Outcomes in a Community-Based Intensive Cardiac Rehabilitation Program: Comparison with Hospital-Based and Academic Programs

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ABSTRACT

BACKGROUND: The purpose of this study was to test the hypothesis that a community-based intensive cardiac rehabilitation program could produce positive changes in risk factor profile and outcomes in an at-risk population.

METHODS: Participants seeking either primary or secondary coronary artery disease prevention voluntarily enrolled in the 12-week intensive cardiac rehabilitation program. Data were obtained at baseline and 6-12 months after completion of the program.

RESULTS: A total of 142 individuals, mean age 69 years, completed the Heart Series between 2012 and 2016. Follow-up data were available in 105 participants (74%). Participants showed statistically significant improvements in mean weight (165 to 162 lbs, P = .0005), body mass index (26 to 25 kg/m², P = .001), systolic blood pressure (126 to 122 mm Hg, P = .01), diastolic blood pressure (73 to 70 mm Hg, P = .0005), total cholesterol (175 to 168 mg/dL, P = .03), low-density lipoprotein cholesterol (LDL-C) (100 to 93 mg/dL, P = .005), LDL-C/high-density lipoprotein cholesterol (HDL-C) ratio (1.8 to 1.6, P = .005), and cholesterol/HDL-C ratio (3.2 to 3.0, P = .003). Changes in HDL-C, triglycerides, and fasting blood glucose did not reach statistical significance, but all trended in favorable directions. Adverse cardiovascular disease outcomes were rare (one stent placement, no deaths).

CONCLUSIONS: A total of 105 participants completed our 12-week community-based intensive cardiac rehabilitation program and showed significant positive changes in several measures of cardiac risk, with only 1 adverse event. These results compare favorably with those of hospital-based and academic institutional programs.

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KEYWORDS: Cardiac rehabilitation; Intensive cardiac rehabilitation
participation. The intensive cardiac rehabilitation approach to risk factor modification is more comprehensive, in-depth, and integrative. Although intensive cardiac rehabilitation is newer and lacks the track record of traditional cardiac rehabilitation, intensive cardiac rehabilitation programs have shown efficacy and are a complement to traditional cardiac rehabilitation.

Inspired by Dean Ornish’s groundbreaking work, the Heart Series intensive cardiac rehabilitation program was created in collaboration between a cardiologist (CK) and cardiac rehabilitation RN (ES). The goal is to educate patients about lifestyle modification with the intent to comprehensively transform lifestyle, improve risk factors, and prevent heart disease events. This study was designed to analyze the program’s effectiveness.

**METHODS**

The Heart Series is a 12-week program that follows the Medicare definition of intensive cardiac rehabilitation: “a physician-supervised program that furnishes cardiac rehabilitation services more frequently and often in a more rigorous manner.” Enrollment is limited to fewer than 20 participants per session, and the program is offered 2 times each year for a fee of $350.

Each group meets weekly for 3 hours. Each week has a different theme, covering risk factors, pathophysiology, nutrition, safe and effective exercise, yoga, stress management, communication, food label reading, creating resiliency, supplements, and medications. The sessions are designed around engagement and active participation. Each weekly session includes evidence-based education, the practice of tai chi, and the sharing of a whole-food, plant-based potluck meal.

We offer the following general guidelines, which we encourage participants to adopt:

- **Aerobic Exercise:** 4-6 sessions per week, 30-60 minutes per session
- **Light Weights:** 1-2 sessions per week, 15-30 minutes per session
- **Nutrition:** Whole-food, plant-based diet; walk away from the standard American diet
- **Stress Management:** 15-30 minutes per day with multiple options, including, for example, tai chi, yoga, meditation biofeedback (Heart Math), reading, writing, music, religion, playing with a pet
- **Community Involvement:** The goal is to avoid isolation and enhance one’s support system

At the conclusion of each 12-week Heart Series, we hold a graduation, at which each participant shares the creation of their own personal program, which they consider sustainable. No 2 programs are identical, but each contains components of nutrition, exercise, community involvement, and stress management. We have no formal contact with participants after graduation.

