Update on Cardiac Rehabilitation

Vera Bittner, MD, MSPH, FNLA
Professor of Medicine
Section Head, Preventive Cardiology
Division of Cardiovascular Disease
University of Alabama at Birmingham
Disclosures related to this presentation: None
Outline

- Physical activity and physical fitness
  - CV Outcomes
  - Effect on lipids

- Cardiac rehabilitation
  - Eligibility and utilization
  - Core components
  - Outcomes
2008 PA Guidelines

- Some PA is better than none

- Substantial Health Benefits:
  - $\geq 150$ min (2.5 hrs) a week of moderate-intensity PA or
  - $\geq 75$ min/week of vigorous-intensity PA or
  - equivalent combination of moderate and vigorous aerobic PA
  - Should be performed in bouts of $\geq 10$ min
  - Should be spread throughout the week

- Additional Health Benefits:
  - Increase aerobic PA to 300 min (5 hrs) a week of moderate-intensity
  - or 150 min/week of vigorous-intensity aerobic physical activity
  - or equivalent combination of moderate- and vigorous-intensity PA

- Muscle-Strengthening Activities
  - Moderate or high intensity
  - Involve all major muscle groups
  - 2 or more days a week

Be Active, Healthy, and Happy!

www.health.gov/paguidelines
Intensity of PA

Moderate PA (3-5.9 METS)
- Brisk walking (≥3 mph)
- Water aerobics
- Bicycling (<10 mph)
- Tennis (doubles)
- Ballroom dancing
- General gardening

Vigorous PA (≥6 METS)
- Race-walking, jogging, or running
- Swimming laps
- Tennis (singles)
- Aerobic dancing
- Bicycling (≥10 mph)
- Jumping rope
- Heavy gardening
- Hiking uphill or with heavy backpack

www.health.gov/paguidelines
Cardiorespiratory Fitness and All Cause Mortality

- 33 studies
- 102,980 participants
- Age 37-51 y
- 6,910 deaths
- F/U 1.1-26 y

Summary RR: 0.87 (0.84-0.90)

Kodama et al. JAMA. 2009;301:2024-2035
Changes in Physical Fitness and CVD Mortality: Aerobic Center Longitudinal Study

- 87 deaths in 9,777 men
- 4.9 years between exams

Mortality Rate

Fitness at Two Exams

Unfit–Unfit: 65.0
Unfit–Fit: 31.4
Fit–Fit: 14.2

Blair SN et al. JAMA 1995;273:1093-1098 (adapted from www.lipidsonline)
None for primary prevention
Walking and CV Events

