Changing physical activity behavior in type 2 diabetes: a systematic review and meta-analysis of behavioral interventions

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CRD summary
This review concluded that behavioural interventions that targeted increased physical activity and exercise in clinical/community settings produced clinically significant improvements in glycated haemoglobin (HbA1c) levels, in adults with type 2 diabetes. The unclear risk of bias among studies included in this review means the authors' conclusions may not be reliable.

Authors' objectives
To compare the effectiveness of behavioural interventions that targeted "free-living" physical activity and exercise versus usual care in adults with type 2 diabetes.

Searching
Six databases (including MEDLINE and The Cochrane Library) were searched to January, 2012 for publications in English. Search terms were reported in supplementary material. Manual searches of reference lists and citation searching of included studies were also performed.

Study selection
Randomised controlled trials were eligible if they compared the effectiveness of behavioural interventions that targeted free-living physical activity/exercise versus usual care in adults (aged 18 years or older) with type 2 diabetes. Study populations had to control their diabetes with diet, oral medication or insulin therapy, and trials were required to have a minimum follow-up of one month from baseline. Eligible interventions were delivered in clinical or community settings. The primary outcomes of interest were changes in levels of physical activity and exercise, glycated haemoglobin (HbA1c) and body mass index.

Most of the included studies were conducted in Europe (including two in the UK). Where reported, mean participant age ranged from 53 to 67 years. Interventions were based on various health behaviour change theories/models, and included supervised exercise sessions and structured counselling sessions. Where reported, intervention duration ranged from eight weeks to two years. Interventions varied in intensity, mode of delivery, type of interventionist and the measurement tools used. Studies also varied in definitions of usual care.

Two reviewers independently selected studies for inclusion; any disagreements were resolved by discussion with the review team.

Assessment of study quality
Risk of bias within and across studies for each outcome was rated as low, unclear or high using Cochrane Collaboration criteria. It appeared that two reviewers independently carried out risk of bias assessments.

Data extraction
Data on the outcomes (post-intervention means and standard deviations) were extracted to calculate standardised mean differences and 95% confidence intervals. Authors were contacted for additional data when necessary. It appeared that two reviewers independently extracted data.

Methods of synthesis
Pooled standardised or weighted mean differences and 95% confidence intervals were calculated for each outcome using random-effects models. When studies included multiple intervention arms, data on each intervention arm compared with the usual care arm were included in the meta-analysis. Excessive weightings were controlled in these studies using published guidance. Statistical heterogeneity was assessed using $I^2$; values of more than 50% indicated heterogeneity. Sensitivity and moderator analyses were also performed. Measures of intervention effects were classified according to length of follow-up, as short-term (between one and less than six months), short- to medium-term (six...
Results of the review

Nineteen publications of 17 randomised controlled trials were included in the review (1,975 participants, ranging from 26 to 606 per trial). Five trials were assessed as being at low risk of bias, and twelve had an unclear risk of bias (results fully reported in the supplementary material). Follow-up duration ranged from three months to two years.

Compared with usual care groups, a statistically significant increase in objectively assessed levels of physical activity/exercise was observed in intervention groups overall (SMD 0.45, 95% CI 0.21 to 0.68; six trials; \( I^2 = 55\% \)); the effect was maintained among studies with follow-up periods between one and six months, and 12 months. Sensitivity analysis (excluding one study with a high attrition rate) revealed a slight decrease in the magnitude of the effect, though it remained statistically significant. A statistically significant positive effect was also observed among studies with self-reported data (SMD=0.79, 95% CI 0.59 to 0.98; 14 trials; \( I^2 = 74\% \)); this effect was maintained across all follow-up periods with the exception of 24 months.

A statistically and clinically significant improvement in HbA1c levels was observed for intervention groups, compared with usual care groups (WMD -0.32%, 95% CI -0.44 to -0.21; 17 trials; \( I^2 = 8\% \)). This effect was maintained across all follow-up periods, with the exception of the period between one and less than six months, and at six months. Sensitivity analysis (removal of the study with the high attrition rate) revealed a similar result.

Further comparisons with usual care groups showed that the intervention groups experienced a statistically significant greater reduction in body mass index overall (WMD -1.05 kg/m\(^2\), 95% CI -1.31 to -0.80; 12 trials; \( I^2 = 2\% \)). Similar results were shown in the follow-up subgroup analyses. Further results were reported in the review.

Authors’ conclusions

Behavioural interventions targeting increased physical activity and exercise in clinical/community settings produce clinically significant improvements in HbA1c, in adults with type 2 diabetes.

CRD commentary

The review question and inclusion criteria were clearly defined. A range of relevant sources were searched, but restriction to studies in English meant that relevant studies may have been missed. It appeared as though efforts were taken to perform all of the review processes in duplicate, which reduced risk of reviewer error and bias. A suitable quality assessment tool was used, which showed that the overall risk of bias in most trials was unclear. Study details were presented and revealed many clinical differences between the studies. The methods of synthesis appeared appropriate; there was substantial statistical heterogeneity but this was explored using sub-group and moderator analyses.

The unclear risks of bias among the studies included in this review mean the authors' conclusions may not be reliable.

Implications of the review for practice and research

Practice: The authors stated that behavioural interventions have the potential to effectively reduce HbA1c levels in adults with type 2 diabetes in routine clinical care.

Research: The authors stated that further research was urgently needed to investigate how behavioural interventions might be optimised and implemented into routine clinical care, and to investigate which professional training most enables providers to effectively deliver these interventions. Longer behavioural interventions (i.e. with more than six months follow-up) are needed, and the application of theory for behaviour change and improvements in HbA1c should be considered. More research was needed to evaluate the effectiveness of single or aggregated behaviour change techniques in randomised trials, including ways in which clusters of these techniques might be individually tailored for those with diabetes. Finally, researchers were encouraged to use a reliable taxonomy as an aid when reporting on their intervention's content.

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