Lifestyle Modification in Secondary Prevention

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Faculty Disclosure Information

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DISCLOSURES
Nothing to disclose
Today’s points:

- Cardiovascular disease is prevalent worldwide.

- Lifestyle modification consisting of diet, exercise, and stress reduction has a significant impact on all types of cardiovascular disease.

- Lifestyle modification is underutilized in the treatment and prevention of heart disease.

- I hope to remind you of the data behind these statements to empower you to help your patients make the necessary lifestyle changes to achieve optimal health.
Exhibit 1. Heart Healthy Nutrition and Physical Activity Behaviors

Heart-Healthy Nutrition and Physical Activity Behaviors

The adult population should be encouraged to practice heart-healthy lifestyle behaviors including:

- **Consume a dietary pattern that emphasizes intake of vegetables, fruits, and whole grains; includes low-fat dairy products, poultry, fish, legumes, nontropical vegetable oils, and nuts; and limits intake of sweets, sugar-sweetened beverages and red meats.**
  
  - Adapt this dietary pattern to appropriate calorie requirements, personal and cultural food preferences, and nutrition therapy for other medical conditions (including diabetes).
  
  - Achieve this pattern by following plans such as the DASH dietary pattern, the USDA Food Pattern, or the American Heart Association Diet.

- Engage in 2 hours and 30 minutes per week of moderate-intensity, or 1 hour and 15 minutes (75 minutes) per week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity. Aerobic activity should be performed in episodes of at least 10 minutes, preferably spread throughout the week. (143)

- Achieve and maintain a healthy weight. Refer to the 2013 Overweight and Obesity Expert Panel Report for recommendations on weight loss and maintenance (144).
In our ideal world, behavior change would work like this:

You know, exercise is good for you.

Absolutely! I will now go for a run.
Prevalence of Obesity in U.S. Adults

Percentage of State Obese (BMI ≥ 30)

- No Data
- <10%
- 10–14%
- 15–19%
- 20–24%
- 25–29%
- >30%

Source: CDC Overweight and Obesity
Obesity* Trends Among U.S. Adults
2013
(*BMI ≥30, or ~ 30 lbs. overweight for 5’ 4” person)
Can lifestyle changes reverse coronary heart disease?

The Lifestyle Heart Trial

DEAN ORNISH SHIRLEY E. BROWN LARRY W. SCHERWITZ
JAMES H. BILLINGS WILLIAM T. ARMSTRONG THOMAS A. PORTS
SANDRA M. McLANAHAN RICHARD L. KIRKEIDE
RICHARD J. BRAND K. LANCE GOULD

In a prospective, randomised, controlled trial to determine whether comprehensive lifestyle changes affect coronary atherosclerosis after 1 year, 28 patients were assigned to an experimental group (low-fat vegetarian diet, stopping smoking, stress management training, and moderate exercise) and 20 to a usual-care control group. 195 coronary artery lesions were analysed by quantitative coronary angiography. The average percentage diameter stenosis regressed from 46·0 (SD 16·6)% to 37·8 (16·5)% in the experimental group yet progressed from 42·7 (15·5)% to 46·1 (18·5)% in the control group. When only lesions greater than 50% stenosed were analysed, the average percentage diameter stenosis regressed from 61·1 (8·8)% to 55·8 (11·0)% in the experimental group and progressed from 61·7 (9·5)% to 64·4 (16·3)% in the control group. Overall, 82% of experimental-group patients had an average change towards regression. Comprehensive lifestyle changes may be able to bring about regression of even severe coronary atherosclerosis after only 1 year, without use of lipid-lowering drugs.

We carried out trials in 1977 and 1980 to assess the short-term effects of lifestyle changes on coronary heart disease: with non-invasive endpoint measures (improvements in cardiac risk factors, functional status, myocardial perfusion,7 and left ventricular function8). However, the subjects of those studies were not living in the community during the trial, and we did not use angiography to assess changes in coronary atherosclerosis.

Patients and methods

Patients with angiographically documented coronary artery disease were randomly assigned to an experimental group or to a usual-care control group. Experimental-group patients were prescribed a lifestyle programme that included a low-fat vegetarian diet, moderate aerobic exercise, stress management training, stopping smoking, and group support. Control-group patients were not asked to make lifestyle changes, although they were free to do so. Progression or regression of coronary artery lesions was assessed in both groups by quantitative coronary angiography at baseline and after about a year.

