

# Effects of Combined Phase III and Phase II Cardiac Exercise Therapy for Middle-aged Male Patients with Acute Myocardial Infarction

CHIH-WEI LEE<sup>1)</sup>, JI-HUNG WANG<sup>2)</sup>, JEN-CHE HSIEH<sup>2)</sup>, TSUNG-CHENG HSIEH<sup>3)</sup>, CHIEN-HUI HUANG<sup>1)</sup>\*

<sup>1)</sup> Department of Physical Therapy, Tzu Chi University: 701 Zhongyang Rd., Sec 3, Hualien, 97004 Hualien, Taiwan

<sup>2)</sup> Division of Cardiology, Department of Medicine, Tzu-Chi Medical Center, Taiwan

<sup>3)</sup> Institute of Medical Sciences, Tzu Chi University, Taiwan

**Abstract.** [Purpose] To investigate the effects of cardiac exercise therapy (CET) on exercise capacity and coronary risk factors (CRFs) of patients with acute myocardial infarction (AMI). [Methods] Patients who participated in an 8-week supervised, hospital-based phase II and 6-month home-based phase III CET with monthly telephone and/or home visits were defined as the exercise group (EG) (n=20), while those who did not receive phase II or phase III CET were defined as the no-exercise group (NEG) (n=10). CRFs were evaluated pre- and post-phase II and eight months after discharge. One and two-way repeated measures ANOVA were used to perform intra- and inter-group comparisons. [Results] Thirty men with AMI aged  $49.3 \pm 8.3$  years were studied. EG increased their exercise capacity (METs) ( $6.8 \pm 1.6$  vs.  $10.0 \pm 1.9$ ) after phase II CET and was able to maintain it at 8-month follow-up. Both groups had significantly fewer persons who kept on smoking compared to the first examination. High density lipoprotein cholesterol (HDL-C) increased from  $38.1 \pm 11.0$  to  $43.7 \pm 8.7$  mg/dl at follow-up in EG while no significant difference was noted in NEG. [Conclusion] After phase III CET subjects had maintained the therapeutic effects of smoking cessation, and increasing exercise capacity obtained in phase II CET. HDL-C in EG continued to improve during phase III CET.

**Key words:** Acute myocardial infarction, Cardiac exercise therapy, Coronary risk factors

(This article was submitted May 2, 2013, and was accepted Jun. 7, 2013)

## INTRODUCTION

Comprehensive cardiac rehabilitation programs were established in the 1960s with the primary objective of restoring exercise capacity after prolonged hospitalization for myocardial infarction<sup>1)</sup>. More recently, however, the focus has shifted, with cardiac rehabilitation programs increasingly focusing on the reduction of coronary risk factors (CRFs) and cardiac events.

Supervised, hospital-based Phase II cardiac exercise therapy (Phase II CET) can promote comprehensive cardiac rehabilitation through a program based on increase of exercise capacity and reduction of CRFs, and results in decreased morbidity of the patients. Long-term Phase II CET tends to be a stronger predictor of increase of exercise capacity and improvement of CRFs, with this type of regimen often recommended for acute myocardial infarction (AMI) patients<sup>2, 3)</sup>. Considering the inherent disadvantages of the higher cost and extra inconvenience for patients that are as-

sociated with long-term Phase II CET, it seems that, except where intensive care is required, Phase III cardiac exercise therapy (Phase III CET), which includes lifestyle modification and leisure-time physical activity, may offer a reasonable alternative therapy for increase of exercise capacity and improvement of CRFs<sup>4)</sup>.

Major epidemiological studies such as the Framingham Study have established the risk relationship for CRFs and coronary artery disease (CAD). The effects of Phase III CET on CRFs for subjects recovering from AMI have been less well investigated. The objective of this research was to analyse the effects of Phase III CET on CRFs of male AMI patients aged less than 65 years, with supervision either through monthly home-visits and/or telephone contact by a comparison of exercise and no-exercise groups.