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Exposure</th>
<th>Sample size</th>
<th>Hazard ratio (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Hakim et al (1998)²</td>
<td>Walking &gt;3.2 km/day</td>
<td>707</td>
<td>0.39 (0.10 to 1.49)</td>
</tr>
<tr>
<td>2 Hakim et al (1999)¹⁴</td>
<td>Walking &gt;2.5 km/day</td>
<td>2678</td>
<td>0.43 (0.24 to 0.77)</td>
</tr>
<tr>
<td>3 Bijnen et al (1998)¹³</td>
<td>Walking &gt;1 hour/week</td>
<td>802</td>
<td>0.69 (0.45 to 1.05)</td>
</tr>
<tr>
<td>4 Sesso et al (2000)¹⁷</td>
<td>Walking &gt;10 km/week</td>
<td>12 516</td>
<td>0.88 (0.78 to 1.00)</td>
</tr>
<tr>
<td>5 Davey Smith et al (2000)¹⁹</td>
<td>Brisk walking</td>
<td>6702</td>
<td>0.47 (0.37 to 0.59)</td>
</tr>
<tr>
<td>6a Tanasescu et al (2002)²²</td>
<td>Walking &gt;3.5 hours/week</td>
<td>44 452</td>
<td>0.90 (0.73 to 1.10)</td>
</tr>
<tr>
<td>6b Tanasescu et al (2002)²²</td>
<td>Brisk walking</td>
<td>44 452</td>
<td>0.51 (0.31 to 0.84)</td>
</tr>
<tr>
<td>7 Noda et al (2005)²⁵</td>
<td>Walking &gt;1 hour/day</td>
<td>31 023</td>
<td>0.86 (0.72 to 1.00)</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>143 332</td>
<td>0.68 (0.55 to 0.85)</td>
</tr>
<tr>
<td>Female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1a Manson et al (1999)¹⁵</td>
<td>Walking &gt;3 hours/week</td>
<td>72 488</td>
<td>0.65 (0.47 to 0.91)</td>
</tr>
<tr>
<td>1b Manson et al (1999)¹⁵</td>
<td>Brisk walking</td>
<td>72 488</td>
<td>0.64 (0.47 to 0.88)</td>
</tr>
<tr>
<td>2 Sesso et al (1999)¹⁶</td>
<td>Walking &gt;10 km/week</td>
<td>1564</td>
<td>0.67 (0.45 to 1.01)</td>
</tr>
<tr>
<td>3a Lee et al (2001)²⁰</td>
<td>Walking &gt;2 hours/week</td>
<td>39 372</td>
<td>0.48 (0.29 to 0.78)</td>
</tr>
<tr>
<td>3b Lee et al (2001)²⁰</td>
<td>Brisk walking</td>
<td>39 372</td>
<td>0.52 (0.30 to 0.90)</td>
</tr>
<tr>
<td>4 Manson et al (2002)³¹</td>
<td>Walking &gt;3 hours/week</td>
<td>73 743</td>
<td>0.68 (0.58 to 0.82)</td>
</tr>
<tr>
<td>5 Gregg et al (2003)³³</td>
<td>Walking &gt;898 kcal/week</td>
<td>9518</td>
<td>0.62 (0.49 to 0.78)</td>
</tr>
<tr>
<td>6 Noda et al (2005)²⁵</td>
<td>Walking &gt;1 hour/day</td>
<td>42 424</td>
<td>0.84 (0.70 to 1.02)</td>
</tr>
<tr>
<td>7 Matthew et al (2007)²⁷</td>
<td>Walking &gt;10 MET-hour/day</td>
<td>67 143</td>
<td>0.92 (0.60 to 1.40)</td>
</tr>
<tr>
<td></td>
<td>Subtotal</td>
<td>417 930</td>
<td>0.69 (0.61 to 0.77)</td>
</tr>
<tr>
<td>Male and female</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 LaCroix et al (1996)¹⁰</td>
<td>Walking &gt;4 hours/week</td>
<td>1645</td>
<td>0.68 (0.52 to 0.90)</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>562 907</td>
<td>0.69 (0.61 to 0.77)</td>
</tr>
</tbody>
</table>

Test for heterogeneity
χ²(17) = 42.01, p < 0.001

Test for overall effect
χ²(1) = 47.68, p < 0.001
## Walking and All Cause Mortality

