

THE CORONARY HEALTH IMPROVEMENT PROJECT (CHIP) FOR  
LOWERING WEIGHT AND IMPROVING PSYCHOSOCIAL HEALTH<sup>1</sup>

CARMEN L. THIESZEN

*Department of Psychology  
Loma Linda University, California*

RAY M. MERRILL

*Department of Health Science  
Brigham Young University, Provo, Utah*

STEVEN G. ALDANA

*Lifestyle Research Group, Mapleton, Utah*

HANS A. DIEHL

*Lifestyle Medicine Institute, Loma Linda, California*

MARITA L. MAHONEY

*College of Education  
California State University, San Bernardino*

ROGER L. GREENLAW

*SwedishAmerican Center for Complementary  
Medicine, Rockford, Illinois*

DAVID A. VERMEERSCH

*Department of Psychology  
Loma Linda University, California*

HEIKE ENGLERT

*Department of Nutrition  
University of Applied Sciences, Muenster, Germany*

*Summary.*—This study extends previous research evaluating the association between the CHIP intervention, change in body weight, and change in psychological health. A randomized controlled health intervention study lasting 4 wk. was used with 348 participants from metropolitan Rockford, Illinois; ages ranged from 24 to 81 yr. Participants were assessed at baseline, 6 wk., and 6 mo. The Beck Depression Inventory (BDI) and three selected psychosocial measures from the SF-36 Health Survey were used. Significantly greater decreases in Body Mass Index (BMI) occurred after 6 wk. and 6 mo. follow-up for the intervention group compared with the control group, with greater decreases for participants in the overweight and obese categories. Significantly greater improvements were observed in BDI scores, role-emotional and social functioning, and mental health throughout follow-up for the intervention group. The greater the decrease in BMI through 6 wk., the better the chance of improved BDI score, role-emotional score, social functioning score, and mental health score, with odds ratios of 1.3 to 1.9. Similar results occurred through 6 mo., except the mental health variable became nonsignificant. These results indicate that the CHIP intervention significantly improved psychological health for at least six months afterwards, in part through its influence on lowering BMI.

Unlike a century ago when acute, infectious diseases were the primary cause of death, today the leading cause of death in the United States is coronary heart disease (CHD), followed by cancer, stroke, and then chronic lower respiratory diseases (Centers for Disease Control and Prevention, 2009). Coronary heart disease is also the leading cause of death in Great Britain and in other developed countries (Allender, Peto, Scar-

<sup>1</sup>Address correspondence to Ray M. Merrill, Ph.D., Department of Health Science, Brigham Young University, 229-A Richards Building, Provo, UT 84602 or e-mail (Ray\_Merrill@byu.edu).

borough, Boxer, & Rayner, 2007). The primary causes of CHD are related to biophysical and genetic factors (Kannel & Gordon, 1980; Chen, Campbell, & Peto, 1990; Anderson, Wilson, Odell, & Kannel, 1991), with major modifiable risk factors including elevated cholesterol and triglycerides, high blood pressure, cigarette smoking, obesity, diabetes, and sedentary living. Several studies have associated CHD with increased depression (Carney & Freedland, 2008; Lichtman, Bigger, Blumenthal, Frasure-Smith, Kaufmann, Lespérance, *et al.*, 2008). Psychosocial factors, such as depression, anxiety, stress, hostility, lack of social support, and impaired quality of life, have also been shown to increase the risk of CHD (Denollet, 1993a; Hoffmann, Pfiffner, Hornung, & Niederhauser, 1995; Carney, Freedland, Sheline, & Weiss, 1997; Rumsfeld, MacWhinney, McCarthy, Shroyer, VillaNueva, O'Brien, *et al.*, 1999; Yusuf, Hawken, Ounpuu, Dans, Avezum, Lanas, *et al.*, 2004; Lett, Davidson, & Blumenthal, 2005).

