Physical Activity and Health
Prevention Across the Lifespan
Center for Healthy Living
Western Washington University
March 12, 2004
Bellingham, Washington

Steven N. Blair
President and CEO
Cooper Institute
Dallas, Texas
Aerobics Center Longitudinal Study
Design of the ACLS

1970 More than 75,000 patients 2003

Cooper Clinic examinations--including history and physical exam, clinical tests, body composition, EBT, and CRF

Mortality surveillance to 1996
More than 2300 deaths

1982 '86 '90 '95 '99
Mail-back surveys for case finding and monitoring habits and other characteristics
Aerobics Center Longitudinal Study

• Prospective investigation of 7,080 women and 25,341 men examined at the Cooper Clinic at least once during 1970-1989

• Average age: women=42.7 yrs; men=42.9 yrs

• Approximately 97% white, mid- to upper-socioeconomic strata

• Followed for mortality to 12/31/89
  – 89 deaths during 52,982 woman-years
  – 601 deaths during 211,996 man-years

Blair SN et al. JAMA 1996; 276:205-10
CVD Death Rates* by Fitness Groups, 7,080 Women and 25,340 Men, ACLS

Deaths/10,000 PY

Adjusted for age, exam year, and other risk factors

Blair SN et al. *JAMA* 1996; 276:205-10
Cardiorespiratory Fitness, Risk Factors and All-Cause Mortality, Men, ACLS

Cardiorespiratory Fitness Groups
*Adjusted for age, exam year, and other risk factors

Blair SN et al. *JAMA* 1996; 276:205-10
Mortality Rates per 10,000 Person-Years by Musculoskeletal Fitness Category, ACLS

FitzGerald S et al. *J Phys Act Health* 2004
Older Women and Men
Risk of Death by Fitness Groups, 749 Women and 1758 Men 60 and Older, ACLS

- Age, exam-year, BMI, cholesterol, high blood pressure, diabetes, smoking, CVD, parental CVD adjusted RR for all-cause mortality
- Patients with cancer and failure to achieve at least 85% of predicted max HR were excluded

Death Rates/1000 by Fitness Groups, 2135 Men Aged 60 and Older, ACLS

Fitness and Functional Limitations, Women and Men, ACLS

- OR for self-reported functional limitation adjusted for age, follow-up, BMI, smoking, alcohol intake, baseline disease, & disease at follow-up

Huang et al. MSSE 1998, 30:1430-5
Benefits of Physical Activity for Individuals of Any Size
Cardiorespiratory Fitness, Body Composition, and All-Cause Mortality

- 21,925 men, followed an average of 8 years, 428 CVD deaths
- Excluded men with MI, stroke, or cancer at baseline
- Exposures
  - CRF from a maximal exercise test on a treadmill
  - Body composition determined by hydrostatic weighing, sum of 7 skinfolds, or both
- RR adjusted for age, exam year, smoking, and parental history of CVD

Adjusted RR for All-Cause Mortality by Fitness and Waist Circumference

- Waist circumference measurements in a subgroup 14,043 men
- 162 deaths in 78,008 man-years
- RR adjusted for age, examination year, smoking habit, alcohol intake, and parental history of CHD

Adjusted RR for All-Cause Mortality by Fitness and BMI, ACLS Women

Adj RR*  
*adj for age, exam year, smoking, & health status

Prevalence of Moderate or High Fitness, ACLS Women

Physical Activity, Fitness, Type 2 Diabetes, and Metabolic Syndrome
Time Trends in U.S. Prevalence of Diagnosed Diabetes

Courtesy of Dr. M. Harris. NIDDK, NIH
What Is the Cause of the Increases in Obesity Rates?
Trends in Energy Intake
NHANES 1971-2000

• Data sources
  – NHANES I—1971-1974
  – NHANES II—1976-1980
  – NHANES—1999-2000

• Surveys were representative samples of noninstitutionalized U.S. women and men aged 20 to 74 years

Source: MMWR Feb 6, 2004
Trends in Energy Intake
1971 to 2000, Men, NHANES

Source: MMWR Feb 6, 2004
NHANES Survey Methods 1971-2000

• NHANES I and NHANES II
  – 24-hour dietary recall, Monday-Friday
• NHANES III and NHANES
  – 24-hour dietary recall, Monday-Sunday
• Other changes in methodology included better probing techniques and better training of interviewers
• Other changes in dietary behavior included more meals eaten away from home and increasing portion sizes
Trends in Energy Intake
1971 to 2000, Women, NHANES