ADDRESS: Pacific Presbyterian Medical Center, Preventive Medicine Research Institute, and Departments of Medicine and Psychology, University of California San Francisco School of Medicine (D. Ornish, M.D.; E. Brown, M.D.; J. H. Billings, Ph.D.); UCSF-School of Dental Public Health and Hygiene (L. W. Armstrong, M.D.).


Introduction
Lifestyle changes in 28 subjects

- Low-fat vegetarian diet
  - 10% fat, 15-20% protein, 70-75% complex carbohydrates
  - No caffeine, less than 2 units EtOH, B12 supplements
  - No lipid lowering drugs
- Moderate aerobic exercise (1 hour three time per week)
- Stress management (1 hour per day)
  - Stretching, breathing techniques, meditation, progressive relaxation, imagery
- Smoking cessation
- Group support
  - 2 sessions per week, led by a clinical psychologist
195 lesions
40.0/42.7% stenosis

Correlation of overall adherence score and changes in percentage diameter stenosis in experimental group only (A) and in whole study group (B).

A = 7 subjects in each tertile; B = 13, 14, 13.
Genetic Risk, Adherence to a Healthy Lifestyle, and Coronary Disease

Amit V. Khera, M.D., Connor A. Emdin, D.Phil., Isabel Drake, Ph.D., Pradeep Natarajan, M.D., Alexander G. Bick, M.D., Ph.D., Nancy R. Cook, Ph.D., Daniel I. Chasman, Ph.D., Usman Baber, M.D., Roxana Mehran, M.D., Daniel J. Rader, M.D., Valentin Fuster, M.D., Ph.D., Eric Boerwinkle, Ph.D., Olle Melander, M.D., Ph.D., Marju Orho-Melander, Ph.D., Paul M Ridker, M.D., and Sekar Kathiresan, M.D.

Coronary Heart Disease

Coronary Collateral Growth Induced by Physical Exercise
Results of the Impact of Intensive Exercise Training on Coronary Collateral Circulation in Patients With Stable Coronary Artery Disease (EXCITE) Trial

Sven Möbius-Winkler, MD*; Madlen Uhlemann, MD*; Volker Adams, PhD; Marcus Sandri, MD; Sandra Erbs, MD; Karsten Lenk, MD; Norman Mangner, MD; Ulrike Mueller, MD; Jennifer Adam, MA; Martin Grunze, MD; Susanne Brunner, MD; Thomas Hilberg, MD, PhD; Meinhard Mende, PhD; Axel P. Linke, MD; Gerhard Schuler, MD

Circulation. 2016;133:1438-1448
Mechanisms of atrial fibrillation

AF indicates atrial fibrillation; Ca\(^{2+}\), ionized calcium; and RAAS, renin-angiotensin-aldosterone system.
2014 AHA/ACC/HRS Guideline for the Management of Patients With Atrial Fibrillation: Executive Summary

A Report of the American College of Cardiology/American Heart Association Task Force on Practice Guidelines and the Heart Rhythm Society

Developed in Collaboration With the Society of Thoracic Surgeons
2016 ESC Guidelines for the management of atrial fibrillation
Yoga

- Psycho-somatic Spiritual Discipline
- Healthy Body; Sound Mind
- Integrates physical poses (Asanas), breath exercises (Pranayama) and meditation (Dhyana).
- Improves flexibility, strength, relaxation, cardiovascular fitness
- Promotes mindfulness and calm
- Observational studies have shown symptom stability in CHF, increased exercise tolerance, increased cardiovascular endurance, improved cardiac function, improved autonomic function, decreased systemic and regional inflammatory markers, improve endothelial function, increase baseline parasympathetic tone, decrease systemic stress, downregulate the hypothalamic-pituitary-adrenal axis, decreased myocardial stress, decreased depression, increased quality of life
Yoga My Heart

- Single center, prospective, self-controlled (3 months control; 3 months intervention)
- Paroxysmal atrial fibrillation on stable medical therapy; change in therapy would result in exclusion
- 2 60 minute group sessions weekly with a DVD for home use. Participants were encouraged to practice daily at home and compliance was monitored with biweekly phone calls
- Iyengar Yoga group sessions:
  - 10 minute pranayama
  - 10 minute warm-up
  - 30 minute asanas
  - 10 relaxation exercises
### Baseline Characteristics of Participants