It has been found that lifestyle intervention programs which reduce biophysical risk factors of CHD can also improve psychological health (Linden, Stossel, & Maurice, 1996; Sledge, Ragsdale, Tabb, & Jarmulki, 2000; Lett, *et al.*, 2005; Milani & Lavie, 2007; Merrill, Taylor, & Aldana, 2008; Merrill & Aldana, 2009). Research indicates that long-term behavior change is improved and maintained when interventions use existing community resources and a variety of behavioral strategies (Toobert, Strycker, Glasgow, Barrera, & Bagdale, 2002). One such community-based intervention program in which changes in individual behavior and decreases in coronary risk have been demonstrated is the Coronary Health Improvement Project (CHIP) (Diehl, 1998; Aldana, Greenlaw, Diehl, Salberg, Merrill, Ohmine, *et al.*, 2005; Merrill, *et al.*, 2008). This program highlights the importance of making better choices in nutrition, physical activity, and tobacco use for preventing, reducing, and possibly reversing CHD (Englert, Diehl, & Greenlaw, 2004). Clinical outcome data from a randomized clinical trial utilizing CHIP found participants had healthier nutrition, enhanced physical activity, and improvements in several coronary risk factors (Aldana, *et al.*, 2005; Aldana, Greenlaw, Diehl, Salberg, Merrill, & Ohmine, 2006; Englert, Greenlaw, Diehl, Aldana, & Willich, 2007).

Two previous studies have evaluated whether the CHIP intervention can also affect psychological health. The first study showed that after the CHIP intervention, the mean Beck Depression Inventory (BDI) score was significantly lower after 6 weeks and 6 months (Merrill, Taylor, & Aldana, 2008). The decrease in BDI scores was associated with lowered saturated fat and increased dietary pyridoxine (B6). There was also evidence that lowered BDI scores were associated with social interaction, positive reinforcement, and distraction. A second study focused on whether the CHIP intervention led to improved health based on the SF-36v2 Health

Survey, which includes certain measures related to mental health (Merrill & Aldana, 2009). The CHIP intervention significantly improved scores for functional health and well-being as well as psychometric measures of physical and mental health. The purpose of the current study was to further assess the relationship between the CHIP-mediated changes in body weight and changes in selected psychological health measures: BDI, role-emotional, social functioning, and mental health (nervousness and depression). It was hypothesized that improvements in the psychological measures would be related to decreasing Body Mass Index.

#### METHOD

##### *Participants*

Participants were recruited by the SwedishAmerican Center for Complementary Medicine (SACCM) in Rockford, Illinois, and surrounding metropolitan areas. Recruitment methods included targeted advertising, marketing through the SwedishAmerican Medical Group, corporate client sites, and CHIP alumni groups. Recruitment efforts were aimed at adults aged at least 18 years. A program fee of \$290 was required, but returned if the person attended at least four-fifths of the classes.

To participate in the study, each individual had to be willing to begin participation in either March or October of 2003. The latter group served as controls. Eligible and interested participants provided informed consent. Participants were encouraged to participate with a spouse or significant other and were randomized as a paired unit. All other participants were randomized as individual units. The allocation sequence was created using a random number generator. Program sign-up, randomization, and group assignments were done by the study coordinator. All participants provided informed consent and the study was approved by the Institutional Review Board of the SwedishAmerican Health System on August 29, 2002.

There were 403 individuals assessed for eligibility, 26 of whom were excluded. Of 377 who completed baseline data collection, 29 refused to participate further, leaving 348 people to be randomly assigned to the intervention and control groups. Through 6 mo. of follow-up, 21 in the intervention group dropped out of the study, and nine in the control group dropped out of the study.

