The Role of Exercise in CVD Risk Reduction: Does it make a difference?

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About the Presenter
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DISCLOSURES
No potential conflicts related to this presentation

Exercise
- Role in CV Risk Reduction
- Mechanisms of benefit
- Athlete’s Heart
- Role of Exercise in Prevention
### CV Health Metric Definitions

<table>
<thead>
<tr>
<th>Metric</th>
<th>Poor Health</th>
<th>Intermediate Health</th>
<th>Optimal Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carotid Imaging - Adults</td>
<td>&gt;10 in Prior 30 Days</td>
<td>Areas &lt; 2 mm² or &lt; 1 mm²</td>
<td>Areas &lt; 1 mm² or &lt; 0.5 mm²</td>
</tr>
<tr>
<td>Body Mass Index - Adults</td>
<td>&lt;18.5</td>
<td>18.5 - 24.9</td>
<td>25.0 - 29.9</td>
</tr>
<tr>
<td>Physical Activity - Adults</td>
<td>None</td>
<td>&lt;30 min/week or &lt;100 kcal/week</td>
<td>&lt;100 kcal/week or &lt;50 kcal/week</td>
</tr>
<tr>
<td>Healthy Diet Score - Adults</td>
<td>5-8 Factors</td>
<td>2-4 Factors</td>
<td>0-1 Factors</td>
</tr>
<tr>
<td>Total Cholesterol - Adults</td>
<td>&lt;200</td>
<td>200-239</td>
<td>240 or more</td>
</tr>
<tr>
<td>Blood Pressure - Adults</td>
<td>SBP &lt;120 or DBP &lt;80</td>
<td>SBP 120-139 or DBP 80-89</td>
<td>SBP 140 or more or DBP 90 or more</td>
</tr>
<tr>
<td>Blood Pressure - Children</td>
<td>SBP &lt;90 and DBP &lt;60</td>
<td>SBP 90-99 or DBP 60-69</td>
<td>SBP 100 or more or DBP 70 or more</td>
</tr>
</tbody>
</table>

### Exercise and the Healthy Human

“Not less than two hours a day should be devoted to exercise”

Thomas Jefferson, 1776
Many US Adults Are Physically Inactive

Regular, Sustained Activity of Any Intensity (5x/week, >30 minutes)

Irregularly Active
38%

Sedentary
25%

Regular Vigorous Activity (3x/week, >20 minutes)
15%


Pedometer-Determined Physical Activity in Healthy Adults

- < 5000 steps/day: ‘sedentary lifestyle index’
- 5000-7499 steps/day: 'low active'
- 7500-9999: 'somewhat active'
- > or =10000 steps/day: ‘active’
- > 12500 steps/day: ‘highly active’

Work-Related Physical Activity among Cardiovascular Specialists
Thura Abd, Adwer Kobylivker, Adam Perry, Julie Ramos, Joseph Miller III, Laurence Sperling

Introduction
Current recommendations by the American Heart Association, the American College of Sports Medicine, and the US Surgeon General are that adults should accumulate a total of 10,000 steps per day. This study examines work-related physical activity among cardiovascular specialists.

Methods
All participants were from an academic tertiary center (N=28)
- 8 cardiothoracic (CT) surgeons
- 7 general cardiologists
- 5 procedural cardiologists
- 8 cardiac anesthesiologists

Demographic information
- age
- resting heart rate
- blood pressure
- body-mass index
- waist circumference
- past medical and social history

Subjects were asked to wear a spring levered pedometer on their hip for two weeks while at work and to record the total number of steps as well as number of hours worked each day.

Results
The average daily steps walked during work were 6540, 6039, 5910, and 5553 for general cardiologists, CT surgeons, procedural cardiologists, and cardiac anesthesiologists, respectively.

Conclusions
Work-related PA of CV specialists do not meet the recommended guidelines. Given their busy work schedule, obtaining the adequate amount of physical activity may be challenging. It is recommended that CV specialists engage in additional, out-of-hours exercise in order to achieve the adequate amount of daily required physical activity.