<table>
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<th>Clinical characteristic</th>
<th>Value (N, %)</th>
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<tr>
<td>Gender (M/F)</td>
<td>23 (46.9)/26 (53.1)</td>
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<tr>
<td>Age, yrs</td>
<td>60.6 ± 11.5</td>
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<td>BMI, kg/m²</td>
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<td>Duration of AF, months</td>
<td>63.9 ± 71.9</td>
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<td>Symptomatic AF</td>
<td>43 (87.7)</td>
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<td>LV ejection fraction, %</td>
<td>58.5 ± 6.3</td>
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<tr>
<td>LA size, cm</td>
<td>4.01 ± 0.50</td>
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<td>Comorbid conditions</td>
<td></td>
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<tr>
<td>Coronary artery disease</td>
<td>9 (18.4)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1 (2.0)</td>
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<tr>
<td>Hypertension</td>
<td>19 (38.8)</td>
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<tr>
<td>Hyperlipidemia</td>
<td>20 (40.8)</td>
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<tr>
<td>Obstructive sleep apnea</td>
<td>11 (22.4)</td>
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<td>Prior revascularization (PCI/CABG)</td>
<td>4 (8.2)</td>
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<tr>
<td>Medication use</td>
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<tr>
<td>Aspirin</td>
<td>28 (57.1)</td>
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<tr>
<td>Beta-blockers</td>
<td>31 (63.3)</td>
</tr>
<tr>
<td>ACE-IV/ARB</td>
<td>10 (20.4)</td>
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<tr>
<td>Statins</td>
<td>16 (32.7)</td>
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<tr>
<td>Antiarrhythmic medications</td>
<td>38 (77.6)</td>
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<td>Type of Score (n = 49)</td>
<td>Baseline (Day 0)</td>
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<tr>
<td>SDS (Depression)</td>
<td>31.0 (27.0-37.0)</td>
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<tr>
<td>SAS (Anxiety)</td>
<td>34.0 (31.5-37.0)</td>
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<td>SF-36 (domain-wise)</td>
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<td>1. Physical functioning</td>
<td>85.0 (80.0-95.0)</td>
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<td>2. Role physical</td>
<td>100.0 (75.0-100.0)</td>
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<tr>
<td>3. Bodily pain</td>
<td>100.0 (67.0-100.0)</td>
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<tr>
<td>4. General health</td>
<td>65.0 (50.0-77.5)</td>
</tr>
<tr>
<td>5. Vitality</td>
<td>84.0 (68.0-88.0)</td>
</tr>
<tr>
<td>6. Social functioning</td>
<td>100.0 (75.0-100.0)</td>
</tr>
<tr>
<td>7. Role emotional</td>
<td>68.0 (60.5-80.0)</td>
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<tr>
<td>8. Mental health</td>
<td>75.0 (65.0-85.0)</td>
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<tr>
<td>Hemodynamic parameters</td>
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<td>Heart rate</td>
<td>66.9 ± 8.3</td>
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<td>Systolic BP</td>
<td>135.0 ± 7.5</td>
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<tr>
<td>Diastolic BP</td>
<td>80.9 ± 7.7</td>
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Table Title:
Comparison of Baseline, and Pre- and Post-Yoga Intervention Secondary Efficacy Outcome Measures
Differences in Primary Efficacy Outcomes Measures Between the Control and Intervention Phase
Values are mean ± SD.