##### *Intervention*

The CHIP intervention is a 4-wk., 40-hr. educationally intensive lifestyle intervention program that has been shown to improve coronary risk factors in the community (Englert, *et al.*, 2004; Aldana, *et al.*, 2005) and in the work place (Aldana, Greenlaw, Diehl, Englert, & Jackson, 2002). It is a comprehensive program geared toward decreasing the risk of CHD and

comorbid factors (e.g., overweight, Type II diabetes, essential hypertension) through better lifestyle choices. The primary goals of the CHIP intervention are to lower elevated blood lipids, blood sugar (in diabetics), and blood pressure (in hypertensives). Secondary goals are to facilitate needed weight loss, eliminate smoking, enhance daily exercise, decrease medication requirements for participants with hypertension, diabetes, and heart disease, and to set the stage for the regression of atherosclerotic lesions, which represent the underlying pathology of CHD.

Theory-based intervention planning was used to develop the curriculum, class design, events for alumni, and take-home assignments (Green & Kreuter, 1999; McKenzie & Smeltzer, 2001). The intervention consists of 16 sessions, each 120 min. long (lectures, question and answer periods, interactive learning, food demonstrations, and testimonials), offered daily from Monday through Thursday over 4 wk., plus a shopping tour and an Applied Nutrition Workshop. The focus is on developing better self-care involving a clearer understanding of the nature and etiology of CHD, its epidemiology and risk factors, and to provide participants with appropriate skills to adopt healthy behaviors. The CHIP curriculum includes information on modern medicine (accomplishments and limitations), atherosclerosis, coronary risk factors, obesity, dietary fiber, exercise, fat and cholesterol, the Optimal Diet, diabetes, hypertension, hyperlipidemia, smoking, lifestyle and health, behavioral change, and self-worth.

Participants are encouraged to implement a general fitness regime centered on 30 min. of daily walking and to develop a more optimal diet. The Optimal Diet emphasizes largely whole foods, unrefined "foods-as-grown," such as grains, legumes, vegetables, and fresh fruits. These foods, when simply prepared, are usually high in unrefined complex carbohydrates and very low in fat, animal protein, sugar, and salt (Englert, *et al.*, 2004). They are also high in fiber, antioxidants, micronutrients, and are virtually free of cholesterol.

Participants are also encouraged to attend CHIP-sponsored shopping tours at local supermarkets and a half-day Applied Nutrition Workshop. Furthermore, they have the opportunity to attend weekly focus groups that address special topics, such as medications, diabetes, hypertension, CHD, and obesity. These activities are voluntary, and attendance is not recorded. To improve understanding and integration of the concepts and information presented in the lectures a textbook, a workbook, and a substantial syllabus with key articles and learning objectives are made available. At program completion, participants are encouraged to become involved with the CHIP Alumni Organization, which organizes monthly support meetings, walking groups, and special lectures on healthful living and relapse prevention. In a previous study, the CHIP intervention

was shown to improve dietary measures involving calories, sugars, fats, fiber, and cholesterol over 6 wk. and 6 mo. of follow-up (Merrill, Taylor, & Aldana, 2008).

#### *Measures*

Data were collected at baseline, 6 wk., and 6 mo. by a registered nurse. The demographic data collected at baseline included age, sex, race, marital status, income, and education. Measure of energy expenditure was based on a 7-day self-recorded pedometer log maintained by each participant. Participants wore the Walk4Life Model 2000 Life Stepper pedometer (Plainfield, IL) on a belt at the right hip directly above the right kneecap each day for 7 days at baseline and the weeks prior to the 6 wk. and 6 mo. assessments. Immediately prior to going to bed, the pedometer counts for the day were recorded and the number reset. Strike counts from pedometers are a valid and reliable method of monitoring and measuring free-living physical activity (Mizuno, Yoshida, & Udo, 1990; Sieminski, Cowell, Montgomery, Pillai, & Gardner, 1997; Hendelman, Miller, Baggett, Debold, & Freedson, 2000). Weight and height were measured using standard medical scales recently calibrated by the Biometrics Department of the SwedishAmerican Health System. Body Mass Index (BMI) was determined using the formula: weight (kg)/height (m<sup>2</sup>). In addition, the participants in the current study also completed the Beck Depression Inventory and The Short-Form-36 Health Survey Version 2.0 (SF-36v2).