## SUBJECTS AND METHODS

The sample population was AMI patients who had been admitted to Tzu-Chi Medical Center. During hospitalization, patients and their families received education about the meaning of reducing CRFs, precautions for preventing recurrence of infarction in daily life, possible problems after being discharged, and the importance of long-term follow-up and back-to-hospital evaluation. Furthermore, all of them were followed by questionnaire concerning the status

\*Corresponding author. Chien-Hui Huang (e-mail: chien-huang@mail.tcu.edu.tw)

©2013 The Society of Physical Therapy Science

This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial No Derivatives (by-nc-nd) License <<http://creativecommons.org/licenses/by-nc-nd/3.0/>>.

of home-based exercise and quitting smoking during phase II and phase III. This study was approved by the institutional review board (IRB) of Tzu Chi Medical Center, and written informed consent was received from each subject.

Patients were divided into exercise and no-exercise groups. Exercise group (EG) patients agreed to participate in an exercise therapy program designed specifically for each patient by the same experienced physical therapist after being discharged from hospital. This program consisted of eight weeks of Phase II CET, and six months of Phase III CET, made up of leisure-time physical activity at least three times per week lasting more than 30 minutes per session. Patients who were unable to maintain leisure-time physical activities, such as those diagnosed as peripheral vascular disease, were excluded from the EG. The inclusion criterion for the no-exercise group (NEG) was no regular aerobic exercise (comparable to Phase II or III CET) for more than eight months after discharge from hospital due to unwillingness or injuries.

Phase II CET began  $19 \pm 9$  days after AMI, and continued for eight weeks at a frequency of two times per week. Phase II CET consisted of three stages: 1) warm-up, performed using ten minutes of calisthenics (gentle stretching) and aerobic exercise; 2) the main exercise utilizing a treadmill, with the exercise intensity individually prescribed on the basis of baseline, graded treadmill exercise test results, which was gradually increased to a goal of 60 to 79% of the predicted age-adjusted maximum heart rate (MHR) and maintained for 20 minutes at a level below that which caused symptomatic or silent ischemia; and 3) cool-down, consisting of five minutes of calisthenics.

For Phase III CET, patients were asked to continue leisure-time physical activities by themselves, with an exercise formula prescribed according to the results of the second of the exercise tests, performed at the end of Phase II CET. With an over-riding emphasis on safety, exercise familiar to each individual was chosen for Phase III CET. All EG patients were telephoned and/or visited at home by the same investigator each month to provide relevant information and personal support<sup>5</sup>. For patients with regular medication, 79% or below the symptom-limited maximum exercise capacity was deemed the appropriate maximum exercise intensity to enhance exercise adherence and safety<sup>6</sup>.

Patient safety was the primary consideration, with observation of the whole process of the exercise test before testing. Further, therapy and testing took place on the same machine making it easier to monitor HR, blood pressure (BP), and electrocardiograms (ECG) during the training session.

During the phase II CET, the physical therapist shared the real-time HR information with the patients as exercise proceeded, and trained them in self-monitoring in the second part of the program. Phase III CET programs were designed specifically for each individual and data were collected for six months. Data for duration of hospital stay, medication, cigarette smoking, hypertension (HTN), diabetes mellitus (DM), body mass index (BMI), and fasting plasma serum levels for total cholesterol (T-Chol), triglyceride (TG), high density lipoprotein cholesterol (HDL-C), and low density

lipoprotein cholesterol (LDL-C) were collected during hospitalization (first examination). Smoking habits, BMI and plasma serum lipids were re-evaluated at the times of the second and third examinations (two and eight months after discharge from hospital). Patient medication was re-evaluated at the third examination.

Exercise tests were performed at the beginning and the end of Phase II CET, and during the Phase III CET program at eight months after discharge from hospital for EG only. EG patients performed an exercise test on a treadmill (Marquette MAX1, Milwaukee WI, USA), in accordance with the Bruce protocol<sup>7, 8</sup>. Symptom-limited maximal exercise capacity, expressed in metabolic equivalents (METs), was obtained at the end of the exercise test. The Borg scale of ratings of perceived exertion (RPE) was recorded at the same time. The ECG was monitored continuously, with both HR and BP (Suntech 4240 BP monitor, Raleigh NC, USA) measured every three minutes.

Criteria for terminating the exercise test included ischemic signs and/or symptoms, or inability to continue the exercise due to fatigue, ventricular arrhythmia (such as ventricular tachycardia or fibrillation), ST segment depression ( $\geq 2$  mm) or elevation ( $\geq 1$  mm), target HR exceeding 90% of the predicted age-adjusted maximal HR, and BP  $> 220$  mmHg or lower than that determined at the beginning of the test. In addition, in accordance with the emphasis on minimization of patient risk, for the first exercise test, a maximum HR below 130 bpm or 140 bpm was stipulated for patients aged over or less than 40 years, respectively.

