Exercise, Obesity, and the Heart

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Objectives:
• Describe how body mass index and fat content affect cardiovascular health
• Analyze how the obesity paradox applies to heart failure
• Identify how lifestyle modifications such as exercise and dietary changes may affect morbidity and survival
Exercise and Longevity

Focus on Heart and Vascular Disease
Cardiomythology

- 1800–1880 Exercise caused strain, hypertrophy and dilation of the heart
- 1880–1940 Exercise caused the physiologically normal heart to temporarily adapt to even extreme degrees without damage but without change
- 1940–1970 Athlete’s heart became accepted as a physiological and desirable set of adaptations and not pathological
- However this was not universally accepted then or now.
- 1979 NEJM letter to the editor questioned the heart healthiness of marathon running and coined “cardiomythology”
the human frame is constructed to bear an amount of strain specified by the laws of nature, and ... if the amount of strain be exceeded by an appeal to violence, the entire vital system suffers in proportion to the excess. “moderation” 1867
“there is not in England a trained professional athlete of the age of thirty-five, who has been ten years at his calling, who is not disabled”

Richardson 1889
“a search of the literature has failed to document a single death due to coronary atherosclerosis among marathoners of any age”

“The AMJA has been unable to substantiate a single ischemic heart disease death among marathon finishers of any age”

NEJM 1972 and 1976 Thomas Bassler MD, cardiologist

CARDIOMYTHOLOGY
Symptomatic Coronary Artery Disease in a Marathon Runner

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Abstract
A highly trained marathon runner had progressive angina pectoris. His exercise stress test showed ischemia, and selective coronary angiography demonstrated a 99% obstruction of the left anterior descending coronary artery. A lipid analysis revealed normal total serum cholesterol levels with elevated high-density lipoprotein and markedly decreased low-density lipoprotein fractions. The remaining risk factors for coronary artery atherosclerosis were also absent. Unlike previous reports of ischemic heart disease in runners, in which the level of conditioning has been low, the duration of running brief, the risk factors operative, or the documentation weak, this patient represents unequivocal evidence that a long-distance marathon runner's life-style is not necessarily protective against the progression of coronary atherosclerosis.

(JAMA 1982;248:717–719)
The controversy continues
What is the truth about exercise?

- 12% of mortality in the US relates to lack of physical activity
- Physical inactivity results in doubling of coronary event rates?
- Chronic high rates of physical activity confer immunity for CAD?
- 20–30 minutes per day three days per week of mild to moderate exercise is about right?
- Cardiovascular fitness and cardiovascular health are the same concept?
- Evidence for exercise benefits in primary and in secondary prevention are equally strong?
What is the truth about exercise?

- Athlete’s heart is a form of physiological adaptation which is healthy
- Athlete’s heart is pathological
- Exercise increases the incidence of sudden cardiac death
- Exercise decreases the incidence of sudden cardiac death
- Women are at greater risk than men (marathon approved as Olympic sport 1984)
What is the truth about exercise?

- Just like other “medications” there is a correct dose. It is possible to take too much or too little.
- Dose of exercise is well established for almost everyone at an hour per day at 80% max predicted HR.
- Excess exercise produces adverse cardiac structural as well as electrical pathology.
- Risks of excess exercise are short term rather than long term.
What is the truth about exercise?

- Increased incidence of atrial fibrillation and VT in endurance athletes
- Increased coronary calcium scores in athletes completing more than 25 marathons in past 25 years (ACC 2010 scientific sessions)
Exercise, why the controversy?

- Very difficult to do large prospective studies.
- Cannot prohibit exercise in control group
- Cannot get treatment group to exercise
- Therefore the differences in the amount of exercise between control and treatment groups is small
- Most studies are either very short and have relatively few patients
- Large observational studies predominate.
- There is not a single large prospective study evaluating primary prevention
Epidemiological studies Primary prevention

- Harvard Alumni (10,269 men)
- Honolulu Heart program (707 men)
- Nurses Health Study (72,488 women)
- Paffenbarger (7337 men)
- Women’s Health Initiative (70,000 women)
- Women’s Health Study (40,000 women)
- Finnish Twin Cohort study (8000 twins)
- Health Professionals Follow-up study (44,452 men)
- Aerobics Center Longitudinal (55,137 people)
Relation of fitness to cardiac morbidity and mortality

- Multiple studies in men show near linear relation of fitness (treadmill testing) to reduction in CV morbidity and mortality
- Likewise in women EST at study entry and then followed for multiple years
- Similar in younger patients and in older patients
- Contrary to earlier recommendations achievement of goal heart rate which is appropriate for fitness is not necessary for risk reduction.
All cause mortality reduced in most but not all trials.