<table>
<thead>
<tr>
<th>Specialty</th>
<th>Daily Steps (in thousands)</th>
<th>Hours of Work</th>
<th>Steps/hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>CT surgeons</td>
<td>6038.8</td>
<td>12.4</td>
<td>478.2</td>
</tr>
<tr>
<td>Cardiac anesthesiologist</td>
<td>5553.3</td>
<td>9.3</td>
<td>594.9</td>
</tr>
<tr>
<td>General cardiologists</td>
<td>6540.1</td>
<td>10.1</td>
<td>683.6</td>
</tr>
<tr>
<td>Procedural cardologists</td>
<td>5910.4</td>
<td>10.8</td>
<td>542.0</td>
</tr>
</tbody>
</table>

Average daily steps and work hours for study population

Peak VO2=
Exercise (functional) capacity=
Prognosis!!
(1 MET = 3.5 ml O2/kg/min)

VO2 max= Maximal aerobic capacity (aerobic potential)
- Effected by
  - Genetics
  - Training
  - Age
- Major determinate – max C.O. (O2 supply)
  - Also O2 utilization (A-V O2 difference)
- VO2 max (ml/kg/min)
  - Non-athletes ages 20-29: 35-50
  - Cyclist / cross country skier: 65-90
  - Pre-heart t-plant: < 14
Low physical fitness is associated with increased mortality.

Exercise reduces CV and all-cause mortality

N = 9791, moderate exercise vs little or no exercise
NHANES I Epidemiological Follow-up Survey (1971-1992)

Exercise capacity and relative risk of all-cause mortality in individuals with type 2 diabetes mellitus according to MET levels achieved.
Walking as Exercise Reduces CVD Risk in Women


![Relative Risk of CHD vs. MET Quartile](image)

“Dose” of Physical Activity Improves CV Risk in Diabetes

Health Professionals Follow-up Study (HPFS)


![Relative Risk vs. Total Physical Activity (MET-hours/week)](image)

- N=2803 men with Type 2 DM
- 14-year follow-up
- 266 MACE accrued

Exercise and Atherosclerosis

- 62 pts with CAD
- randomized to physical activity vs. usual care
- repeat angiogram 1 yr later
- Those exercising <1000 kcal/week had progression of CAD
- Those exercising >2200 kcal/week had regression of CAD

Harmbrecht et al. JACC 1993; 22:468-77
Exercise (Cardiac Rehab) vs. PCI

Percutaneous Coronary Angioplasty Compared With Exercise Training in Patients With Stable Coronary Artery Disease
A Randomized Trial

Ranee Bhattacherjee, MD, Claudia Walker, MD, Zoya Mohanan-Wilkins, MD, Stefan Gofen, MD, Azizul Ishaq, MD, Katrina Corradi, MD, Yarden Esh, MD, Roger Kings, MD, Kai Klockenborg, MD, Osama Safab, MD, Peter Yeh, MD, Gerard Schafat, MD

Background: Exercise in patients with stable coronary artery disease has been shown to improve myocardial perfusion and reduce disease progression. We therefore conducted a randomized trial to compare the effects of exercise training versus standard pharmacological coronary intervention (PCI) with studies on clinical outcomes, exercise capacity, maximal test performance, cost effectiveness, and frequency of rehospitalization and arrhythmias. Patients assigned to the low-dose aspirin, rosuvastatin, and angiotensin-converting enzyme inhibitors with or without exercise training were randomly assigned to treatment groups.

Methods and Results: A total of 108 patients aged 55 to 75 years were randomized to the exercise intervention or standard PCI. After 12 months of follow-up, exercise training improved exercise capacity and quality of life significantly more than PCI. The primary endpoint, mortality, was significantly lower in the exercise training group (25%) compared with the PCI group (45%). Significant reductions in mortality were also observed in patients with diabetes mellitus, hypertension, and severe coronary artery disease.