Figure Legend:
Patient Selection

Flow diagram demonstrating patient recruitment and attrition. AF = atrial fibrillation; AV = aortic valve; BMI = body mass index; Dx = diagnosis; WF = weight fluctuation; WG = weight gain; WL = weight loss.
<table>
<thead>
<tr>
<th></th>
<th>≥10% WL Group (N = 135)</th>
<th>3%–9% WL Group (N = 103)</th>
<th>&lt; 3% WL Group (N = 117)</th>
<th>p Value†</th>
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<tbody>
<tr>
<td></td>
<td>Baseline</td>
<td>Follow-Up‡</td>
<td>p Value*</td>
<td>Baseline</td>
</tr>
<tr>
<td>Weight, kg</td>
<td>101 ± 17</td>
<td>85 ± 14</td>
<td>&lt;0.001</td>
<td>99 ± 16</td>
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<tr>
<td>BMI, kg/m2</td>
<td>33.7 ± 4.7</td>
<td>28.4 ± 4.0</td>
<td>&lt;0.001</td>
<td>32.7 ± 4.4</td>
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<tr>
<td>Mean SBP, mm Hg</td>
<td>147 ± 17</td>
<td>129 ± 12</td>
<td>&lt;0.001</td>
<td>144 ± 17</td>
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<tr>
<td>DM with HbA1c ≥7</td>
<td>40 (30)</td>
<td>5 (4)</td>
<td>—</td>
<td>28 (27)</td>
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<tr>
<td>Medication use</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Anti-HTN</td>
<td>1.0 ± 0.9</td>
<td>0.5 ± 0.6</td>
<td>&lt;0.001</td>
<td>0.7 ± 0.8</td>
</tr>
<tr>
<td>On lipid Rx</td>
<td>66 (49)</td>
<td>37 (27)</td>
<td>—</td>
<td>45 (44)</td>
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<tr>
<td>AAD</td>
<td>1.1 ± 0.7</td>
<td>0.1 ± 0.4</td>
<td>&lt;0.001</td>
<td>1.0 ± 0.7</td>
</tr>
<tr>
<td></td>
<td>≥10% WL Group (N = 135)</td>
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<td>&lt; 3% WL Group (N = 117)</td>
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<tr>
<td></td>
<td>Baseline</td>
<td>Follow-Up‡</td>
<td>p Value*</td>
<td>Baseline</td>
</tr>
<tr>
<td>Serology and lipid profile</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>hsCRP, mg/l</td>
<td>5.1 ± 9.2</td>
<td>1.2 ± 2.4</td>
<td>&lt;0.001</td>
<td>4.4 ± 5.8</td>
</tr>
<tr>
<td>Fasting insulin, mU/l</td>
<td>18.3 ± 6.6</td>
<td>8.4 ± 3.9</td>
<td>&lt;0.001</td>
<td>16.9 ± 6.1</td>
</tr>
<tr>
<td>LDL level, mg/dl</td>
<td>116 ± 37</td>
<td>89 ± 31</td>
<td>&lt;0.001</td>
<td>116 ± 35</td>
</tr>
<tr>
<td>HDL level, mg/dl</td>
<td>50 ± 15</td>
<td>58 ± 15</td>
<td>&lt;0.001</td>
<td>46 ± 11</td>
</tr>
<tr>
<td>TG level, mg/dl</td>
<td>141 ± 62</td>
<td>97 ± 35</td>
<td>&lt;0.001</td>
<td>141 ± 53</td>
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<tr>
<td>Total cholesterol, mg/dl</td>
<td>189 ± 38</td>
<td>158 ± 35</td>
<td>&lt;0.001</td>
<td>185 ± 42</td>
</tr>
<tr>
<td></td>
<td>≥10% WL Group (N = 135)</td>
<td>3%–9% WL Group (N = 103)</td>
<td>&lt; 3% WL Group (N = 117)</td>
<td>p Value†</td>
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</tr>
<tr>
<td></td>
<td>Baseline</td>
<td>Follow-Up‡</td>
<td>p Value*</td>
<td>Baseline</td>
</tr>
<tr>
<td>Indexed LA volume, ml/m2</td>
<td>37.6 ± 5.4</td>
<td>30.9 ± 6.4</td>
<td>&lt;0.001</td>
<td>39.5 ± 6.2</td>
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<tr>
<td>IV septum, mm</td>
<td>11.7 ± 2.0</td>
<td>10.1 ± 0.7</td>
<td>0.001</td>
<td>11.5 ± 2.0</td>
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<tr>
<td>LVEDD, cm</td>
<td>5.0 ± 0.6</td>
<td>4.6 ± 0.9</td>
<td>&lt;0.001</td>
<td>5.0 ± 0.6</td>
</tr>
<tr>
<td>E/E' ratio</td>
<td>12.8 ± 4.2</td>
<td>8.5 ± 3.3</td>
<td>&lt;0.001</td>
<td>11.9 ± 4.6</td>
</tr>
<tr>
<td>AF symptom score</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>AF frequency (1–10)</td>
<td>7.0 ± 1.5</td>
<td>3.0 ± 1.9</td>
<td>&lt;0.001</td>
<td>7.0 ± 1.3</td>
</tr>
<tr>
<td>AF duration (1.25–10)</td>
<td>7.1 ± 1.8</td>
<td>4.2 ± 2.5</td>
<td>&lt;0.001</td>
<td>6.7 ± 1.8</td>
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<tr>
<td>AF episode severity (1–10)</td>
<td>7.0 ± 1.9</td>
<td>3.3 ± 1.8</td>
<td>&lt;0.001</td>
<td>7.1 ± 1.4</td>
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<tr>
<td>AF symptom subscale (0–35)</td>
<td>19.1 ± 5.9</td>
<td>9.2 ± 5.0</td>
<td>&lt;0.001</td>
<td>18.1 ± 4.9</td>
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<tr>
<td>Global well-being (1–10)</td>
<td>2.7 ± 0.8</td>
<td>8.1 ± 1.2</td>
<td>&lt;0.001</td>
<td>2.4 ± 0.9</td>
</tr>
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</table>
Outcomes of Atrial Fibrillation Freedom According to Weight Trend and Weight Fluctuation