Source: MMWR Feb 6, 2004
Hypothetical Model for the Cause of the Obesity Epidemic of the Late 20th Century

Energy balance

Energy intake

Energy expenditure

Kcal

1900 1950 2000
Physical Activity Patterns and Trends

- Walking has declined significantly
- Activity at work continues to decline
- Activity at home production and leisure declined significantly
- Attempts now focus on understanding patterns and determinants of activity and inactivity
- Research to date has largely ignored work and home production [cleaning, cooking, etc]
**Travel**

- **US average= 73 mins/day of driving**
- **One-fourth of all trips made are one mile or less, but three-fourths of these short trips are made by car**
- **Children between the ages of 5-15 walk/bike 40% less in 1995 than in 1977**
- **For school trips one mile or less, only 31% are made by walking; within 2 miles, only 2% are made by biking.**
- **In the US, 6% of trips are by walking/biking. In contrast, Italy (54%), Sweden (49%)**
Hypothesis Regarding Energy Intake, Expenditure, and Balance

Concept from Jim Hill & Russ Pate
<table>
<thead>
<tr>
<th>Activity</th>
<th>Sedentary Way</th>
<th>Active Way</th>
</tr>
</thead>
<tbody>
<tr>
<td>Using remote to change channel</td>
<td>&lt;1 kcal</td>
<td>3 kcal</td>
</tr>
<tr>
<td>30 min of phone calls--reclining</td>
<td>4 kcal</td>
<td>20 kcal</td>
</tr>
<tr>
<td>Using garage door opener</td>
<td>&lt;1 kcal</td>
<td>2-3 kcal</td>
</tr>
<tr>
<td>Hiring maid to clean and iron</td>
<td>0 kcal</td>
<td>152 kcal</td>
</tr>
</tbody>
</table>

Kcal estimates for 150-160 pound person

Taken from article by L. Beil, *Dallas Morning News*, 1999
## Lifestyle and Energy Expenditure

<table>
<thead>
<tr>
<th>Sedentary Way</th>
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<tbody>
<tr>
<td><strong>kcal</strong></td>
<td><strong>kcal</strong></td>
</tr>
<tr>
<td>30 min waiting for pizza delivery</td>
<td>15</td>
</tr>
<tr>
<td>Buying pre-sliced vegetables</td>
<td>0</td>
</tr>
<tr>
<td>Using a leaf blower for 30 min</td>
<td>100</td>
</tr>
<tr>
<td>Using a lawn service</td>
<td>0</td>
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<td><strong>Kcal</strong></td>
</tr>
<tr>
<td>Using car wash once/month</td>
<td>Washing &amp; waxing car, 1 hr/month</td>
</tr>
<tr>
<td>Letting dog out the back door</td>
<td>Walking dog for 30 min</td>
</tr>
<tr>
<td>Drive 40 min, 5 min walk (parking)</td>
<td>15 min walk to bus stop, 2 X day</td>
</tr>
<tr>
<td>Emailing colleague, 4 min</td>
<td>Walk 1 min, talk 3 min (standing)</td>
</tr>
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<th>Activity</th>
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<th>Active Way kcal</th>
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</thead>
<tbody>
<tr>
<td>Taking elevator up 3 flights</td>
<td>0.3</td>
<td>15</td>
</tr>
<tr>
<td>Park close as poss, 10 sec walk</td>
<td>0.3</td>
<td>8</td>
</tr>
<tr>
<td>Cashier unloads shopping cart</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>Ride escalator 3 times</td>
<td>2</td>
<td>15</td>
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<td>kcal</td>
<td>kcal</td>
</tr>
<tr>
<td>1 hour internet shopping</td>
<td>30</td>
</tr>
<tr>
<td>Sitting in car at drive-in window, 30 min</td>
<td>15</td>
</tr>
<tr>
<td>Paying at the pump</td>
<td>0.6</td>
</tr>
<tr>
<td>Sitting &amp; listening to lecture, 60 min</td>
<td>30</td>
</tr>
</tbody>
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Kcal estimates for 150-160 pound person

