Physical Inactivity as Determinant of Obesity

The Evolution of the Homo Sapiens

It's Calories that Counts

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Overview

- Trends in physical activity over the years
- Is inactivity causing the obesity problem?
- How much physical activity do we need?
- Conclusions
Prevention of Obesity by Physical Activity

How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement

James WPT. Int. J. Obesity, 1995


- Food intake of 750 kcal/day↓ since 1970
- Mean body weight of 2.5 kg↑
- Daily energy expenditure of 800 kcal/day↓

Trends in Leisure-Time Physical Activity Among Adults 18+ Years: BRFSS, 1990-1998

Recommended levels = 30 minutes or more of moderate intensity activity ≥5 times/week or 20 minutes or more vigorous activity ≥3 times/week or both

MMWR, 50(9); March 9, 2001
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Changes in Fat Intake Among US Adults

Age-Adjusted Trends in Obesity and Type 2 Diabetes Among US Adults 20 to 74 Years: 1980 - 1994

Enns CW et al., family economics and nutrition review, 1997
Flegal, et al., 1998; Harris M, NDDK, 2000; and Blair and Nohman, 2001

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Edible Fat Production from National Food Balance Sheets

<table>
<thead>
<tr>
<th>Availability fat (g/day)</th>
<th>1965</th>
<th>1998</th>
<th>+%</th>
</tr>
</thead>
<tbody>
<tr>
<td>USE</td>
<td>117</td>
<td>143</td>
<td>+23%</td>
</tr>
<tr>
<td>EU</td>
<td>117</td>
<td>149</td>
<td>+27%</td>
</tr>
</tbody>
</table>

WHO 2004

The American Paradox Unmasked (?)

Goris et al., AJCN 2000

Summary of Reported Leisure-Time Physical Activity Data

- Slightly increasing trend in reported leisure-time physical activity among adults
- Overall decreasing trend in daily activity levels among children
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Components of Physical Activity
Energy Expenditure

Trends in Automobile Use
- 1983 and 1990 – vehicle miles traveled per household day increased by 29%
- 1970 and 1990 – commuting to work by car increased by 11%
- 1995 – only 16% of trips ≤ 1 mile are walked
- 1995 – only 0.6% of trips ≤ 5 miles are biked


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Trends in Transportation to Work


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The Solution

Summary of the Available Indicators of Trends in Physical Activity

All indicators of physical activity are pointing at a dramatic decrease over the last decades

Physical Activity and Weight Gain: Prospective Studies

- 11/12(13) studies allowing for the estimation of PAL show a protective effect
- 6/11 studies with more limited quantification of physical activity show a protective effect

Rissanen 2002
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Prevalence of Obesity (%) by Physical Activity

- Man
- Overweight

Prevalence of Obesity (%) by Physical Activity

- Woman
- Overweight

Physical Activity and Obesity in the European Union

Martinez et al., J/O 1999

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24-Month Increase in Energy Expenditure

24-Month Change in Weight and Percent Body Fat

Baseline Characteristics of 4-Examination Cohort, 3075 Women and Men

- 13% women and 87% men
- Average age = 40.9 ± 7.0 years
- Average weight = 78.1 ± 13.0 kg
- Average follow-up = 5.2 ± 3.3 years
- 86% were non-smokers
- Average PAL = 1.48 ± 0.09

Dunn et al., JAMA 1999

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Weight Change Over Time by PAL Change Groups

Dietary Guidelines for Americans 2005*
Physical Activity Recommendations

Physical Activity and Energy Balance from an Evolutionary Prospective

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How Much Is Enough to Prevent Unhealthy Weight Gain?

- Prospective DLW trials n = 2
- R.C. DLW trials n = 0

Mean body weights after weight loss of previously obese women, according to physical activity level (PAL, by DLW) after weight loss (at 0 months).

Weight Regain

Free-Living Activity Energy Expenditure in Women Successful and Unsuccessful at Maintaining a Normal Body Weight

Maintainers
n = 27
(BW gain ≤ 3%)
BMI 23.1
△ BW -0.5 kg

Gainers
n = 20
(BW gain > 10%)
BMI 24.4
△ BW +9.5 kg

Weinsier et al., AJCN 2002

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Free-Living Activity Energy Expenditure in Women Successful and Unsuccessful at Maintaining a Normal Body Weight

