Physical activity and prevention and treatment of diabetes

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One of the most common disorders, affecting people of all ages

In England ~2.2million people have type 2 diabetes

T2DM and obesity are intimately linked: 80-90% of people with T2DM are also obese

Severe long term consequences

Expensive to manage
Evidence for the health benefits of physical activity

- The general “healthy” population
- Those at high risk of diabetes
- People who have diabetes
- The role of sedentary behaviour
Physical activity and risk of type 2 diabetes

- Review of studies published 1991-2006
- 20 studies representing 13 cohorts
- 353 - 87,253 participants, 4-16 yrs follow up
- 7 female only, 7 men only
- 24-74 yrs old at recruitment
- USA, Europe and Asia
- Wide range of exercise modalities from episodes of vigorous activity to active commuting

Physical activity and risk of type 2 diabetes

Vigorous exercise 5x/week associated with 42% reduction in risk in men

Manson et al 1992. JAMA;268:63-67

Walking associated with an approximately 50% reduction in risk in women

Summary: prevention of diabetes

- Physical activity is protective against type 2 diabetes in the general population with a reduction in risk of 10-40%.
- This is observed in men and women, across the BMI range and across ethnic groups.
- Current physical activity guidelines are appropriate for prevention of type 2 diabetes.

<table>
<thead>
<tr>
<th>Recommendation</th>
<th>Evidence</th>
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<tbody>
<tr>
<td>Over a week, activity should add up to at least 150 minutes (2½ hours) of moderate intensity activity.</td>
<td>Strong</td>
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<tr>
<td>Comparable benefits can be achieved through 75 minutes of vigorous intensity activity spread across the week or a combination of moderate and vigorous intensity activity.</td>
<td>Strong</td>
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Start Active, Stay Active (2011)
What is the role of physical activity in the prevention of type 2 diabetes in those at high risk?

<table>
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<td>At least 2.5 h/week of moderate to vigorous PA should be undertaken as part of lifestyle changes to prevent type 2 diabetes onset in high-risk adults.</td>
<td>A</td>
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</tbody>
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ADA/ACSM guidelines (2010) Diabetes Care 33: e147-167
Prevention of diabetes in those at high risk

- There have been several major prevention trials
  - Malmo Feasibility Study
  - Da Qing Study
  - Finnish Diabetes Prevention Study
  - US Diabetes Prevention Program
  - Indian Diabetes Prevention Programme

- Reduction in incidence of diabetes as the outcome

- Focus on lifestyle rather than physical activity
Lifestyle intervention targets

- Intervention groups received a multi-component lifestyle intervention
- Individualised counselling/encouragement aimed at:
  - Increasing physical activity by ≥ 30 min per day
  - Reducing body mass by ≥ 5%  
    - Reducing total fat to ≤ 30%
    - Reducing saturated fat to ≤ 10%
    - Increasing fibre intake to ≥ 15g per 1000 Kcal

- Control groups received general oral and written advice about diet and activity
The Finnish Diabetes Prevention Study

US Diabetes Prevention Program

Indian Diabetes Prevention Programme

Diabetes prevention: physical activity or weight loss?

- Reductions in diabetes incidence occurred in trials inducing no weight loss:
  - 46% reduction in Exercise only arm of Da Qing study
  - 28.5% reduction in Indian DPP

- But greater reductions in diabetes incidence were observed in trials where weight loss occurred:
  - 63% reduction in Malmo Feasibility Study
  - 58% reduction in Finnish DPP
  - 58% reduction in USDPP

- What is the independent effect of physical activity?
What is the magnitude of effect of physical activity?