The basic survey questionnaire of Hsieh et al.<sup>9</sup> was adopted. Patient adherence to individualized training target HRs, and effects of leisure-time physical activities on exercise capacity and smoking status were evaluated using these items.

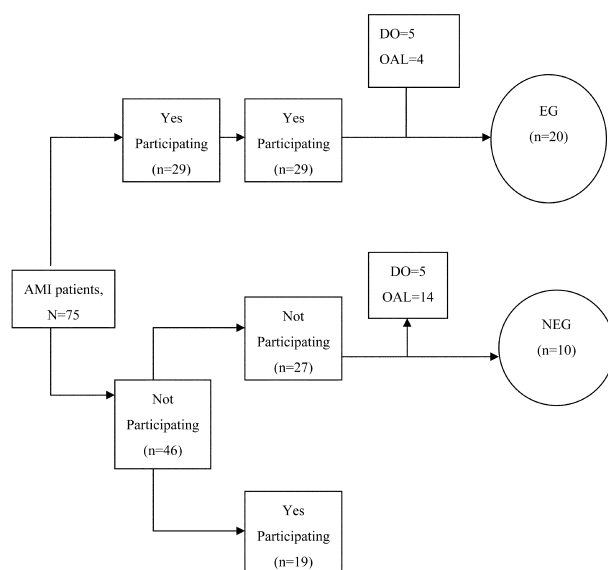
Coronary stenosis was defined as greater than 50% from coronary angiography. The left ventricular ejection fraction (LVEF) was calculated from the left ventriculogram which was obtained using echocardiography (Hewlett Packard, Sonos 5500, USA).

As not all of the parameters were normally distributed, non-parametric analysis was used for comparison. Inter-group differences were assessed using the chi-squared and Mann-Whitney U tests for categorical and continuous variables, respectively. Intra-group differences in pre- and post-intervention measures of all variables were determined using the General Linear Model – one way repeated measure ANOVA and the covariance (BMI) of two way repeated measures ANOVA with subsequent Least Significant Difference pairwise comparison. All statistical analysis was performed using SPSS 10.0 for Window (SPSS Inc. Chicago, IL, USA) and statistical significance was accepted for values of  $p$  less than 0.05. Continuous values were expressed as the mean  $\pm$  SD.

## RESULTS

A total of 30 patients (mean age  $49.3 \pm 8.3$  years; range 34 to 63), 20 EG and 10 NEG patients, were enrolled for this research. Figure 1 shows that 75 of AMI subjects had

| Hospitalization | Phase II | Phase III | Drop out (DO) and over age limit numbers of (OAL) | Final subject numbers of each group |
|-----------------|----------|-----------|---|-------------------------------------|
|-----------------|----------|-----------|---|-------------------------------------|



EG : Exercise Group. NEG : No-exercise Group.  
 Phase II : Supervised, Hospital-based Phase II Cardiac Exercise Therapy.  
 Phase III : Minimally Supervised, Home-based Phase III Cardiac Exercise Therapy.  
 DO: lost contact with the subjects; i.e. subjects moving away or not answering the phone

**Fig. 1.** The flow chart of the grouping process

received patient education during hospitalisation, twenty-nine subjects participated in the Phase II and Phase III CET; however, five of them dropped out through loss of contact, and four were excluded due to having an age of more over than 65 years. From the survey by questionnaire, twenty-four out of the 75 subjects didn't perform any exercise during Phase II or Phase III. Fourteen of them aged more than 65 years were excluded, and the remaining 10 subjects were enrolled into the NEG of this study.

Baseline clinical and demographic data of both NEG and EG patients are presented in Table 1. No significant differences were found in mean age, hospitalization days, ejective fraction (EF), average number of stenosis vessels, Q or non-Q wave, infarct wall, HTN, DM, cigarette smoking and serum lipids, between the two groups. Significantly higher BMI levels were found in NEG than in EG ( $26.7 \pm 3.1$  vs.  $25.2 \pm 3.7$  kg/m<sup>2</sup>;  $p < 0.05$ ).

Of the 20 EG patients, 17 walked, jogged, or cycled, with three playing racket sports; one playing tennis, and one playing table tennis, and one playing golf.