(A) Kaplan-Meier curve for total AF-free survival (multiple ablation procedures with and without drugs) according to weight trend. (B) Kaplan-Meier curve for total AF-free survival (multiple ablation procedures with and without drugs) according to weight fluctuation. Abbreviations as in Figure 1.

Figure Legend:
Atrial Fibrillation Freedom Outcome According to Group

(A) Kaplan-Meier curve for AF-free survival without the use of rhythm control strategies. (B) Kaplan-Meier curve for AF-free survival for total AF-free survival (multiple ablation procedures with and without drugs). Abbreviations as in Figure 1.
Weight Management and Atrial Fibrillation

(Left) Obesity is associated with a variety of associated comorbidities. These are all associated with progression of the atrial substrate and the development of atrial fibrillation (AF). (Top) A dedicated weight management program with weight loss (WL) is associated with reverse remodeling of the atrial substrate and a dose-dependent reduction in the AF burden, which is sustained in the long term. (Bottom) The consequence of weight fluctuation, which somewhat curtails the beneficial effects of WL.
From: Impact of CARDIOrespiratory FITness on Arrhythmia Recurrence in Obese Individuals With Atrial Fibrillation: The CARDIO-FIT Study

J Am Coll Cardiol. 2015;66(9):985-996. doi:10.1016/j.jacc.2015.06.488

**Flow diagram demonstrating patient recruitment and attrition.**

AF = atrial fibrillation; AV = atrioventricular; BMI = body mass index; CRF = cardiorespiratory fitness; Dx = disease; EST = exercise stress test; MET = metabolic equivalent.

**Figure Legend:**

**Patient Selection**

Flow diagram demonstrating patient recruitment and attrition. AF = atrial fibrillation; AV = atrioventricular; BMI = body mass index; CRF = cardiorespiratory fitness; Dx = disease; EST = exercise stress test; MET = metabolic equivalent.
AF Freedom Outcome According to Baseline Cardiorespiratory Fitness (Baseline METs Achieved)

(A) Kaplan-Meier curve for AF-free survival without the use of rhythm control strategies. (B) Kaplan-Meier curve for AF-free survival for total AF-free survival (multiple ablation procedures ± drugs; right). Abbreviations as in Figure 1.
Figure Legend:

Outcomes of AF Freedom According to Cardiorespiratory Fitness Gain (<2 METs Gain vs. ≥2 METs Gain)
From: Impact of CARDIOrespiratory FITness on Arrhythmia Recurrence in Obese Individuals With Atrial Fibrillation: The CARDIO-FIT Study

J Am Coll Cardiol. 2015;66(9):985-996. doi:10.1016/j.jacc.2015.06.488

Figure Legend:
Outcomes of AF Freedom According to Cardiorespiratory Fitness Gain (<2 METs Gain vs. ≥2 METs Gain) and Weight Loss (<10% vs. ≥10% Weight Loss)