- Studies limited by poor physical activity measurement

- In the Finnish DPS post hoc analyses identified a 49% difference in risk of T2DM between highest & lowest tertiles of MVPA

- Difference in MVPA between highest and lowest tertiles was 246 minutes per week

- The difference of 120 minutes of MVPA between lowest and middle tertile was not associated with reduced risk of diabetes

- These data suggest that the guidelines of 150 minutes/week are insufficient to prevent diabetes in the absence of other lifestyle change

Summary: pre-diabetes

- Lifestyle intervention involving diet and exercise can prevent or delay progression to type 2 diabetes in patients with impaired glucose tolerance.

- The independent effect of exercise is yet to be determined but it is likely that in the absence of dietary change, levels of physical activity in excess of the current guidelines are required.
What is the role of physical activity in the management of type 2 diabetes?

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<tr>
<td>Persons with type 2 diabetes should undertake at least 150 min/week of moderate to vigorous aerobic exercise spread out during at least 3 days during the week</td>
<td>B</td>
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<tr>
<td>In addition to aerobic training, persons with type 2 diabetes should undertake moderate to vigorous resistance training at least 2–3 days/week</td>
<td>B</td>
</tr>
<tr>
<td>Supervised and combined aerobic and resistance training may confer additional health benefits</td>
<td>B/C</td>
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</tbody>
</table>

ADA/ACSM guidelines (2010) Diabetes Care 33: e147-167
The Early ACTID Study

- 593 patients with newly diagnosed T2DM
- 3 groups:
  - Usual care
  - Diet
  - Diet + exercise
- 1 year intervention
- Home based exercise intervention
- Primary outcomes: HbA1c and blood pressure

Participant visits in Early ACTID

**Screening x1**

**BL Measurements x2**

**Clinical review + Dietician x1**

RANDOMISATION

**Usual care**

6-month measurements x2
Clinical review x1

12-month measurements x2
Clinical review + Dietician x1

10 visits

**Diet only**

Dietician + Nurse x2
Nurse only x4

6-month measurements x2
Clinical review + dietician x1

Dietician + nurse x1
Nurse only x2

12-month measurements x2
Clinical review + Dietician x1

19 visits

**Diet + exercise**

Dietician + Nurse x2
Nurse only x4

6-month measurements x2
Clinical review + dietician x1

Dietician + nurse x1
Nurse only x2

12-month measurements x2
Clinical review + Dietician x1

19 visits
Change in physical activity & weight in Early ACTID

Compliance: 579 (98%) of participants still in study at 12 months and 71% of visits attended

HbA1c

6 months Difference P value
D vs D +E -0.05 0.56
D vs U -0.28 0.002
D +E vs U -0.33 <0.0001

12 months Difference P value
D vs D +E -0.08 0.6
D vs U -0.26 0.005
D +E vs U -0.33 <0.0001
What type of exercise is effective in people with diabetes?

- Recent meta-analysis identified 23 trials of structured exercise and 24 trials of exercise advice
- Mixture of aerobic, resistance and combined programmes
- Change in HbA1c was outcome
- >150 minutes -0.89%
- <150 minutes -0.36%

Summary: people with diabetes

- Supervised aerobic & resistance exercise, and both combined, had a similar magnitude of effect (overall -0.67%)
- Longer duration was more effective (above current guidelines?)
- No evidence of an intensity effect
- Advice should be combined with diet
- How much change is possible?
  - ACTID: 10 minutes
  - FDPS: 9 minutes
  - USDPP: 15 minutes

Sedentary behaviour and health

- Set of behaviours - largely sitting
  - Watching TV, reading, computer use, driving

- Associations with metabolic risk factors
  - 2hr glucose, HOMA-IR, HDL, waist circumference

- Prolonged TV viewing is associated with greater risk of type 2 diabetes

Grøntved (2011) JAMA 305: 2448-2455
Summary

- Physical activity meeting current guidelines is effective in preventing type 2 diabetes
- In people with pre-diabetes, the independent role of physical activity is unclear
- In people with diabetes, structured exercise appears to effective in improving glycaemic control....
- ...but exercise advice alone may not be sufficient
- Future work will explore the potential for targeting sedentary time