From 2012 to 2016 we collected baseline data on all participants before beginning each 12-week intensive cardiac rehabilitation program. Data included weight, height, blood pressure, fasting glucose, cholesterol, high-density lipoprotein cholesterol (HDL-C), low-density lipoprotein cholesterol (LDL-C), triglycerides, medications, and cardiac event history. Data came from direct measurements by Heart Series staff, reports from physician offices and laboratories, and self-reporting. Participants were contacted 6 months after the completion of their program for repeat data collection. In some cases it took several months to acquire the follow-up data set.

**Statistical Methods**

Data are presented as mean and standard deviation. Paired comparison t tests were conducted for each measurement, comparing baseline with 6- to 12-month measures. The analysis was conducted using the SPSS statistical data analysis program, version 21 (IBM, Armonk, NY). Interim analyses conducted in 2014 and 2016 indicated results were trending in the desired direction (using t tests and Cohen’s d effect size because the data set was small). Because of these preliminary data, a 1-tailed t test was used for the present data analysis. A P value of <.05 was used as a determination of statistical significance.

**Baseline Characteristics**

Of the 105 participants, 61 were receiving primary prevention and 44 secondary prevention. Average age was 69 years. The majority of the primary prevention participants had at least one risk factor. The secondary prevention patients all had documented clinical coronary artery disease.

**RESULTS**

Between 2012 and 2016, we obtained complete baseline and follow-up data sets on 105 of 142 participants (74%). Table 1 shows parameters at baseline and at 6-12 months after completing the Heart Series program. Statistically significant changes from baseline occurred in weight (165 to 162 lbs, \( P = .0005 \)), body mass index (BMI) (26 to 25 kg/m², \( P = .001 \)), systolic blood pressure (126 to 122 mm Hg, \( P = .01 \)), diastolic blood pressure (73 to 70 mm Hg, \( P = .0005 \)), total cholesterol (175 to 168 mg/dL, \( P = .03 \)), LDL-C (100 to 93 mg/dL, \( P = .005 \)), LDL-C/HDL-C ratio (1.8 to 1.6, \( P = .005 \)), and cholesterol/HDL-C ratio (3.2 to 3.0, \( P = .003 \)). Changes in triglyceride (\( P = .241 \)), HDL-C (\( P = .0685 \)), and
fasting glucose \((P = .197)\) were not significant but all were trending in favorable directions.

Our intensive cardiac rehabilitation program results compare favorably to cardiac rehabilitation programs at primarily academic institutions\(^{18-20}\) (Table 2). In 92 elderly cardiac rehabilitation patients, mean age 70.1 years, Lavie et al\(^ {18}\) found significant reductions in BMI and increases in HDL-C but did not find significant changes in triglycerides, LDL-C, or total cholesterol. In a larger study at the same academic institutions, Maines et al\(^ {20}\) found significant reductions in BMI and triglycerides and increase in HDL-C but no significant decreases in total cholesterol or LDL-C in 591 patients, mean age 62 years.

In another cardiac rehabilitation study,\(^ {20}\) focusing on exercise training alone without attention to diet, there were only modest improvements in risk factors. This led the authors to conclude that nutritional and medical therapy were important components to achieve more substantial risk factor reduction goals.

Our intensive cardiac rehabilitation program results also compare favorably to other intensive cardiac rehabilitation programs that are hospital-based\(^ {11}\) and academic center–based\(^ {21}\) (Table 3).

A report on Ornish intensive cardiac rehabilitation program results in 2974 men and women at 24 sites\(^ {11}\) analyzed full data sets in 90.9% of participants at 12 weeks and less than 50% of participants at 1 year. Findings included significant changes in BMI, systolic and diastolic blood pressure, total cholesterol, LDL-C, and triglycerides. High-density lipoprotein cholesterol did not significantly increase from baseline. This study included primary and secondary prevention patients.

Another observational intensive cardiac rehabilitation study\(^ {21}\) looked at outcomes in 637 patients, 72% male, comparing preintervention and 3-month postintervention data. Interventions included smoking cessation, moderate aerobic exercise, nutrition counseling (Mediterranean diet), relaxation training, and cognitive/behavioral skills. Significant improvement occurred in systolic and diastolic blood pressure, total cholesterol, LDL-C, HDL-C, triglycerides, BMI, and several psychological measures.