### Hazard Ratio

<table>
<thead>
<tr>
<th>Authors (year)</th>
<th>Exposure</th>
<th>Sample size</th>
<th>Hazard ratio (95% CI)</th>
<th>0.0</th>
<th>1.0</th>
<th>1.6</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Male</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Wannamethee et al (1998)</td>
<td>Walking &gt; 1 hour/day</td>
<td>4311</td>
<td>0.62 (0.37 to 1.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Hakim et al (1998)</td>
<td>Walking &gt; 3.2 km/day</td>
<td>707</td>
<td>0.55 (0.37 to 0.83)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Bijnen et al (1999)</td>
<td>Walking &gt; 1 hour/week</td>
<td>802</td>
<td>0.71 (0.58 to 0.88)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Davey Smith et al (2000)</td>
<td>Brisk walking</td>
<td>8702</td>
<td>0.55 (0.48 to 0.63)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 Fujita et al (2004)</td>
<td>Walking &gt; 1 hour/day</td>
<td>20004</td>
<td>0.92 (0.80 to 1.06)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6a Schnohr et al (2007)</td>
<td>Walking &gt; 2 hours/day</td>
<td>3204</td>
<td>0.89 (0.69 to 1.14)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6b Schnohr et al (2007)</td>
<td>Brisk walking</td>
<td>3204</td>
<td>0.43 (0.32 to 0.59)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>38934</td>
<td>0.66 (0.53 to 0.83)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 Gregg et al (2003)</td>
<td>Walking &gt; 898 kcal/week</td>
<td>9518</td>
<td>0.71 (0.62 to 0.82)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Fujita et al (2004)</td>
<td>Walking &gt; 1 hour/day</td>
<td>21159</td>
<td>0.72 (0.59 to 0.89)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3a Schnohr et al (2007)</td>
<td>Walking &gt; 2 hours/day</td>
<td>4104</td>
<td>0.81 (0.59 to 1.10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3b Schnohr et al (2007)</td>
<td>Brisk walking</td>
<td>4104</td>
<td>0.48 (0.35 to 0.66)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Matthew et al (2007)</td>
<td>Walking &gt; 10 MET-hours/day</td>
<td>67143</td>
<td>0.86 (0.71 to 1.05)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Subtotal</strong></td>
<td></td>
<td>106028</td>
<td>0.72 (0.62 to 0.84)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Male and female</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 LaCroix et al (1996)</td>
<td>Walking &gt; 4 hours/week</td>
<td>1645</td>
<td>0.73 (0.48 to 1.10)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Stessman et al (2000)</td>
<td>Walking &gt; 4 hours/week</td>
<td>456</td>
<td>0.14 (0.04 to 0.50)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td></td>
<td>147063</td>
<td>0.68 (0.59 to 0.78)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test for heterogeneity

\[
\chi^2(13) = 31.35, \ p < 0.001
\]

Test for overall effect

\[
\chi^2(1) = 57.86, \ p < 0.001
\]

Hazard Ratio 0.68 (0.59-0.78)
## Benefits of PA

### Adults and Older Adults

#### Strong evidence
- Lower risk of early death
- Lower risk of coronary heart disease
- Lower risk of stroke
- Lower risk of high blood pressure
- Lower risk of adverse blood lipid profile
- Lower risk of type 2 diabetes
- Lower risk of metabolic syndrome
- Lower risk of colon cancer
- Lower risk of breast cancer
- Prevention of weight gain
- Weight loss, particularly when combined with reduced calorie intake
- Improved cardiorespiratory and muscular fitness
- Prevention of falls
- Reduced depression
- Better cognitive function (for older adults)

#### Moderate to strong evidence
- Better functional health (for older adults)
- Reduced abdominal obesity

#### Moderate evidence
- Lower risk of hip fracture
- Lower risk of lung cancer
- Lower risk of endometrial cancer
- Weight maintenance after weight loss
- Increased bone density
- Improved sleep quality

[www.health.gov/paguidelines](http://www.health.gov/paguidelines)
Exercise and Lipids
Exercise RCT’s: Difficult to interpret ...

- Small studies
- Short-term
- Variable patient characteristics
  - Variable baseline lipoprotein profiles
- High drop-out rates
- Variable exercise frequency, intensity, duration, and type
- Often confounded by concomitant diet changes and weight changes
Exercise RCTs in Children and Adolescents

Meta-analysis of 12 trials

- **HDL-C**: -1.4 (-4.8, 1.9)
- **LDL-C**: 1.2 (-4.3, 6.7)
- **TG**: -11.0 (-22.8, 0.8)

HDL-C and Exercise

- **N= 35 trials**
  - N=1,404 subjects (age range 23-75 years)
  - Mean duration 27 weeks
  - HDL-C at BL: 36-78 mg/dL

- **Exercise:**
  - Mean of 3.7 sessions per week
  - Mean of 40.5 min per session
  - Intensity: 64.8% of max aerobic capacity (5.3 METs)
  - Mean weekly energy expenditure: 1019 kcal/wk