There may be a detrimental effect after a certain level of exercise. More than 7 METs (4 MPH @ 7% grade) in Wen Lancet. 2011; 378 1244

Significant reduction in recurrent MI
Exercise and heart disease

- What is the difference between cardiovascular health and cardiovascular fitness?
- What is the importance of distinguishing acute effects from chronic effects of exercise?
Cardiac fitness
Cardiac health
No athlete will find success training at moderate levels of exertion four or five times per week.
Performance is enhanced by high levels of both strength and aerobic training.
This effect is temporary
There seems to not be an upper threshold for athletic performance enhancement
Cardiac health

- Is found even with low levels of chronic exercise
- Lower risk of cardiovascular disease prevalence, at least in observational studies
- Both observational as well as secondary prevention prospective trials show equivalent and additive protection compared to smoking, obesity, hypertension control
- However increasingly demonstrated that exercise is associated with lower mortality in a dose response fashion. Progression from low to moderate to high levels of physical activity affords progressively greater protection from premature death
Unequivocal Benefits

- Better lipid profile (TG and HDL)
- Blood pressure control
- Diabetes prevention and control; insulin sensitivity
- Miscellaneous beneficial effects on inflammation (CRP)
- Health of vascular endothelium
- Improved smoking cessation
- Weight loss
- Better red cell health
- Psychological health, less depression
Miscellaneous benefits of exercise

- Better sleep
- Less osteoporosis
- Less diabetes and metabolic syndrome
- Less of certain cancers including colon and breast
- Better cognitive function
- Fewer falls in elderly
- Relieves depression and anxiety, improves mood
- Promotes ideal weight
Benefits of Exercise

- If it could be sold in a bottle it would make its developer instantaneously wealthy
- Unfortunately although “natural”, inexpensive, and universally available it is often not prescribed and less often adhered to
- For every reason to exercise there are many excuses not to exercise
Physical Activity. How are we doing?

- USA children and adults are sedentary for 58% of waking hours, and this figure is increasing (NHANES 2008)
- In USA 43% are aerobically active, defined as >150 minutes per week of moderate activity or > 75 minutes per week of vigorous activity
- World wide 80% of children and adults are aerobically active
Quantification of Physical Activity

- Moderate (3–6 mets) brisk walking 150 minutes per week or leisure cycling, mowing the lawn
- Vigorous (>6 mets) running, cross country skiing, back packing or other vigorous exercise
Exercise for Seniors; how are we doing?

- For secondary prevention 14% of medicare patients had cardiac rehab prescribed after MI
- Only 31% of patients after CABG have cardiac rehabilitation prescribed
- This despite lower risk of death and MI at 4 years confirmed in several trials
- Number of exercise sessions attended correlates strongly with measured benefits
Exercise for Seniors, how?

- Ideal prescription is not known
- Target 65–75% of maximal safe HR. For most benefits do not need to be at “goal” HR
- This is a reduction from prior recommendation of 75–85% of MPHR and lower than for younger patients
- Why lower intensity for seniors? Cooling is less efficient. Muscle and joint trauma more easily induced
- For equivalent benefit exercise needs to be of longer duration than for younger individuals
- Warm up with stretching
- Cool down gradual to avoid hypotension
Exercise for Seniors; how

- Obesity management: Need to remember:
  - Young man burns 700–1000 calories per hour
  - Older man burns 250–400 calories per hour.
  - Less intensity. Less muscle mass
  - Ham sandwich is 450 calories for both!
  - Exercise for longer duration, more days per week.
  - Current 2011 guidelines: 30–60 minutes 5–7 days per week
  - Most age related physiological changes are magnified by sedentary life style.
Cardiovascular Risk factors

- Traditional teaching has been that there is no increased benefit seen above infrequent mild exercise.
- The goals of blood pressure reduction, lipid improvement, and diabetes prevention are all seen with mild to moderate exercise five days per week, 30–60 minutes per day.
- However, studies demonstrate even more HDL improvement in those who run 50 than in those who run 40 miles per week and in 40 more than 20.
- CV risk of men running over 40 miles per week compared to those running up to 10 miles per week was 30% less over ten years (Arch Intern. Med 1997;157(2)191).
- These findings are confirmed in multiple observational studies.
Primary prevention

12,516 men mean age 57 followed for 16 years

Five levels of average exercise (<2000 cal/week to >1200 cal/week)

Followed for MI, angina, revascularization, CV death

Relative risk reduction of 23% between lowest and highest

Controlled for other risk factors
Honolulu Heart Program

Hakim NEJM 1998; 338:94–99

- Primary prevention: 707 non-smoking retired men; 208 died in 12 year follow up
- 41 versus 24% mortality in those who walked <1 mile/day versus > 2 miles/day
- Mortality according to year of follow up and distance walked
Primary prevention: 72,488 middle aged healthy female nurses
8 year follow up 645 MI or CV death
Highest group walked >3 miles/week at brisk pace versus infrequent walkers (lowest group)
.88, .81, .74, .66 relative risk for coronary event depending on which quintile of exercise
Women’s Health Study
Lee JAMA 2001;285(11):1447