*Beck Depression Inventory-Short Form.*—The Beck Depression Inventory is one of the most widely accepted tests in screening for depression (Steer, Beck, & Garrison, 1985; Steer, Beck, Riskind, & Brown, 1986). Originally designed to assess the severity of depression in psychiatric patients, it is commonly used as an extensively validated and robust instrument to screen for the presence of depressive symptoms in average populations. The Beck Depression Inventory-Short Form is prominently used, both in clinical practice and in research, as an equivalent to the original as a screen for depression. High internal consistency and high correlation with the BDI have been published (Beck, Rial, & Rickels, 1974). In addition, reliability and validity of the Short Form with older adults have been documented (Scogin, Beutler, Corbishley, & Hamblin, 1988), as well as with the general population for whom norms for the Short Form have been constructed (Knight, 1984). This form has 13 items addressing attitudes and symptoms of depression (Beck & Beck, 1972). Each attitude and symptom are rated on a 4-point scale with anchors of 0: Least severe and 3: Most severe, which includes sadness, pessimism, sense of failure, dissatisfaction, guilt, self-dislike, self-harm, social withdrawal, indecisiveness, self-image change, work difficulty, fatigability, and anorexia. Depression is categorized as: 0–4 = None or Minimal Depression; 5–7 = Mild Depression;

8–15 = Moderate Depression; and 16–39 = Severe Depression. Cronbach's  $\alpha$  at baseline was .83, and at 6-wk. follow-up, it was .81.

*The Short-Form-36 Health Survey Version 2.0 (SF-36v2).*—This health survey uses 36 questions to measure overall health and functional status from which health-related quality of life may be inferred. It is a generic measure that is not restricted to a single disease state, age group, or treatment group (Ware, Snow, Kosinski, & Gandek, 1993; Ware, Kosinski, & Dewey, 2000; Ware & Kosinski, 2001). It is a proven survey for comparing the relative burden of diseases as well as differentiating health benefits produced by a wide range of different interventions. The SF-36v2 is a valid and reliable tool that has been extensively adopted in research (Ware, Gandek, & the IQOLA Project Group, 1994). The SF-36v2 was administered to participants using pencil and paper.

The SF-36v2 yields an eight-scale profile of functional health and well-being scores as well as psychometrically based physical and mental health summary measures and a preference-based health utility index. These eight scale profiles are physical functioning, role physical, bodily pain, general health perceptions, vitality, social functioning, role-emotional, and mental health. Details of these scale items are described elsewhere (Ware & Kosinski, 2001). Scales were scored so that a higher score indicates a better health state. Raw scale scores were transformed to a 100-point scale. The eight scale items had a Cronbach's alpha of .90, which indicates that the items are doing a good job measuring the same underlying concept. The current study will only consider the three psychologically-related scales: social functioning, role-emotional, and mental health.

The social functioning domain is based on two questions. The first asked to what extent, in the past four weeks, physical health or emotional problems interfered with normal social activities with family, friends, neighbors, or groups (1: Not at all to 5: Extremely). The second asked how much of the time, in the past four weeks, physical health or emotional problems interfered with social activities (1: All of the time to 5: None of the time). The role-emotional domain is based on three questions about whether, in the past four weeks, emotional problems (such as feeling depressed or anxious) resulted in cutting down the amount of time spent on work or other activities, accomplishing less than one would like, and didn't do work or other activities as carefully as usual (1: Yes, 2: No). Finally, the mental health domain is based on five questions related to feeling nervous, down in the dumps, peaceful, depressed or downhearted, and happy, each measured on a 6-point scale (1: All of the time to 6: None of the time).