None of the subjects in NEG performed any exercise. According to the survey, the reasons included never done any exercise ( $n=3$ ), and being too busy at work ( $n=3$ ). Four of them were unable to do exercise regularly due to orthopedic injuries ( $n=1$ ), and the remaining three were unable to perform exercise because of other metabolic problems ( $n=1$ ) and deep vein thrombosis ( $n=2$ ).

Changes in EG METs and RPE over time are presented in Table 2. Mean EG METs increased ( $6.8 \pm 1.6$  to  $9.8 \pm 1.5$  O<sub>2</sub> mL/kg/min,  $F=75.50$ ,  $p < 0.01$ ) at the end of Phase II CET, and this increase was maintained at  $10.0 \pm 1.9$  O<sub>2</sub> mL/kg/min, as measured in the third exercise test, a significant result ( $p < 0.01$ ). The RPE ratings did not alter during Phase II and Phase III CET. Mean EG serum HDL-C increased significantly during Phase III CET ( $38.1 \pm 11.0$  to  $43.7 \pm 8.7$  mg/dl;  $F=4.18$ ,  $p < 0.05$ ). The proportion of cigarette smokers decreased significantly from the time of the first examination to the time of the second and the third examination in both the EG and the NEG (Table 1).

## DISCUSSION

The improvement in exercise capacity and cessation of smoking which were achieved during Phase II CET were maintained during the Phase III CET, together with a significant improvement in low serum HDL-C, a characteristic of Taiwanese coronary artery disease (CAD) patients<sup>10</sup>.

Low METs levels are associated with subsequent cardiac events during long-term follow-up<sup>11</sup>. For this reason, it was deemed appropriate to use the METs level as an index of exercise capacity in this study. Borg's RPE scale is probably more of a psychological measure than a physiological one, allowing an individual to concentrate more on how particular exercise intensity feels, while still having some assurance that they are within the target HR range<sup>12</sup>. In comparison to the first exercise trial, METs of the second and the third trials were significantly increased, demonstrating the effectiveness of phase II CET and the importance of Phase III CET for the maintenance of exercise capacity.

Phase II CET is playing an increasingly important role in the care of post-coronary-event patients<sup>13</sup>. AMI patients who participate in phase II CET often report increased confidence for in-home physical training and other types of leisure-time physical activities during phase III CET, with confidence appearing to be an important factor in continuity of leisure-time physical activity<sup>14</sup>. Patient compliance is a key factor in most Phase III CET programs, the success of which may depend on patients' attitudes toward both exercise and illness<sup>6</sup>. Compliance-improving behaviours strategies, such as goal setting, self-monitoring, and education, may also offer potential for improving exercise adherence<sup>6</sup>. Further, recent research suggests that the benefits of Phase III CET are dependent on program participation and long-term adherence to exercise and other cardiovascular disease risk-reducing behaviours<sup>15</sup>. Leisure-time physical activity has long been recognized as an independent measure, lowering the risk of CAD by 35 to 55%<sup>16</sup>. Additionally, for Phase III CET, it can be argued that a familiar form of exercise can make the patient feel more comfortable, allaying anxiety as the body's response to that form of exercise is known through direct experience<sup>17</sup>.

The most recent guidelines for CAD patients suggest at least 30 minutes of moderate-intensity, leisure-time physical activity, on most, and preferably all days<sup>18</sup>. Thus, it seems reasonable to propose that the adoption of moderately intense exercise, especially brisk walking, by the

