviewer errors and biases at the study selection stage, which represents a further limitation to the methodological robustness of the review. Study details were adequately provided. The chosen method of synthesis was appropriate, given wide variations within those studies selected for inclusion. Given the poor quality of heterogeneous studies included in this review, the authors' conclusion accurately reflected the evidence presented, but the conclusion may not be generalisable beyond the populations studied. Methodological concerns within the review process means that the extent to which the authors' conclusion is
Implications of the review for practice and research

**Practice:** The authors stated that it was reasonable for now to assume a similar treatment policy for adults with spinal cord injury as that currently recommended for able-bodied individuals.

**Research:** The authors stated that high-quality RCTs were needed to compare the effectiveness of treatments suitably modified for adults with spinal cord injury. The risks and long-term benefits of and barriers to participation in community-based exercise programmes required further exploration.

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