An area where our data are not in line with published intensive cardiac rehabilitation and cardiac rehabilitation data is with regard to triglycerides. This may be explained by our low baseline level of triglyceride, 105 mg/dL, compared with baseline levels of 179 mg/dL,\(^ {11}\) 141 mg/dL,\(^ {15}\) 172 mg/dL,\(^ {19}\) 225 mg/dL,\(^ {20}\) and 158 mg/dL\(^ {21}\) in the studies included in Tables 2 and 3. In a cardiac rehabilitation study focusing on triglyceride level,\(^ {22}\) data showed that percent changes in triglycerides depended on the baseline levels. Patients with low

### Table 1 Heart Series Intensive Cardiac Rehabilitation Program Results (n = 104)

<table>
<thead>
<tr>
<th>Variable</th>
<th>Mean</th>
<th>SD</th>
<th>Mean</th>
<th>SD</th>
<th>% Change</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight (lb)</td>
<td>165</td>
<td>36</td>
<td>162</td>
<td>37</td>
<td>−2</td>
<td>.0005</td>
</tr>
<tr>
<td>BMI (kg/m(^2))</td>
<td>26</td>
<td>5</td>
<td>25</td>
<td>5</td>
<td>−2.3</td>
<td>.001</td>
</tr>
<tr>
<td>Systolic BP (mm Hg)</td>
<td>126</td>
<td>17</td>
<td>122</td>
<td>13</td>
<td>−3.2</td>
<td>.01</td>
</tr>
<tr>
<td>Diastolic BP (mm Hg)</td>
<td>73</td>
<td>9</td>
<td>70</td>
<td>10</td>
<td>−4.6</td>
<td>.0005</td>
</tr>
<tr>
<td>Cholesterol (mg/dL)</td>
<td>175</td>
<td>50</td>
<td>168</td>
<td>38</td>
<td>−3.6</td>
<td>.03</td>
</tr>
<tr>
<td>LDL-C (mg/dL)</td>
<td>100</td>
<td>42</td>
<td>93</td>
<td>34</td>
<td>−8</td>
<td>.005</td>
</tr>
<tr>
<td>LDL/HDL</td>
<td>1.8</td>
<td>1.6</td>
<td>1.6</td>
<td>1.6</td>
<td>−11</td>
<td>.005</td>
</tr>
<tr>
<td>Chol/HDL</td>
<td>3.2</td>
<td>3.0</td>
<td>3.0</td>
<td>3.0</td>
<td>−6.3</td>
<td>.003</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>105</td>
<td>47</td>
<td>102</td>
<td>45</td>
<td>−2.4</td>
<td>.241</td>
</tr>
<tr>
<td>HDL-C (mg/dL)</td>
<td>54</td>
<td>17</td>
<td>56</td>
<td>17</td>
<td>+3</td>
<td>.069</td>
</tr>
<tr>
<td>Fasting glucose (mg/dL)</td>
<td>94</td>
<td>10</td>
<td>93</td>
<td>11</td>
<td>−1.1</td>
<td>.197</td>
</tr>
</tbody>
</table>

Values are expressed as mean values at baseline and after the program, %Δ, and \(P\) values.

BMI = body mass index; BP = blood pressure; HDL-C = high-density lipoprotein cholesterol; LDL-C = low-density lipoprotein cholesterol; SD = standard deviation.