- **Mean net $\Delta$ in HDL-C: ** 2.53 mg/dL ($P<.001$)
  - Range: -3.5 to +9 mg/dL
  - 1.4 mg/dL $\Delta$ in HDL-C per 10 min prolongation of exercise per session
  - No association with exercise frequency or intensity

- **Weekly exercise volume to increase HDL-C:**
  - $\geq$900 kcal of energy expenditure per week
  - $\geq$120 min of exercise per week

Kodama et al. Arch Intern Med. 2007;167:999-1008
Studies of Targeted Risk Reduction Interventions through Defined Exercise (STRRIDE)

- N=111 sedentary, overweight men and women with mild-to-moderate dyslipidemia
  - 84 subjects included in analysis
- Duration: 6 months (control), 8 months (intervention)
- 3 exercise groups:
  - High-amount–high-intensity (caloric equivalent of jogging 20 miles/week at 65-80% of peak VO2)
  - Low-amount–high-intensity (caloric equivalent of jogging 12 miles/week at 65-80% of peak VO2)
  - Low-amount–moderate-intensity (caloric equivalent of walking 12 miles/week at 40 -55% of peak VO2)
- Goal: no significant change in baseline body weight
- NMR Lipoprotein profile and verification by measurement of cholesterol in lipoprotein subfractions

Studies of Targeted Risk Reduction Interventions through Defined Exercise (STRRIDE)

Studies of Targeted Risk Reduction Interventions through Defined Exercise (STRRIDE)

![Bar chart showing triglycerides mg/dL for different exercise groups.](chart.png)

Studies of Targeted Risk Reduction Interventions through Defined Exercise (STRRIDE)

Exercise did not change LDL-C

Kraus et al. NEJM 2002;347:1483-92
Benefits of Lifestyle Modification on LDL-C and Total Cholesterol in Women

LDL-C

Control: -2.5
Exercise: -5.6
Diet: -7.3
Diet + Exercise: -14.5

Total Cholesterol

Control: -1
Exercise: -5.7
Diet: -7.9
Diet + Exercise: -17.5

* P<0.05 vs placebo
† P<0.01

What do FH Patients Know About FH?

- N = 68
  - 41 men
  - 27 women

- Age 52±16 y
  - Range 22-83

- Survey

**TABLE 2: Patients’ Knowledge About Familial Hypercholesterolemia**

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total correct answers</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Cholesterol knowledge</td>
<td>62</td>
<td>93</td>
</tr>
<tr>
<td>Reason for drug treatment</td>
<td>61</td>
<td>90</td>
</tr>
<tr>
<td>Self-care prevention</td>
<td>60</td>
<td>88</td>
</tr>
<tr>
<td>Risk of diseases caused by FH</td>
<td>51</td>
<td>75</td>
</tr>
<tr>
<td>Reason for adherence</td>
<td>49</td>
<td>72</td>
</tr>
<tr>
<td>Cause of FH</td>
<td>46</td>
<td>69</td>
</tr>
<tr>
<td>Importance of exercise</td>
<td>35</td>
<td>52</td>
</tr>
<tr>
<td>Complications</td>
<td>32</td>
<td>48</td>
</tr>
<tr>
<td>The pathology of FH</td>
<td>26</td>
<td>39</td>
</tr>
<tr>
<td>Risk of genetic transmission</td>
<td>23</td>
<td>34</td>
</tr>
<tr>
<td>Family history</td>
<td>14</td>
<td>21</td>
</tr>
</tbody>
</table>

PRO-FIT Trial

- Parallel group randomized trial in the Netherlands among FH patients
- N=340; 12 month intervention
- Usual care vs. web-based and personal counseling to improve physical activity, diet, smoking and statin adherence
- No treatment benefit except for better diet in women in the intervention group

Broekhuizen K et al.. PLoS ONE 7(12): e50032. doi:10.1371/journal.pone.0050032
Cardiac Rehabilitation
Referral to CR: Class I Recommendation in AHA/ACC Guidelines and Performance Measure

- STEMI Guideline
- CABG Guideline
- PCI Guideline
- Secondary Prevention Guideline
- Women and CVD Guideline
- UA/NSTEMI Guideline
- SIHD Guideline
- Heart failure
- ...