**Table 1.** Baseline characteristics and changes of CRFs of the Exercise Group (EG) and the No-Exercise Group (NEG).

|                            | EG (n= 20)   |               |                          | NEG (n= 10)  |               |               |
|----------------------------|--------------|---------------|--------------------------|--------------|---------------|---------------|
|                            | First        | Second        | Third                    | First        | Second        | Third         |
| Mean age (yrs)             | 49.8 ± 7.5   | -             | -                        | 48.2 ± 10.2  | -             | -             |
| Disease Severity           |              |               |                          |              |               |               |
| Hospital stay (days)       | 11.4 ± 5.3   | -             | -                        | 13.5 ± 6.8   | -             | -             |
| Ejection fraction (%)      | 55.4 ± 10.4  | -             | -                        | 44.6 ± 20.5  | -             | -             |
| Number of stenotic vessels | 1.55 ± 0.76  | -             | -                        | 2.00 ± 0.94  | -             | -             |
| ECG                        |              |               |                          |              |               |               |
| Q                          | 18           | -             | -                        | 8            | -             | -             |
| Non-Q                      | 2            | -             | -                        | 2            | -             | -             |
| Infarct wall of Q wave MI  |              |               |                          |              |               |               |
| Anterior                   | 8            | -             | -                        | 3            | -             | -             |
| Inferior or Posterior      | 10           | -             | -                        | 4            | -             | -             |
| Lateral                    | 0            | -             | -                        | 1            | -             | -             |
| Drugs                      |              |               |                          |              |               |               |
| Diuretic drugs (%)         | 30           | -             | 25                       | 40           | -             | 40            |
| β-blocker (%)              | 75           | -             | 80                       | 30           | -             | 40            |
| ACE-I (%)                  | 65           | -             | 55                       | 60           | -             | 50            |
| Hypolipemic Drugs (%)      | 25           | -             | 30                       | 30           | -             | 40            |
| Smoking (%)                | 70           | 5*            | 20*                      | 80           | 30*           | 30*           |
| Serum lipids               |              |               |                          |              |               |               |
| Total cholesterol (mg/dl)  | 186.2 ± 41.3 | 180.0 ± 30.4  | 182.4 ± 35.8             | 206.0 ± 69.5 | 211.0 ± 53.0  | 189.1 ± 63.9  |
| Triglyceride (mg/dl)       | 179.0 ± 72.3 | 172.5 ± 129.4 | 160.2 ± 70.6             | 184.4 ± 96.4 | 231.2 ± 125.5 | 189.0 ± 132.5 |
| HDL (mg/dl)                | 38.1 ± 11.0  | 38.8 ± 8.7    | 43.7 ± 8.7* <sup>+</sup> | 40.6 ± 10.4  | 36.6 ± 8.6    | 35.9 ± 12.0   |
| LDL (mg/dl)                | 111.7 ± 37.5 | 106.1 ± 35.0  | 103.1 ± 37.5             | 128.5 ± 64.9 | 128.2 ± 52.0  | 122.7 ± 66.0  |
| BMI (kg/m <sup>2</sup> )   | 25.2 ± 3.7   | 25.4 ± 3.7    | 25.3 ± 3.6               | 26.7 ± 3.1*  | 26.7 ± 3.1    | 26.5 ± 3.1    |

First: During hospitalization. Second: Two months after discharge from hospital. Third: Eight months after discharge from hospital. HDL: High density lipoprotein cholesterol; LDL: Low density lipoprotein cholesterol; BMI: Body mass index

\*: p<0.05 when compared with the first examination within group. <sup>+</sup>: p<0.05 when compared with the second examination within group.

\*: p<0.05 when compared with the first examination between group.

**Table 2.** Changes in Metabolic Equivalents (METs) and Borg Scale of Ratings of Perceived Exertion (RPE) over time in the Exercise Group

| Exercise test Variables | Phase II   |            | Phase III   |
|-------------------------|------------|------------|-------------|
|                         | First      | Second     | Third       |
| METs                    | 6.8 ± 1.6  | 9.8 ± 1.5* | 10.0 ± 1.9* |
| RPE                     | 14.3 ± 1.1 | 14.4 ± 1.3 | 14.4 ± 1.0  |

Phase II: Supervised, hospital-based phase II cardiac exercise therapy, Phase III: Minimally supervised, home-based phase III cardiac exercise therapy, First: Beginning of the phase II, Second: Ending of the phase II, Third: Eight months after discharge of hospital.

\*: Value is significantly higher than the first exercise test.

sedentary majority of post-AMI patients would yield cardiovascular disease benefits comparable to those achieved by more vigorous exercise. These findings support current federal guidelines that endorse moderate exercise, which is safe, achievable, and feasible for the majority of the population<sup>18</sup>. Furthermore, our questionnaire results demonstrate that walking-related exercise types made up the major part (60%) of Phase III CET activities of the EG.