<table>
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<tr>
<th>Time (Days)</th>
<th>Follow-Up (Days)</th>
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<tr>
<td>0</td>
<td>365</td>
</tr>
<tr>
<td>77</td>
<td>71</td>
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<td>53</td>
<td>37</td>
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<tr>
<td>28</td>
<td>13</td>
</tr>
<tr>
<td>≥10% WL+ MET Gain ≥2</td>
<td></td>
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<tr>
<td>28</td>
<td>26</td>
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<tr>
<td>11</td>
<td>9</td>
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<td>7</td>
<td>6</td>
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<tr>
<td>&lt;10% WL+ MET Gain &lt;2</td>
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<td>48</td>
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<td>24</td>
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<td>8</td>
<td>4</td>
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<td>&lt;10% WL+ MET Gain ≥2</td>
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<td>151</td>
<td>84</td>
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<td>50</td>
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<td>40</td>
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<td>109</td>
<td>74</td>
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<tr>
<td>36</td>
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From: Maintenance of sinus rhythm in patients with atrial fibrillation: An AFFIRM substudy of the first antiarrhythmic drug


Figure Legend:

Time to recurrence of atrial fibrillation—amiodarone versus class I drugs. Time zero is the first day sinus rhythm was documented. Patients were censored at death, if lost to follow-up, or upon withdrawal of consent.
Figure Legend:

Cardiorespiratory Fitness and AF Recurrence: CARDIO-FIT trial

AF = atrial fibrillation; BP = blood pressure; CARDIO-FIT = CARDIOrespiratory FITness; CRF = cardiorespiratory fitness; MET = metabolic equivalent.
From: Treatment of Obstructive Sleep Apnea Reduces the Risk of Atrial Fibrillation Recurrence After Catheter Ablation


**Figure Legend:**

**Study Cohort: Flowchart**

Flow diagram showing the establishment of the study cohort and division into treatment groups (shown in dark gray and control groups in light gray). CPAP = continuous positive airway pressure; OSA = obstructive sleep apnea; pts = patients; PVI = pulmonary vein isolation.
Kaplan-Meier Survival Curves According to Treatment Group
Log-rank p = 0.02. AF = atrial fibrillation; other abbreviations as in Figure 1.
From: Effect of Caloric Restriction or Aerobic Exercise Training on Peak Oxygen Consumption and Quality of Life in Obese Older Patients With Heart Failure With Preserved Ejection Fraction: A Randomized Clinical Trial


Flow of Participants Through the Study

BMI indicates body mass index (calculated as weight in kilograms divided by height in meters squared); COPD, chronic obstructive pulmonary disease; NYHA, New York Heart Association.

*Violated protocol by immediately undertaking formal, aggressive diet and exercise interventions outside of protocol.

Figure Legend:
EXERCISE: 1-hour supervised exercise sessions 3 times per week for 20 weeks consisting primarily of walking exercise using an individualized exercise prescription.

DIET: Hypocaloric diet using meals (lunch, dinner, and snacks) prepared by the Wake Forest University General Clinical Research Center metabolic kitchen; -350 cal deficit for the exercise group and -400 cal deficit for the diet group (based on metabolic needs. Diet consisted of 1.2 g protein/kg ideal body weight and 25-30% fat calories.

CONTROL: Participants randomized to control voluntarily agreed to not make diet or exercise changes during the 20-week study. They received telephone calls every 2 weeks from staff in an attempt to match that received by participants in the diet and exercise groups.
From: Effect of Caloric Restriction or Aerobic Exercise Training on Peak Oxygen Consumption and Quality of Life in Obese Older Patients With Heart Failure With Preserved Ejection Fraction: A Randomized Clinical Trial