<table>
<thead>
<tr>
<th></th>
<th>Maintainers</th>
<th>Gainers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Followup</td>
</tr>
<tr>
<td>PAL</td>
<td>1.68</td>
<td>1.73</td>
</tr>
<tr>
<td>Activity Kcal</td>
<td>702</td>
<td>679</td>
</tr>
</tbody>
</table>

Weinsier et al., AJCN 2002

Prospective DLW Studies on Weight (Re-)Gain and PA

Schoeller: additional 3.4 kcal/kg/d
AEE needed to match maintainers

80 minutes moderate activity

Weinsier: additional 4.0 kcal/kg/d
AEE needed to match maintainers

77 minutes moderate activity

Exercise and Weight Regain in the National Registry of Weight Losers

Estimated energy cost of exercise: 11-12 MJ per week
Duration at 30 kJ per minute: 50-60 minutes/week

McGuire et al., IJO 1998, 22: 572-7
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Prevention of Obesity by Physical Activity

How much physical activity is enough to prevent unhealthy weight gain? Outcome of the IASO 1st Stock Conference and consensus statement

There is compelling evidence that prevention of weight regain in formerly obese individuals requires 60-90 minutes of moderate intensity activity or lesser amounts of vigorous intensity activity; although definitive data are lacking, it seems likely that moderate intensity activity of approximately 45 to 60 minutes per day or 1.7 PAL, is required to prevent the transition to overweight or obesity; for children, even more activity time is recommended.

Saris et al., Obesity Rev., 2003

How Much Physical Activity Is Enough to Prevent Unhealthy Weight Gain?

Physical Activity Recommendations

- How much physical activity is required?
  - for health benefits?
    - 30 minutes/day
  - to prevent weight gain?
    - 60 minutes/day
  - to prevent weight regain in the formerly obese?
    - 60-90 minutes/day

Source: U.S. Dietary Guidelines, 2005
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Energy Costs of Activities for 1 hr for 70 and 100 kg Person

<table>
<thead>
<tr>
<th>Type of physical activity</th>
<th>70 kg person</th>
<th>100 kg person</th>
</tr>
</thead>
<tbody>
<tr>
<td>Walking with the dog</td>
<td>210 kcal</td>
<td>300 kcal</td>
</tr>
<tr>
<td>equal to ~6000 steps</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Vigorous walking</td>
<td>350 kcal</td>
<td>500 kcal</td>
</tr>
<tr>
<td>Bicycling for pleasure</td>
<td>280 kcal</td>
<td>400 kcal</td>
</tr>
<tr>
<td>Bicycling moderate effort</td>
<td>560 kcal</td>
<td>800 kcal</td>
</tr>
<tr>
<td>Health club exercise</td>
<td>385 kcal</td>
<td>550 kcal</td>
</tr>
<tr>
<td>Jogging</td>
<td>490 kcal</td>
<td>700 kcal</td>
</tr>
<tr>
<td>Standing quietly</td>
<td>115 kcal</td>
<td>150 kcal</td>
</tr>
</tbody>
</table>

Ainsworth et al., MSSE, 2000

Does the Intensity of the Exercise Make a Difference?

Effect of ISO Energetic High or Low Intensity Exercise on 24-HR Substrate Metabolism

Saris and Schrauwen/JO 2003
Effect of ISO Energetic High or Low Intensity Exercise on 24-HR Substrate Metabolism

Moderate Intensity Exercise

- 4.5 - 5.9 METs (40-64 y) (Surgeon General, 1996)
- \(5 \text{ METs} = 5 \times 3.5 \text{ ml O}_2 \text{ min}^{-1} \text{ kg}^{-1} = 17.5 \text{ ml O}_2 \text{ min}^{-1} \text{ kg}^{-1}\)
- = 70% \(\text{VO}_2\text{max}\) of 'average' obese
- hard relative exercise intensity

Moderate Intensity Exercise for Obese

- = 45-60 % \(\text{VO}_2\text{max}\)
- \(\text{VO}_2\text{max}\) of 'average' obese = 25 ml \(\text{O}_2\text{ min}^{-1} \text{ kg}^{-1}\) or 7 METs
- 45-60 % \(\text{VO}_2\text{max}\) = 3-4 METs
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Exercise Training and Compliance

- Training program:
  - 40 weeks
  - aim to run a half marathon

Westerterp et al., BJN, 1992

Conclusions

- There is general consensus that increase in physical activity is a key component in body weight control.

- However the existing guideline of 30 minutes a day of moderate activities is most probably not enough to prevent weight gain and certainly not regain.

- 60 to 90 minutes seems to be more appropriate to prevent undesired weight gain and regain.