- Performance Measures for CR Referral
  - Inpatient Referral
  - Outpatient Referral
- Endorsed by NQF 5/5/2010
CMS has expanded CR Eligibility

Before 2006
- Eligible
  - S/P MI
  - S/P CABG
  - Stable Angina
- Not Eligible
  - S/P PTCA
  - Heart Failure
  - S/P Cardiac Tx

Since 2006
- Eligible
  - S/P MI / ACS
  - S/P CABG
  - Stable Angina
  - S/P PCI
  - S/P Valve Surgery
  - S/P Cardiac Tx
- Not Eligible
  - Heart Failure

Since 2014
- Eligible
  - S/P MI / ACS
  - S/P CABG
  - S/P PCI
  - S/P Valve Surgery
  - S/P Cardiac Tx
  - Heart Failure
    - Feb 18, 2014
Cardiac Rehab Is Underutilized in Medicare Beneficiaries

- N=267,427
  - S/P MI or CABG 1997
  - Survived ≥30 days post D/C
- Overall CR use was 18.7%
  - MI 13.9%
  - CABG 31%
  - 9-fold variation among States (6.6-53.5%)

- Negative predictors of CR:
  - Older age
  - Women
  - Nonwhites
  - Co-morbidities (incl. HF, previous stroke, DM, cancer)

- Positive predictors of CR:
  - CABG
  - Higher income and education
  - Proximity to CR facility

CR is Underutilized in GWTG Hospitals

- 72,817 CR-eligible patients discharged between 1/00 and 9/07
- Overall referral rate: 56%

- Wide variation between hospitals: <20% referral rate in >1/3 hospitals

- CR utilization is lower than other secondary prevention measures

Brown TM et al. JACC 2009;54:515-521
AHA/AACVPR 2007: CR Core Components

- Patient assessment and treatment plan
  - Evidence-based meds
  - Flu vaccine
  - Collaboration with referring MD

- Nutritional counseling and weight management

- BP management
  - <140/90 mmHg
  - if DM, CKD, HF: <130/80 mmHg

- Lipid management
  - LDL-C <100 mg/dL
  - LDL-C <70 mg/dL “reasonable”
  - non-HDL-C <130 (<100) mg/dL

- Diabetes management
- Tobacco cessation
- Psychosocial management
- Physical activity counseling
- Exercise training
  - Aerobic
  - Resistance
  - Flexibility
  - Self-monitoring

Outcome Domains in CR
AACVPR Consensus Statement 2004

- Behavioral
  - Physical activity, diet habits, smoking, stress management techniques

- Clinical
  - Functional capacity, lipid levels, blood pressure, hemoglobin A1C, BMI, depression screen

- Health
  - Morbidity and mortality
  - “Patient centered”: health status, health-related QOL

- Service
  - Utilization rates, costs, patient and staff satisfaction

Sanderson et al. JCRP 2004;24:68-79
Cochrane Review of RCTs: Update 2011

- Meta-analysis of RCT’s with >6 m F/U
- N = 10,794 patients in 47 trials
  - Age range 46-84 years; generally “low risk”
  - 20% women, few minorities
  - Considerable loss to F/U or drop out (33/47 studies had >80% F/U)
- F/U time is important:

<table>
<thead>
<tr>
<th></th>
<th>RR 6-12 m</th>
<th>95% CI</th>
<th>RR &gt;12 m</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total mortality</td>
<td>0.82</td>
<td>0.67 – 1.01</td>
<td>0.87</td>
<td>0.75 – 0.99</td>
</tr>
<tr>
<td>CV mortality</td>
<td>0.93</td>
<td>0.71 – 1.21</td>
<td>0.74</td>
<td>0.63 – 0.87</td>
</tr>
<tr>
<td>Hospital Admission</td>
<td>0.69</td>
<td>0.51 – 0.93</td>
<td>0.69</td>
<td>0.87 – 1.11</td>
</tr>
</tbody>
</table>

Heran BS et al. Cochrane Library 2011, Issue 8
Are Prior Clinical Trial Data Applicable?