<table>
<thead>
<tr>
<th>Table 1. Baseline Characteristics of Factorial Groups at Randomization</th>
</tr>
</thead>
<tbody>
<tr>
<td>Characteristic</td>
</tr>
<tr>
<td>Demographic and Weight Characteristics, Mean (SD)</td>
</tr>
<tr>
<td>Age, y</td>
</tr>
<tr>
<td>Women, No. (%)</td>
</tr>
<tr>
<td>White, No. (%)</td>
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<tr>
<td>Body weight, kg</td>
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<tr>
<td>Body surface area, m²</td>
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<tr>
<td>BMI</td>
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<tr>
<td>Body fat, %</td>
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<tr>
<td>Cardiovascular Measures, Comorbidities, and Medications, Mean (SD)</td>
</tr>
<tr>
<td>NYHA heart failure class, No. (%)</td>
</tr>
<tr>
<td>III</td>
</tr>
<tr>
<td>Ejection fraction, %</td>
</tr>
<tr>
<td>Left ventricular mass, g</td>
</tr>
<tr>
<td>Relative wall thickness</td>
</tr>
<tr>
<td>Diastolic filling pattern, No. (%)</td>
</tr>
<tr>
<td>Inappropriate relaxation</td>
</tr>
<tr>
<td>Pseudonormal</td>
</tr>
<tr>
<td>Restrictive</td>
</tr>
<tr>
<td>E', cm/s</td>
</tr>
<tr>
<td>E'/e' rate</td>
</tr>
<tr>
<td>B-type natriuretic peptide, median (IQR), pg/mL</td>
</tr>
<tr>
<td>Current atrial fibrillation, No. (%)</td>
</tr>
<tr>
<td>History of diabetes mellitus, No. (%)</td>
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<tr>
<td>History of hypertension, No. (%)</td>
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<tr>
<td>Blood pressure, mm Hg</td>
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<tr>
<td>Diastolic</td>
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<tr>
<td>Current medications, No. (%)</td>
</tr>
<tr>
<td>Diuretics</td>
</tr>
<tr>
<td>E-Blockers</td>
</tr>
<tr>
<td>Calcium antagonists</td>
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<tr>
<td>Nitrates</td>
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<tr>
<td>Angiotensin receptor blockers</td>
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<tr>
<td>Exercise Capacity, Mean (SD)</td>
</tr>
<tr>
<td>Peak VO₂</td>
</tr>
<tr>
<td>% predicted*</td>
</tr>
<tr>
<td>mL/min</td>
</tr>
<tr>
<td>Peak RER</td>
</tr>
<tr>
<td>Exercise time, min</td>
</tr>
<tr>
<td>6-min walk distance</td>
</tr>
<tr>
<td>% predicted*</td>
</tr>
</tbody>
</table>

Abbreviations: ACR, angiotensin converting enzyme; BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); E- wave velocity; e’, early mitral annulus velocity (measured by tissue Doppler imaging); IQR, interquartile range; NYHA, New York Heart Association; RER, respiratory exchange ratio.
Conversion factor: 1 foot is equal to 0.3 meters.
* Diastolic filling pattern determined according to American Society of Echocardiography criteria. The diastolic filling pattern was not recorded for 1 participant in the exercise group and the diet group.
* As compared with 60 healthy age and sex-matched sedentary controls.**
### From: Effect of Caloric Restriction or Aerobic Exercise Training on Peak Oxygen Consumption and Quality of Life in Obese Older Patients With Heart Failure With Preserved Ejection Fraction: A Randomized Clinical Trial


<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall Baseline, Mean (SD)</th>
<th>Exercise Factorial Groups</th>
<th>Diet Factorial Groups</th>
<th>P Value for Interaction Between Exercise and Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Least Squares Mean (95% CI)</td>
<td>Exercise (n = 46)</td>
<td>No Exercise (n = 46)</td>
<td>Least Squares Mean (95% CI)</td>
</tr>
<tr>
<td><strong>Primary Outcomes</strong></td>
<td></td>
<td></td>
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<tr>
<td>Peak $\dot{V}_O_2$, mL/kg/min</td>
<td>14.5 (2.6)</td>
<td>16.0 (15.6 to 16.4)</td>
<td>14.8 (14.4 to 15.2)</td>
<td>16.1 (15.7 to 16.5)</td>
</tr>
<tr>
<td>MLHF Questionnaire score</td>
<td>29 (20)</td>
<td>18 (14 to 22)</td>
<td>19 (15 to 23)</td>
<td>16 (12 to 20)</td>
</tr>
</tbody>
</table>
# Table 2. Primary and Secondary Outcomes by Diet and Exercise Factorial Groups