#### *Statistical Analyses*

Frequency distributions and means were generated to describe the

variables. Cross-tabulations were used to perform bivariate analyses between selected variables, with statistical significance based on the chi-squared test for independence. Analysis of covariance was used to evaluate differences in means between groups, with the *F* test used to assess statistical significance. The Pearson product-moment correlation coefficient (*r*) was used to assess the linear associations between selected variables. Finally, multiple logistic regression was used to obtain adjusted odds ratios. Analyses were performed using SAS Version 9.2 (SAS Institute Inc., Cary, NC). Statistical significance was based on the .05 level.

#### RESULTS

The 348 participants ranged in age from 24 to 81 yr. ( $M=50.4$ ,  $SD=11.0$ ), with 98 (28.2%) men and 250 (71.8%) women. Most participants were Caucasian (94.5%), married (76.6%), had an annual family income of at least \$60,000 (51.2%), and had at least some college experience (72.8%). There was no significant difference between the intervention and control groups with respect to these variables (chi-squared  $p$  value  $> .20$ ).

At 6 wk., BMI was significantly lower for those in the intervention group compared with the control group ( $M=31.1$ ,  $SD=7.9$  vs  $M=32.2$ ,  $SD=9.0$ ;  $F_1=199.54$ ,  $p<.001$ ), after adjusting for age, sex, and BMI at baseline. At 6 months, BMI remained significantly lower for those in the intervention group compared with the control group ( $M=30.3$ ,  $SD=7.5$  vs  $M=31.7$ ,  $SD=9.2$ ;  $F_1=58.68$ ,  $p<.001$ ), after adjusting for age, sex, and BMI at baseline. The odds of lowering BMI through 6 wk. are significantly greater among those in the intervention group (Table 1). The odds of low-

TABLE 1  
LOWERING BODY MASS INDEX THROUGH 6 WEEKS AND 6 MONTHS OF FOLLOW-UP  
ACCORDING TO INTERVENTION STATUS AND BODY WEIGHT CLASSIFICATION AT BASELINE

BMI Criterion	Baseline		Improvement at 6 Wk.		Improvement at 6 Mo.	
	<i>n</i>	%	Odds Ratio <sup>a</sup>	95%CI <sup>a</sup>	Odds Ratio <sup>a</sup>	95%CI <sup>a</sup>
Healthy weight (18.5–24.9)						
Control	43	64.2	10.1	2.0, 50.8	4.2	1.3, 13.4
Intervention	24	35.8				
Overweight (25–29.9)						
Control	56	55.5	25.9	3.3, 205.9	3.4	1.2, 9.6
Intervention	45	44.5				
Obese ( $\geq 30$ )						
Control	75	41.7	26.6	9.6, 73.8	5.3	2.4, 11.8
Intervention	105	58.3				

Note.—Odds ratios expressed as the increase in odds for the intervention group. <sup>a</sup>Adjusting for age, sex, and BMI at baseline.

TABLE 2  
 BODY MASS INDEX, BECK DEPRESSION INVENTORY (0-39), AND SELECTED SF-36V2 SUMMARY MEASURES (0-100 SCALE) AT  
 BASELINE, 6 WK., AND 6 MO. OF FOLLOW-UP AMONG PARTICIPANTS IN A THERAPEUTIC LIFESTYLE-MODIFICATION PROGRAM

Variable	Baseline		Between-group Comparison		6-wk. Follow-up		Between-group Comparison		6-mo. Follow-up		Between-group Comparison	
	M <sup>a</sup>	SD	F <sub>1</sub>	p	M <sup>b</sup>	SD	F <sub>1</sub>	p	M <sup>b</sup>	SD	F <sub>1</sub>	p
BDI												
Control	3.6	4.4	3.58	.06	3.6	3.7	43.89	<.001	3.3	4.2	17.72	<.001
Intervention	4.6	4.8			1.8	3.5			2.1	3.5		
Role Emotional												
Control	87.0	19.3	2.13	.15	86.9	18.5	18.95	<.001	89.6	17.8	2.89	.09
Intervention	83.7	21.8			93.6	16.1			92.4	16.7		
Social Functioning												
Control	86.3	18.7	3.49	.063	84.8	19.1	19.81	<.001	86.9	19.5	4.78	.03
Intervention	82.4	23.6			92.5	18.0			90.8	18.1		
Mental Health												
Control	76.9	16.8	3.43	.07	77.3	15.8	31.60	<.001	76.4	17.5	12.8	<.001
Intervention	73.6	17.1			84.1	12.9			81.4	14.1		