Key Words: exercise training • aspirin • rosuvastatin • ACE inhibitors

Mortality Reduction Potential of Lifestyle Changes (Studies in Coronary Artery Disease Patients): Comparison With Preventive Drug Interventions After MI


<table>
<thead>
<tr>
<th>Intervention</th>
<th>Mortality Risk Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low-dose aspirin</td>
<td>14%</td>
</tr>
<tr>
<td>Moderate alcohol</td>
<td>20%</td>
</tr>
<tr>
<td>Statins</td>
<td>25%</td>
</tr>
<tr>
<td>Beta-Blockers</td>
<td>23%</td>
</tr>
<tr>
<td>Physical activity</td>
<td>25%</td>
</tr>
<tr>
<td>ACE inhibitors</td>
<td>26%</td>
</tr>
<tr>
<td>Smoking cessation</td>
<td>35%</td>
</tr>
<tr>
<td>Combined dietary changes</td>
<td>43%</td>
</tr>
</tbody>
</table>

“TO PREVENT A HEART ATTACK, TAKE ONE ASPIRIN EVERY DAY. TAKE IT OUT FOR A JOG, THEN TAKE IT TO THE GYM, THEN TAKE IT FOR A BIKE RIDE...”

© 1998 Randy Glasbergen. E-mail: randy@glasbergen.com
Mechanisms by which moderate to vigorous exercise training may reduce the risk of nonfatal and fatal cardiovascular events.

**Potential Cardioprotective Effects of Regular Physical Activity**

<table>
<thead>
<tr>
<th>Anti-atherosclerotic</th>
<th>Psychologic</th>
<th>Anti-Thrombotic</th>
<th>Anti-Ichmic</th>
<th>Anti-Arrhythmic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved lipid</td>
<td>↓ Depression</td>
<td>↓ Platelet</td>
<td>↓ Myocardial</td>
<td>↑ Vagal tone</td>
</tr>
<tr>
<td></td>
<td></td>
<td>adherence</td>
<td>O2 demand</td>
<td></td>
</tr>
<tr>
<td>Lower BP</td>
<td>↓ Stress</td>
<td>↑ Fibrinolysis</td>
<td>↑ Coronary flow</td>
<td>↑ Sympathetic activity</td>
</tr>
<tr>
<td>Reduced adiposity</td>
<td>↑ Social support</td>
<td>↓ Fibrinogen</td>
<td>↑ Endothelial dysfunction</td>
<td>↑ HR variability</td>
</tr>
<tr>
<td>↑ Insulin sensitivity</td>
<td>↓ Blood viscosity</td>
<td>↑ EPCs and CACx</td>
<td>↑ Nitric Oxide</td>
<td></td>
</tr>
<tr>
<td></td>
<td>↑ Inflammation</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Franklin B A, Cushman M Circulation 2011;123:2274-2283

Copyright © American Heart Association
Anti-Ischemic effect of exercise: Oxygen Supply and Demand

- Oxygen Supply
- Oxygen Demand
- Coronary Blood Flow
- Decreased viscosity
- Increased NO release
- Increase parasymp tone
- Duration of Diastole
- Contractility
- Heart Rate
- Systolic Pressure
- LV Wall Tension
- Volume

Ischemia

Physical Activity reduces inflammatory markers
- CRP reduced 30% in sedentary men after walking 5X / week
- Soluble ICAM & VCAM
- GM-CSF
- MCP-1 in heart failure

Church,T. ATVB 11/02
JACC 2005;45:1563

Exercise, Shear and Atherogenesis
- Laminar shear
- ROS: NO
- Non-laminar shear
Effect of Exercise Training on NO & EPCs

Laufs U et al. Circulation 2004;109

Low NOS
Low EPCs

High NO synthase
High levels of EPCs

I wonder if I would have a chance on American Idol!

Figure 5: Training and EPC levels in humans.

More to CV Prevention then just exercise……

CV Care of the Athlete / Athlete’s Heart

Atheletic participation is common

- Participation in athletic activities continues to escalate
  - 2 million participants in marathons and half-marathons in 2010
- Over 1 million teenagers participated in high school football in between 2010-2011


Risks of exercise?