Taken from article by L. Beil, *Dallas Morning News*, 1999
Lifestyle and Energy Expenditure

• Assume a person’s caloric intake remains the same
• Completing all of the tasks reviewed daily or as listed
  – Active way=10,500 kcal/month
  – Sedentary way=1,700 kcal/month
• Difference of 8,800 kcal/month is energy equivalent of 2.5 pounds/month or 30 pounds/year

Kcal estimates for 150-160 pound person
Taken from article by L. Beil, *Dallas Morning News, 1999*
Cardiorespiratory Fitness and Mortality, ACLS Men with Metabolic Syndrome or Type 2 Diabetes
Fitness, Metabolic Syndrome, and Mortality in ACLS Men

- Metabolic syndrome is diagnosed if you have any 3 of—
  - High blood sugar
  - High triglycerides
  - Low HDL-cholesterol
  - High blood pressure
  - Big waist

- 19,223 men, 20-83 years of age
  - 3,757 men (~20%) with metabolic syndrome
  - 15,466 healthy men

- Followed for approximately 10 years
- 480 men died

Cardiorespiratory Fitness and All-Cause Mortality, ACLS Men

Death rate/10,000 man-years

Healthy
Death rate=2.3%

Metabolic Syndrome
Death rate=3.5%

Rates adjusted for age and exam year

All-Cause Mortality by Fitness Groups in 3,757 Men with Metabolic Syndrome

Odds Ratio

Low   Moderate   High

Cardiorespiratory Fitness Groups

p for trend <0.001

Katzmarzyk et al. In Press. *Arch Int Med*
Fitness, Fatness, and Mortality in Men with Type 2 Diabetes

• Observational cohort study
• 2196 men with confirmed type 2 diabetes
  – fasting glucose >125 mg/dL or on pharmacological therapy for diabetes
• Mortality follow-up for up to 26 years (32,162 man-years of observation)
  – 275 deaths from all causes
  – 134 deaths from CVD
  – 71 deaths from cancer

Church et al. Diab Care 2004; 27:83-8
All-Cause Mortality by Fitness and BMI Categories, Men with Type 2 Diabetes

Deaths/10,000 MY

<table>
<thead>
<tr>
<th></th>
<th>Low</th>
<th>Moderate</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Overweight</td>
<td>140</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Obese</td>
<td>120</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Deaths: 24 37 23  64 44 13  55 15

Men: 101 263 335  294 466 220  328 189

Linear trends p<0.0001 across fitness categories in all BMI groups
*Adjusted for age and year of examination

Church et al. Diab Care 2004; 27:83-8
Amount of Specific Physical Activities for Moderately Fit Women and Men

- Detailed physical activity assessments in women and men who also completed a maximal exercise test
- Average min/week for the moderately fit who only reported each specific activity

Stofan JR et al. *AJPH* 1998; 88:1807
Public Health Burden of Sedentary Lifestyles
Physical Activity Levels for U.S. Adults

- Sedentary: 38%
- Irregularly Active: 22%
- Regularly Active, Low to Moderate Intensity: 25%
- Regular Vigorous Activity (3 days, 20 minutes): 15%

Surgeon General’s Report, 1996
Consensus Public Health Recommendation for Physical Activity

• Statements from the American College of Sports Medicine/Centers for Disease Control and Prevention, American Heart Association, NIH, and the office of the US Surgeon General conclude:
  – All adults should accumulate at least 30 minutes of at least moderate intensity physical activity each day
  – This is equivalent to walking about 1.5 miles at a pace of 3 to 4 mph
  – Doing more exercise and perhaps more strenuous exercise may produce additional health benefits
Summary

- Physical inactivity and low cardiorespiratory fitness are strong predictors of many health outcomes in most population subgroups—including patients with type 2 diabetes.
- Physical activity (energy expenditure) has largely been engineered out of daily life and the 21st century environment promotes mass physical inactivity.
- Physical activity interventions that seek to improve behavioral skill building in sedentary individuals have demonstrated efficacy.
- 30 minutes of moderate intensity physical activity per day will provide important health benefits.
Conclusion

- Physical inactivity is one of the most important public health problems in many countries, and governments and policy makers should give this issue more attention and concern