<sup>a</sup>Adjusting for age and sex. <sup>b</sup>Adjusting for age, sex, and the baseline value of Beck Depression Inventory, Role Emotional, Social Functioning, or Mental Health.

ering BMI remain significantly greater for those in the intervention group through 6 mo. of follow-up.

Mean scores for the psychological health measures are presented for the intervention and control groups at baseline, 6 wk., and 6 mo. in Table 2. There were no significant differences in the mean scores at baseline, but at 6 wk., the mean scores were significantly better among those in the intervention group for each of the measures. At 6 mo., the mean scores were significantly better among those in the intervention group for BDI, social functioning, and mental health, but not role emotional. The intervention group lowered their average BDI score by 2.8 through 6 wk. and 2.5 through 6 mo., whereas there was almost no change for the control group. In addition, the intervention group improved their role-emotional, social functioning, and mental health scores, on average, by 9.9, 10.1, and 10.5 through 6 wk. and 8.7, 8.4, and 7.8 through 6 mo. Little change occurred in the scores for the control group.

Body Mass Index was statistically significantly correlated with scores on the BDI ( $r = .29, p < .001$ ), role-emotional ( $r = -.16, p = .003$ ), social functioning ( $r = -.26, p < .001$ ), and mental health ( $r = -.19, p < .001$ ) scores at baseline, after adjusting for age and sex. The percent of participants with improved BDI through 6 wk. of follow-up was 44.8 for those of normal weight, 52.5 for overweight, and 67.2 for obese at baseline ( $\chi^2 = 12.36, p = .002$ ; Cramér's phi = .19). The percent with improved social functioning also increased with baseline weight; that is, 20.9 for normal weight, 31.7 for overweight, and 40.6 for obese ( $\chi^2 = 8.79, p = .01$ ; Cramér's phi = .16). Through 6 mo. of follow-up, the percent showing improvement in the psychological health measures was not significantly associated with baseline weight classifications, although for BDI the result was marginally non-significant: 52.2 for normal weight, 52.5 for overweight, and 65.0 for obese ( $\chi^2 = 5.72, p = .06$ ; Cramér's phi = .13), respectively.

The odds of showing improvement in the psychological health measures at 6 wk. and 6 mo. of follow-up according to change in BMI are presented in Table 3. The greater the decrease in BMI through 6 wk. and 6

TABLE 3  
IMPROVING THE SELECTED PSYCHOLOGICAL HEALTH MEASURES  
ACCORDING TO DECREASING CHANGE IN BODY MASS INDEX

Decreasing Change in BMI	Beck Depression Inventory		Role-emotional		Social Functioning		Mental Health	
	Odds Ratio <sup>a</sup>	95%CI <sup>a</sup>	Odds Ratio <sup>a</sup>	95%CI <sup>a</sup>	Odds Ratio <sup>a</sup>	95%CI <sup>a</sup>	Odds Ratio <sup>a</sup>	95%CI <sup>a</sup>
6 wk.	1.5	1.1, 2.0	1.6	1.1, 2.3	1.9	1.3, 2.7	1.5	1.1, 2.0
6 mo.	1.2	1.1, 1.4	1.2	1.0, 1.4	1.1	1.0, 1.4	1.1	0.9, 1.2

<sup>a</sup>Adjusting for age, sex, BMI at baseline, and the baseline values of each measure.

mo., the higher the odds of improving psychological health. Improvement status in the selected psychological health measures at 6 wk. and 6 mo. of follow-up according to change in BMI was not significantly associated with baseline BMI (Wald  $\chi^2 p > .1$ ).