<table>
<thead>
<tr>
<th>Variable</th>
<th>Overall Baseline, Mean (SD)</th>
<th>Exercise Factorial Groups</th>
<th>Diet Factorial Groups</th>
<th>P Value for Interaction Between Exercise and Diet</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Least Squares Mean (95% CI)</td>
<td>Exercise Main Effect, Difference (95% CI)</td>
<td>P Value</td>
</tr>
<tr>
<td>6-min walk, ft</td>
<td>1351 (226)</td>
<td>1503 (1470 to 1536)</td>
<td>1397 (1366 to 1428)</td>
<td>106 (60 to 152)</td>
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<td></td>
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<tr>
<td>Leg power, W</td>
<td>111 (51)</td>
<td>116 (108 to 124)</td>
<td>118 (110 to 126)</td>
<td>-2 (-14 to 10)</td>
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<tr>
<td>Leg muscle quality, W/cm²[^e]</td>
<td>0.90 (0.32)</td>
<td>0.97 (0.89 to 1.05)</td>
<td>1.00 (0.92 to 1.08)</td>
<td>-0.03 (-0.15 to 0.09)</td>
</tr>
<tr>
<td>Quality of life</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KCCQ score[^f]</td>
<td>62 (16)</td>
<td>75 (71 to 79)</td>
<td>73 (69 to 77)</td>
<td>2 (−3 to 7)</td>
</tr>
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<tr>
<td>SF-36 PCS[^g]</td>
<td>37 (9)</td>
<td>42 (40 to 44)</td>
<td>42 (40 to 44)</td>
<td>0 (−3 to 3)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>NYHA heart failure class</td>
<td>2.4 (0.5)</td>
<td>1.7 (1.5 to 1.9)</td>
<td>2.1 (1.9 to 2.3)</td>
<td>−0.4 (−0.6 to −0.2)</td>
</tr>
</tbody>
</table>
Exercise and Heart Failure


From: Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial

CI indicates confidence interval; HR, hazard ratio.\textsuperscript{a}Adjusted for key prognostic factors.
From: Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial


ACE indicates angiotensin-converting enzyme; CI, confidence interval; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NYHA, New York Heart Association.

Figure Legend:

ACE indicates angiotensin-converting enzyme; CI, confidence interval; LVEF, left ventricular ejection fraction; MI, myocardial infarction; NYHA, New York Heart Association.
From: Efficacy and Safety of Exercise Training in Patients With Chronic Heart Failure: HF-ACTION Randomized Controlled Trial


Figure Legend:
CI indicates confidence interval; HR, hazard ratio. *Adjusted for key prognostic factors.
Figure Legend:

Adjusted Kaplan-Meier Curves for Clinical Outcomes

Adjusted Kaplan-Meier curves for all-cause mortality or hospitalization (A) and cardiovascular mortality or heart failure hospitalization (B) in patients event-free for at least 3 months, stratified at the median exercise volume of 4 metabolic equivalent (MET)-h per week; dotted line indicates <4 MET-h per week, solid line indicates ≥4 MET-h per week.
Figure Legend:

Hazard Ratios for Cardiovascular Mortality or Heart Failure Hospitalization

Among patients event-free for at least 3 months, adjusted hazard ratios (solid circles, log scale) are given for cardiovascular mortality or heart failure hospitalization with 95% confidence intervals; reference category is 0 to 1 metabolic equivalent (MET)-h per week. Unadjusted hazard ratios are plotted with open circles.
From: Effects of Exercise Training on Outcomes in Women With Heart Failure: Analysis of HF-ACTION (Heart Failure–A Controlled Trial Investigating Outcomes of Exercise TraiNing) by Sex


Figure Legend:

Endpoint Analysis by Sex Subgroup of Exercise Versus Usual Care
All-cause death/hospitalization, women versus men, p = 0.027. CV = cardiovascular; VO = peak oxygen uptake.
In our ideal world, behavior change would work like this:

By the way, smoking is bad for you.

Oh my goodness! You are right. I will never smoke again.
Conclusion

Data we can share with our patients:

1. Exercise, weight loss, yoga and the treatment of OSA are powerful tools in the prevention of atrial fibrillation.

2. Exercise, weight loss, a low fat, plant based diet, and stress reduction can lead to the regression of coronary artery disease, a decrease in angina and need for revascularization and the prevention of acute myocardial infarction.

3. Patients with HFpEF can improve exercise tolerance and decrease CHF symptoms with weight loss and regular exercise.

4. Patients with HFrEF can safely exercise and if exercise is tolerated, decrease their cardiovascular mortality and need for hospitalization.
QUESTIONS?

Thank you!!