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Exercise demonstrates a dose-response effect on insulin resistance, fatness, and visceral fat

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Question

Among overweight or obese children, what is the clinical efficacy of various doses of exercise on insulin resistance, fatness, visceral fat, and fitness?

Design

Randomized controlled efficacy trial.

Setting

Gymnasium at the Georgia Prevention Institute, Georgia Health Sciences Institute, Augusta, Georgia.

Participants

Overweight or obese sedentary children (mean age, 9.4 years; 222 children; 42% male; 58% black) recruited from 15 public schools (2003 – 2007) in the Augusta, Georgia, area.

Intervention

Low-dose (20 min/d; n = 71) or high-dose (40 min/d; n = 73) aerobic training (5 d/wk; mean duration, 13 [SD, 1.6] weeks) or a control condition (usual physical activity; n = 78).

Outcomes

The primary outcomes were postintervention type 2 diabetes risk assessed by insulin area under the curve (AUC) from an oral glucose tolerance test, aerobic fitness (peak oxygen consumption [VO_2]), percent body fat via dual-energy x-ray absorptiometry, and visceral fat via magnetic resonance, analyzed by intention to treat.

Main Results

Reductions in insulin AUC were larger in the high-dose group (adjusted mean difference, −3.56 [95% CI, −6.26 to −0.85] × 10^3 μU/mL; *P* = .01) and the low-dose group (adjusted

Davis CL, Pollock NK, Waller JL, Allison JD, Dennis BA, Bassali R, et al. Exercise dose and diabetes risk in overweight and obese children: a randomized controlled trial. *JAMA* 2012; 308: 1103-12.

mean difference, −2.96 [95% CI, −5.69 to −0.22] × 10^3 μU/mL; *P* = .03) than the control group. Dose-response trends were also observed for body fat (adjusted mean difference, −1.4% [95% CI, −2.2% to −0.7%]; *P* < .001 and −0.8% [95% CI, −1.6% to −0.07%]; *P* = .03) and visceral fat (adjusted mean difference, −3.9 cm^3 [95% CI, −6.0 to −1.7 cm^3]; *P* < .001 and −2.8 cm^3 [95% CI, −4.9 to −0.6 cm^3]; *P* = .01) in the high- and low-dose vs control groups, respectively. Effects in the high- and low-dose groups vs control were similar for fitness compared with control, adjusted mean difference in peak VO_2, 2.4 [95% CI, 0.4-4.5] mL/kg/min; *P* = .02 and 2.4 [95% CI, 0.3-4.5] mL/kg/min; *P* = .03, respectively). There was no effect on the results by sex or race.

Conclusions

In this trial, after 13 weeks, 20 or 40 min/d of aerobic training improved fitness and demonstrated dose-response benefits for insulin resistance and general and visceral adiposity in sedentary overweight or obese children.

Commentary

Effective interventions to reduce the risk of diabetes in children and adolescents are needed, and exercise appears to be an important lifestyle factor to reduce diabetes risk. The study by Davis et al provides important information on the dose of exercise that appears to reduce diabetes risk in children 6-11 years of age. It appears that 20 minutes of vigorous daily exercise both improves fitness and reduces insulin AUC from an oral glucose tolerance test over a period of approximately 13 weeks. These findings provide a foundation that should be used to influence physical education programs in schools, after school programs, and other recreation programs for children. Unfortunately, physical education typically is not offered daily in schools and engages children in vigorous intensity activity for less than 20 minutes. Other after school or structured recreational programs may not be provided or may not be affordable to all children who can benefit from these programs. Improved cognitive function and academic performance in children also is linked to physical activity. Thus, parents, schools, health-care providers, and community organizations need to implement opportunities for children to engage in sufficient levels of daily vigorous activity. The results presented by Davis et al suggest that significant benefit may be achieved with as little as 20 minutes per day of exercise.