Risks: NCAA athletes

- Overall incidence SCD 1:43,000
- Higher risk –
  - male athletes (1:33,000)
  - black male athletes (1:13,000)
  - male basketball players (1:7,000)

Cardiac Arrest during Long-Distance Running

- 10 yr incidence (2000-2010) 0.54 per 100K
- Marathon > half
- Men > women
- 71% fatal
- Occult CVD accounted for majority (HCM & CAD)


Sudden Death in Young Athletes

HCM (36%)
Coronary Anomalies (17%)


U.S. vs. European athletic screening

Maron BJ et al. Circulation
2007;115:1643-55

Role of exercise in public health / prevention

“We are under-exercised as a nation. We look instead of play. We ride instead of walk. Our existence deprives us of the minimum of physical activity essential for healthy living.”

John F. Kennedy, 1962

The Problem
“Will I still be able to not exercise?”

2-25-08 New Yorker Cartoon

Don’t call it exercise …….

• Afternoon stroll
• Family walk
• Quality time for you and your dog

Need for environmental/ System changes


[Diagram showing various strategies for health improvement]
Our “Toxic” Environment

New York vs Houston

Making the healthy choice the easy choice…..
The Built Environment
Helpful Signage

Making the healthy choice the easy (and safe) choice.....
The Built Environment
2,686 YMCAs

57% of U.S. households are located within 3 miles of a YMCA
Examples of Cost Savings / Value: Primordial / Primary Prevention

- Comprehensive community-based prevention
  - ROI of $5.60 for $1 spent within 5 yrs
- Comprehensive worksite wellness programs
  - Within 12-18 mo. reduction in medical costs by $3.27 for $1 spent
  - Absenteeism costs fall by $2.73 for $1 spent
- Bike and pedestrian trails
  - $3 medical cost savings for $1 invested


Role of exercise in Prevention

Take your head out of the sand

Strong Evidence that physical activity reduces the risk of:

- Early death
- Breast and Colon Cancer
- Chronic heart disease
- Excessive weight gain
- Stroke
- Injuries falls
- High blood pressure
- Depression
- Type 2 Diabetes
- Loss of cognitive function

Physical Activity Guidelines Advisory Committee (DHHS, 2008)
Exercise - “The magical ingredient”

“an agent with lipid-lowering, anti-hypertensive, positive inotropic, negative chronotropic, vasodilating, diuretic, anorexigenic, weight-reducing, cathartic, hypoglycemic, tranquilizing, hypnotic and anti-depressive qualities.”

William Roberts, AJC 1984

Summary: Exercise in CV Risk Reduction

- Exercise capacity & “dose” predict CV health & reduction in CV events
- Multiple potential mechanisms of benefit
- Physiologic adaptations – “athlete’s heart”
- Physical activity is safe for most
- Investment in built environs/ health promotion opportunity for cost savings

PREVENTIVE CARDIOLOGY

- Primary and secondary prevention clinics
- HeartWise Risk Reduction Program
- Optimal Living
- Women’s Heart Program
- Subclinical markers of atherosclerosis
- Screenings and Risk Factor management
- LDL apheresis
- Housestaff / fellow training program
- Clinical and Translational Science Research
Emory University Campus

Exercise – The Magical Ingredient
2500th Anniversary of the Marathon (Greece, Oct. 2010)

thanks
“Luck is what happens when preparation meets opportunity”
Seneca
Roman Philosopher
Born 5 B.C.

Exercise tolerance and Mortality

Myers et al. NEJM 346 (11): 793, 2002

Figure 2. Role of NO in exercise-induced EPC regulation.

Copyright © American Heart Association
Figure 1. Training and EPC levels in mice.


Shanghai

Shanghai ends reign of the bicycle

Succumbing at last to the worldwide love affair with the car, China - of all places - is officially turning up its nose at the humble bicycle.

Its biggest city, Shanghai, plans to ban bikes from all major roads next year to ease congestion, state-run newspapers said on Tuesday.
“What fits your busy schedule better, exercising one hour a day or being dead 24 hours a day?”