### Table 2 Cardiac Rehabilitation Program Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Base/post</th>
<th>% Δ/P Value</th>
<th>Base/post</th>
<th>% Δ/P Value</th>
<th>Base/post</th>
<th>% Δ/P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>BMI (kg/m(^2))</td>
<td>26/25.6</td>
<td>−1.5/−.01</td>
<td>27.1/26.8</td>
<td>−1/−.0001</td>
<td>27.9/27.8</td>
<td>−0.1/NS</td>
</tr>
<tr>
<td>Total cholesterol (mg/dL)</td>
<td>204/204</td>
<td>0/NS</td>
<td>204/201</td>
<td>−1.3/NS</td>
<td>206/205.8</td>
<td>−0.1/NS</td>
</tr>
<tr>
<td>Triglycerides (mg/dL)</td>
<td>141/130</td>
<td>−8/NS</td>
<td>172/156</td>
<td>−9/−.0001</td>
<td>225/205.4</td>
<td>−9/NS</td>
</tr>
<tr>
<td>HDL-C (mg/dL)</td>
<td>40.4/43</td>
<td>+6/+.001</td>
<td>38.7/40.5</td>
<td>+5/+.0001</td>
<td>38/41.1</td>
<td>+8/.001</td>
</tr>
<tr>
<td>LDL-C (mg/dL)</td>
<td>136/133</td>
<td>−2/−NS</td>
<td>131/129</td>
<td>−1.5/NS</td>
<td>126/127.7</td>
<td>1.3/NS</td>
</tr>
<tr>
<td>LDL-C/HDL-C</td>
<td>3.6/3.3</td>
<td>−8/−.01</td>
<td>3.5/3.3</td>
<td>−6/−.001</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Values are expressed as mean values at baseline (base) and after the program (post), %Δ, and \(P\) values.

BMI = body mass index; HDL-C = high-density lipoprotein cholesterol; LDL-C = low density lipoprotein cholesterol; NS = nonsignificant.
baseline triglycerides, <150 mg/dL, did not show significant decreases after cardiac rehabilitation.

We looked at the subset of participants whose baseline triglycerides were greater than 150 mg/dL and found 14 participants who had a mean baseline triglyceride level of 194.9 mg/dL, range 158 to 258 mg/dL, SD = 33.4. Their follow-up mean triglyceride level was 153.9 mg/dL, range 72 to 300 mg/dL, SD = 63.7, P = 0.009. This is consistent with the above-mentioned study.22

In addition to risk factor modification, our adverse clinical outcomes compare favorably to published cardiac rehabilitation and intensive cardiac rehabilitation literature. One patient in the secondary prevention group underwent coronary stent placement (1 of 44, 2.3%).

A nonrandomized cardiac rehabilitation study23 followed 140 post-PCI (percutaneous coronary intervention) patients for 15 months after completing a 3-month cardiac rehabilitation program. They found a 24% rate of major adverse cardiac events.

Another study examined 101 patients with stable angina who were randomized, after baseline coronary angiography, to either PCI with stenting or an exercise protocol.24 At 12 months, 6 of 51 (12%) in the exercise group and 15 of 50 (30%) in the PCI group had experienced death of cardiac cause, stroke, coronary artery bypass surgery, angioplasty, acute myocardial infarction, or worsening angina with objective evidence resulting in hospitalization.

In our participants, we found no difference in statin usage and clinical outcome,8,9 but there are fewer available data on intensive cardiac rehabilitation programs.

The work of Dean Ornish and his colleagues is the main reference point for lifestyle-based risk factor modification in patients with coronary artery disease. Ornish’s original study documented reversal of plaque after intensive cardiac rehabilitation in a randomized controlled study with 28 assigned to the experimental group and 20 to usual care.5 They showed significant decreases in weight, total cholesterol, and LDL-C. Changes in HDL-C and triglycerides were not significant.

Diet and lifestyle are complex interventions. It is challenging to determine which of the multiple available interventions is most efficacious. The Heart Series is based on our belief that the best prevention outcomes will occur when multiple interventions are executed simultaneously and when the lifestyle changes are individualized. Our program is unique in this approach. We provide evidenced-based data and offer hands-on experiences as participants explore lifestyle changes. We work with participants to create their own unique program, which they believe is sustainable and transformational. Our data suggest that personalized programs can yield positive results.

In summary, our data show that a community-based intensive cardiac rehabilitation program resulted in improvement in risk factors, a low incidence of adverse events, and is cost-effective. Our data are comparable to cardiac rehabilitation and intensive cardiac rehabilitation data from hospital-based and academic institutions. This adds to a literature showing benefit from intensive cardiac rehabilitation programs.

Limitations of this study include the lack of a control group. Therefore, we must apply caution in concluding that the changes noted were unequivocally attributable to the Heart Series intensive cardiac rehabilitation program. We also have no way of knowing whether our subjects adhered to the proposed interventions, but the changes in risk factors argue strongly that our subjects did alter their lifestyles.

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References