Given the minimal supervision during Phase III CET, exercise safety was the primary consideration of this study's

design, with secondary emphasis on increasing and maintaining exercise capacity and improving CRFs through therapeutic exercise. The high level of safety demonstrated in this study was attributable to the strict standards employed in the medical screening and assessment of patients, emphasis on thorough education and proper treatment, careful and individualized exercise prescription, well-trained personnel, and regular supervision through home-visits and/or telephone calls during the minimally supervised stage. Further, as no serious cardiac events, such as recurrence of

infarction or cardiac arrest, occurred during Phase III CET for the EG patients in this study, it also seems reasonable to suggest that Phase III CET may offer a safe and efficacious exercise modality for post-AMI patients.

The inverse relationship of serum HDL-C and CAD prevalence was first identified in the 1950s<sup>19</sup>. Associations have been demonstrated between serum HDL-C concentrations and gender, age, medication, cigarette smoking, obesity, DM, and exercise type modality<sup>20, 21</sup>. Factors other than exercise that positively affect serum HDL-C include cessation of cigarette smoking and weight reduction to ideal body weight. Serum HDL-C levels approximately 5.7% lower have been demonstrated for smokers<sup>22</sup>, with cessation associated with a rebound to normal values<sup>23</sup>.

The negative correlation between body weight and serum HDL-C has been found for pre- and post-menopausal women and in men<sup>24</sup>. The pre-eminence of weight loss with increasing serum HDL levels has been emphasized by Wood et al.<sup>25</sup>, who proposed that the effect of exercise therapy on serum HDL-C is mainly due to loss of body weight. In contrast, other researchers have been unable to find any relationship between weight loss, during exercise therapy and increased serum HDL-C, and thus hypothesize a separate and independent effect of exercise<sup>26</sup>. In this study, BMI change was not significant in either group during the experiment. Further, the increase and maintenance of exercise capacity was not associated with changes in BMI in the EG. Additionally, serum HDL-C increased significantly in the EG, but not in the NEG during phase III CET, indicating that BMI may not have been a determining factor in serum HDL-C change in this study.

Exercise therapy can be characterized by type, frequency and duration. Improving exercise performance is still considered the best lifestyle recommendation for increasing serum HDL-C. Further, it has been demonstrated that exercise therapy lowers the risk of CAD<sup>27</sup>. Most investigators attribute the apparent protection afforded by serum HDL to its role in reserve cholesterol transport, which is believed to remove cholesterol from developing plaque deposits<sup>28</sup>. The increases in lipoprotein-lipase activities that have been associated with long-term exercise therapy have attracted attention as potentially effective, physiologically desirable, non-pharmacological ways of increasing serum HDL-C<sup>29</sup>.

Although a comparable rate of smoking cessation was demonstrated by NEG patients in the present study, no significant evident change was noted in serum HDL-C. In the EG, serum HDL-C did not change during Phase II CET, even when the sample was controlled for smoking cessation, body weight, and training intensity. Possible explanations include insufficient duration and/or exercise intensity during the Phase II CET stage. Several studies have concluded that exercise of sufficient duration and adequate intensity does beneficially influence the atherogenic risk as reflected in the serum lipid profile<sup>26, 30</sup>, and Mendoza et al. suggested that significant improvement in serum HDL-C requires a longer CET period, ranging from three to 12 months<sup>31</sup>.

A previous study has demonstrated that moderate training intensities are adequate for eliciting improvements in serum HDL-C<sup>32</sup>. Prolonged exercise therapy periods (be-

yond three months) and increased total caloric expenditure per session are likely to result in further improvements to the serum HDL-C profile<sup>33</sup>. In contrast, other studies have not found changes in HDL-C associated with variations in exercise intensity<sup>34</sup>. In the EG in this study, mean serum HDL-C did not change during Phase II CET, however, it did increase significantly during Phase III CET. It seems reasonable to propose that improvement in serum HDL-C levels after AMI may be dependent on the continuity of Phase III CET. Therefore, the intervention of long-term therapeutic exercise surely assisted the improvement of HDL-C.

Being the only medical center in Eastern Taiwan, patient travel distance was excessive for some (up to 150 km), which contributed to patient dropout. Furthermore, exercise therapy and CRFs were followed for up to 8 months, which additionally contributed to dropout. For the same reason regarding distance and time covered in this experiment, we were unable to randomize group assignment at the beginning of the study.