- Primary prevention 39,372 healthy women
- Mean age 54 (>45 years to start)
- 7 year follow up 244 cases of CHD
- CHD risk .86,.49,.48 based on walking <1 hour.1–1.5 hr,> 2hours
- To maintain ideal weight 30 minutes of vigorous exercise needed per day
- Or 60 minutes of moderate exercise per day
- For overweight or those eating more than a normal diet more exercise needed still.
RESULTS: Men and women who reported having physical activity in the highest category (i.e., walking 1 h/day or doing sports 5 h/week) had a 20% to 60% lower age-adjusted risk of mortality from CVD, compared with those in the second lowest physical activity category (i.e., walking 0.5 h/day, or sports participation for 1 to 2 h/week). Adjustment for known risk factors did not substantially alter these results. The multivariate-adjusted hazard ratios (95% confidence interval) for the highest versus the second lowest categories of walking or sports participation were 0.71 (0.54 to 0.94) and 0.80 (0.48 to 1.31), respectively, for ischemic stroke (IS); 0.84 (0.64 to 1.09) and 0.51 (0.32 to 0.82), respectively, for CHD; and 0.84 (0.75 to 0.95) and 0.73 (0.60 to 0.90), respectively, for CVD.
44,452 men in Health professionals follow-up study 1986–1998 followed at 2 year intervals

Conclusions: Total physical activity, running, weight training, and walking were each associated with reduced CHD risk. *Average exercise intensity was associated with reduced risk independent of the number of MET-hours spent in physical activity.*

Dose Response Between Physical Activity and Risk of Coronary Heart Disease A Meta–Analysis


Methods and Results—. After reviewing 3194 abstracts, we included 33 studies. Among the 33 studies, 9 allowed quantitative estimates of leisure–time physical activity. Individuals who engaged in the equivalent of 150 min/wk of moderate–intensity leisure–time physical activity (minimum amount, 2008 US federal guidelines) had a 14% lower coronary heart disease risk (relative risk, 0.86; 95% confidence interval, 0.77 to 0.96) compared with those reporting no leisure–time physical activity. Those engaging in the equivalent of 300 min/wk of moderate–intensity leisure–time physical activity (2008 US federal guidelines for additional benefits) had a 20% (relative risk, 0.80; 95% confidence interval, 0.74 to 0.88) lower risk. At higher levels of physical activity, relative risks were modestly lower. People who were physically active at levels lower than the minimum recommended amount also had significantly lower risk of coronary heart disease. There was a significant interaction by sex (P=0.03); the association was stronger among women than men.

Conclusions—These findings provide quantitative data supporting US physical activity guidelines that stipulate that “some physical activity is better than none” and “additional benefits occur with more physical activity.”
Exercise–based Cardiac Rehab began in the 1960’s and trials began to be published in the 1980’s

Meta analysis of 48 trials, 8940 patients.

- Reduced all cause mortality of 20%
- Reduced cardiac mortality of 26%
- Reduced blood pressure, cholesterol, smoking.

Secondary prevention: clinical benefits

- Improved maximal oxygen consumption
- Endurance and exercise capacity
- Neuromuscular coordination and balance
- Joint mobility
- Muscular strength
- Bone mass and density
- Apparent cognitive function
- Sexual function
- Reduced depression and improved optimism
- Sleep status
Secondary prevention: laboratory benefits

- Endothelial function
- Reduction in hemostatic factors including blood viscosity, fibrinogen, coagulation factors, VW factor, D-dimer
- C-reactive protein
- Vascular compliance
- Insulin resistance
- Virtually all indices of cardiovascular and peripheral vascular function
Secondary prevention. MI survivors

- Lower incidence fatal MI (19–34% reduction in various studies)
- Rates for elderly are equivalent to reduction in younger patients including >75 years
- All cause mortality
- Readmission rates
- Health costs
- Quality of life indicators
- Morbidity measures
Physically active lifestyle has been associated with various health benefits and decreased risk of diseases, such as CVD. In the present study of 2,172 patients with ACS we found that physical activity was negatively associated with the severity of these syndromes. Furthermore, we found that physical activity was also associated with a reduction of in-hospital mortality rates. It appears that a physically active lifestyle may confer protection during the first month after an ACS, in terms of both mortality and re-hospitalization due to a recurrent event. JACC, 2008;51;2034–2039
Secondary prevention 2011 AHA/ACC guidelines

- **Physical activity Class I**  
  Goal: At least 30 minutes, 7 days per week (minimum 5 days per week)  
  1 For all patients, the clinician should encourage 30 to 60 minutes of moderate-intensity aerobic activity, such as brisk walking, at least 5 days and preferably 7 days per week, supplemented by an increase in daily lifestyle activities (eg, walking breaks at work, gardening, household work) to improve cardiorespiratory fitness and move patients out of the least fit, least active high-risk cohort (bottom 20%) (54,55,58). *(Level of Evidence: B)*  
  2 For all patients, risk assessment with a physical activity history and/or an exercise test is recommended to guide prognosis and prescription (47–52,58). *(Level of Evidence: B)*  
  3 The clinician should counsel patients to report and be evaluated for symptoms related to exercise. *(Level of Evidence: C)*

- **Class IIa**  
  1 It is reasonable for the clinician to recommend complementary resistance training at least 2 days per week (59). *(Level of Evidence: C)*
Other alternatives
Other Alternatives
Other Alternatives
Other alternatives
Alternatives