- Different demographics
  - Older, women, minorities
- Different acute MI treatment
  - Revascularization / lytics
- More NSTEMI than STEMI
- Different “secondary prevention” medications
  - ASA, Plavix, BB, ACE-I, statin
- Shorter time from event to enrollment
- Worse LV function
- More co-morbidities
  - DM, obesity, CKD, arthritis, ....
CR Outcomes: Observational Data

- Trials not ethical
  - Few subgroups with “equipoise” (e.g. HF ACTION)
- Observational data = real life data
- Can be continuously monitored

BUT

- Data subject to bias and confounding
  - Factors associated with CR participation are also often associated with prognosis

- Methods to overcome these:
  - Propensity matching
  - Multivariable regression modeling
  - Use of instrumental variables
CR Use and Mortality

- N = 601,099 Medicare Beneficiaries
- Propensity matched mortality analysis (70,040 matched pairs)
- F/U for mortality 1-5 years

- 12% participated
- 24 ± 12.4 sessions

- Use vs Non-use: 5 y RRR -34%
- More vs less: 5 y RRR -19%

Suaya JA et al. JACC 2009;54:25–33
CR Decreases Mortality and Recurrent MI

 Adjustment for reperfusion therapy, BB, ACE-I, statin, ASA did not alter benefit

 Benefit is seen, even if early deaths are excluded

 Benefit has increased in recent years
  - Referent: 1982
  - Risk of death in 1990: 0.41 (95% CI 0.33-0.52)
  - Risk of death in 1998: 0.28 (95% CI 0.18-0.43)

Witt et al. J Am Coll Cardiol 2004;44:988-996
## CR Benefits in Perspective

<table>
<thead>
<tr>
<th>Intervention</th>
<th>% Mortality Reduction</th>
<th>95% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute ASA in MI</td>
<td>-21</td>
<td>-13 to -26</td>
</tr>
<tr>
<td>IV t-PA &lt;6 hours</td>
<td>-26</td>
<td>-11 to -39</td>
</tr>
<tr>
<td>Longterm anti-platelet Rx</td>
<td>-11</td>
<td>-2 to -20</td>
</tr>
<tr>
<td>Beta blocker after MI</td>
<td>-22</td>
<td>-16 to -30</td>
</tr>
<tr>
<td>ACE-I in systolic HF</td>
<td>-37</td>
<td>-16 to -53</td>
</tr>
<tr>
<td>Exercise after MI</td>
<td>-19</td>
<td>-4 to -32</td>
</tr>
</tbody>
</table>

Yusuf S et al.  Overview of Clinical Trials in Heart Disease.  JAMA 1988;260:2088-2093
Cardiac Rehabilitation

- Lipid management is one of the core components in CR
- Lipids clearly improve during course of CR, but improvement is multi-factorial
  - Exercise
  - Diet
  - Adherence to medications
- Impact of exercise is difficult to tease out
Major Complications of Outpatient CR

Van Camp et al. JAMA 1986;256:1160-1163
- Cardiac arrest: 1 / 111,996 patient-hours
- MI: 1 / 293,990 patient-hours
- Fatalities: 1 / 783,972 patient-hours

Rognmo et al. Circulation 2012;126:1436-1440
- Cardiac arrest: 1 / 58,607 patient-hours (all)
  1 / 129,456 patient-hours (moderate)
  1 / 23,182 patient-hours (high intensity)
- MI: 0
- Fatalities: 1 / 175,820 patient-hours (all)
Conclusions

- Physical fitness and physical activity strongly predict CV risk and overall mortality
- Exercise improves dyslipidemia
- Limited data on impact of exercise on the lipid profile in patients with FH
- Large knowledge gap among FH patients about importance of lifestyle modification
- Participation in CR is associated with improved morbidity and mortality