In this study, we demonstrated that Phase III CET maintained the high percentage of smoking abstinence and levels of cardiac exercise capacity achieved during the resource-intensive Phase II CET program. Further, no cardiac events occurred and serum HDL-C levels increased, suggesting that Phase III CET, a less-expensive and more-convenient exercise regime, is worth introducing to more patients. Given the small sample size, however, the efficacy and ultimate risk associated with this minimally supervised exercise modality needs further investigation to confirm the cost-benefit ratio and attendant risks.

## REFERENCES

- 1) Pashkow FJ: Issues in contemporary cardiac rehabilitation: a historical perspective. *J Am Coll Cardiol*, 1993, 21: 822–834. [Medline] [CrossRef]
- 2) Boesch C, Myers J, Habersaat A, et al.: Maintenance of exercise capacity and physical activity pattern 2 years after cardiac rehabilitation. *J Cardiopulm Rehabil*, 2005, 25: 14–21. [Medline] [CrossRef]
- 3) Lee CW, Wu YT, Lai CP, et al.: Factors influencing the long-term effects of supervised cardiac rehabilitation on the exercise capacity of patients with acute myocardial infarction. *J Formos Med Assoc*, 2002, 101: 60–67. [Medline]
- 4) DeBusk RF: Home-based and worksite-based exercise training for patients with coronary artery disease. *Cardiol Clin*, 1993, 11: 285–295. [Medline]
- 5) : Comparison of a rehabilitation programme, a counselling programme and usual care after an acute myocardial infarction: results of a long-term randomized trial. P.R.E.COR. Group. *Eur Heart J*, 1991, 12: 612–616. [Medline]
- 6) Carlson JJ, Johnson JA, Franklin BA, et al.: Program participation, exercise adherence, cardiovascular outcomes, and program cost of traditional versus modified cardiac rehabilitation. *Am J Cardiol*, 2000, 86: 17–23. [Medline] [CrossRef]
- 7) LeJemtel TH, Liang CS, Stewart DK, et al.: Educated peak aerobic capacity in asymptomatic left ventricular systolic dysfunction. *Circulation*, 1994, 90: 2757–2760. [Medline] [CrossRef]
- 8) Myers J, Buchanan N, Walsh D, et al.: Comparison of ramp versus standard exercise protocols. *J Am Coll Cardiol*, 1991, 17: 1334–1342. [Medline] [CrossRef]
- 9) Hsieh SD, Yoshinaga H, Muto T, et al.: Regular physical activity and coronary risk factors in Japanese men. *Circulation*, 1998, 97: 661–665. [Medline] [CrossRef]
- 10) Lien WP, Lai LP, Chen JJ, et al.: A retrospective hospital-based study of coronary risk factors in Taiwan. Analysis of patients with established diagnosis. *Jpn Heart J*, 1998, 39: 435–444. [Medline] [CrossRef]
- 11) Hamm LF, Stull GA, Ainsworth B, et al.: Short- and long-term prognostic value of graded exercise testing soon after myocardial infarction. *Phys Ther*, 1986, 66: 334–339. [Medline]

- 12) Borg GA: Psychophysical bases of perceived exertion. *Med Sci Sports Exerc*, 1982, 14: 377–381. [[Medline](#)]
- 13) American Heart Association Medical/Scientific Statement; Position Statement: cardiac rehabilitation programs: a statement for health care professionals from the American Heart Association. *Circulation*, 1994, 90: 1602–1610. [[Medline](#)] [[CrossRef](#)]
- 14) Williams MA, Maresh CM, Esterbrooks DJ, et al.: Early exercise training in patients older than 65 years compared with that in younger patients after acute myocardial infarction or coronary bypass grafting. *Am J Cardiol*, 1985, 55: 263–266. [[Medline](#)] [[CrossRef](#)]
- 15) Dawber TR: The Framingham Study. The epidemiology of atherosclerosis disease. Cambridge, Massachusetts and London: Harvard University Press, 1980.
- 16) Satariano WA, Haight TJ, Tager IB: Reasons given by older people for limitation or avoidance of leisure time physical activity. *J Am Geriatr Soc*, 2000, 48: 505–512. [[Medline](#)]
- 17) Kugler J, Dimsdale JE, Hartley LH, et al.: Hospital supervised vs home-based exercise in cardiac rehabilitation effects on aerobic fitness, anxiety, and depression. *Arch Phys Med Rehabil*, 1990, 71: 322–325. [[Medline](#)]
- 18) Manson JE, Hu FB, Rich-Edwards JW, et al.: A prospective study of walking as compared with vigorous exercise in the prevention of coronary heart disease in women. *N Engl J Med*, 1999, 341: 650–658. [[Medline](#)] [[CrossRef](#)]
- 19) Gordon T, Castell WP, Hjortland MC, et al.: High density lipoprotein as a protective factor against coronary heart disease. The Framingham Study. *Am J Med*, 1977, 62: 707–714. [[Medline](#)] [[CrossRef](#)]
- 20) Mykkänen L, Laakso M, Pyorala K: Association of obesity and distribution of obesity with glucose tolerance and cardiovascular risk factors in the elderly. *Int J Obes Relat Metab Disord*, 1992, 16: 695–704. [[Medline](#)]
- 21) Laws A, King AC, Haskell WL, et al.: Metabolic and behavioral co- variance of high-density lipoprotein cholesterol and triglyceride concentration in post-menopause women. *J Am Geriatr Soc*, 1993, 41: 1289–1294. [[Medline](#)]
- 22) Craig WY, Palomaki GE, Haddow JE: Cigarette smoking and serum lipid lipoprotein concentration: an analysis of published data. *BMJ*, 1989, 298: 784–788. [[Medline](#)] [[CrossRef](#)]
- 23) Muscat JE, Harris RE, Haley NJ, et al.: Cigarette smoking and plasma cholesterol. *Am Heart J*, 1991, 121: 141–147. [[Medline](#)] [[CrossRef](#)]
- 24) Krauss RM: The tangled web of coronary risk factors. *Am J Med*, 1991, 90: 36S–41S. [[Medline](#)] [[CrossRef](#)]
- 25) Wood PD, Stefanick ML, Dreon DM, et al.: Changes in plasma lipids and lipoprotein in overweight men during weight loss through dieting as compared with exercise. *N Engl J Med*, 1988, 319: 1173–1179. [[Medline](#)] [[CrossRef](#)]
- 26) Motoyama M, Sunami Y, Kinoshita F, et al.: The effects of long-term low intensity aerobic training and detraining on serum lipid and lipoprotein concentrations in elderly men and women. *Eur J Appl Physiol Occup Physiol*, 1995, 70: 126–131. [[Medline](#)] [[CrossRef](#)]
- 27) Wannamethee SG, Shaper AG, Walker M, et al.: Lifestyle and 15-year survival free of heart attack, stroke and diabetes in middle-aged British men. *Arch Intern Med*, 1998, 158: 2433–2440. [[Medline](#)] [[CrossRef](#)]
- 28) Wilson PW, Anderson KM, Harris T, et al.: Determinants of change in total cholesterol and HDL-C with age: the Framingham Study. *J Gerontol*, 1994, 49: M252–257. [[Medline](#)] [[CrossRef](#)]
- 29) Urata H, Sasaki J, Tanabe Y, et al.: Effects of mild aerobic exercise on serum lipids and apolipoproteins. *Jpn Heart J*, 1987, 28: 27–34. [[Medline](#)] [[CrossRef](#)]
- 30) Stein RA, Michielli DW, Glantz MD, et al.: Effects of different exercise training intensities on lipoprotein cholesterol fractions in healthy middle-aged men. *Am Heart J*, 1990, 119: 277–283. [[Medline](#)] [[CrossRef](#)]
- 31) Mendoza SG, Carrasco H, Zerpa A, et al.: Effect of physical training on lipids, lipoproteins, apolipoproteins, lipase, and endogenous sex hormones in men with premature myocardial infarction. *Metabolism*, 1991, 40: 368–377. [[Medline](#)] [[CrossRef](#)]
- 32) Spate-Douglas T, Keyser RE: Exercise intensity: its effect on the high-density lipoprotein profile. *Arch Phys Med Rehabil*, 1999, 80: 691–695. [[Medline](#)] [[CrossRef](#)]
- 33) Berg A, Halle M, Franz I, et al.: Physical activity and lipoprotein metabolism: epidemiological evidence and clinical trails. *Eur J Med Res*, 1997, 2: 259–264. [[Medline](#)]
- 34) Visich PS, Goss FL, Gorden PM, et al.: Effects of exercise with varying energy expenditure on high-density lipoprotein. *Eur J Appl Physiol Occup Physiol*, 1996, 72: 242–248. [[Medline](#)] [[CrossRef](#)]