#### DISCUSSION

To maximize improvements in physical and psychological health, researchers have developed interventions that simultaneously target both biophysical and psychosocial risk factors of CHD (Toobert, *et al.*, 2002; Lett, *et al.*, 2005). The efficacy of the CHIP intervention at lowering biophysical risk factors, depression, and improving quality of life has been demonstrated (Aldana, *et al.*, 2002, 2005, 2006; Merrill, Taylor, & Aldana, 2008; Merrill & Aldana, 2009). The current study further assesses the relationship between the CHIP-mediated changes in body weight and changes in selected psychological health measures.

In previous research involving the CHIP, younger people and women reported higher BDI at baseline, but greater benefit from the intervention, specifically in lowering BDI scores (Merrill & Aldana, 2009). One study involving younger patients with coronary artery disease showed that these patients may substantially benefit psychologically through formal cardiac rehabilitation (Lavie & Milani, 2006). The fact that younger participants reported slightly more psychosocial benefits may be related to older participants having higher CHD risk scores (Blazen, 1989; Anderson, *et al.*, 1991; Khaw, 1997). The finding on sex may be because women, even more so than men, value the increased social support, new friendships, and a sense of connectedness to the community which the CHIP intervention facilitates by being interactive, social, and community-based. Another explanation may relate to their higher depression scores at baseline. The finding that participants at higher risk at baseline show the greatest improvements was seen in the current study for BMI. Because of the significant influence age and sex have on the psychological health variables, these variables were adjusted for the analyses.

Body Mass Index was an important variable associated with scores on the BDI. In previous research, the CHIP intervention was shown to significantly decrease BMI, as well as calories, sugar, fat, fiber, and cholesterol, and increase total steps at 6 wk. and 6 mo. follow-up (Merrill, Taylor, & Aldana, 2008). In the current study, the decrease in weight observed at 6 wk. and 6 mo. follow-up in the intervention group was significantly greater for those with higher BMI at baseline. Further, improvements in BDI at 6 wk. and 6 mo. follow-up were significantly greater among those with greater decreases in BMI. This finding is consistent with another study that found a strong inverse correlation between weight loss and mood elevation (Weighill & Buglass, 1984). The result is further reinforced by a study

that found that weight loss improved psychosocial functioning and mental well-being (Karlsson, Taft, Sjostrom, Torgerson, & Sullivan, 2003).

At baseline, BMI was also directly associated with scores on the BDI, role-emotional, social functioning, and mental health. There was some evidence that improvement in BDI and social functioning scores, at least at 6-wk. follow-up, was greater among those with greater BMI at baseline. These were the individuals with the most potential to improve their health by lowering their BMI. The psychological well-being of the CHIP participants might have been positively affected by increased feelings of empowerment, making strides toward reducing their body weight, and improving other health indicators. It has been shown that exercise training among patients with coronary artery disease directly reduces mortality (Milani & Lavie, 2009). It is known that physical activity increases endorphin and monoamine levels, which may reduce symptoms of depression, especially in the short term (Lawlor & Hopker, 2001; Penedo & Dahn, 2005; Sjosten & Kivela, 2006). Physically active involvement in structured group activities may also provide social interaction and support, open communication, and motivation. Such social support was an effective component of the Heart Disease Reversing Program (Ornish, Brown, Scherwitz, Billings, Armstrong, Ports, *et al.*, 1990) and other cardiac rehabilitation programs (Clark, Whelan, Barbour, & MacIntyre, 2005). Participants may experience increased mental health given a heightened sense of self-efficacy (Bandura, 1986). As newly acquired behaviors and participation in the program are associated with improved health, participants' sense of despair, failure, and possibly social isolation may be replaced with a growing sense of accomplishment, increased social support and a new sense of hope. In a previous study involving CHIP (Merrill, Taylor, & Aldana, 2008), baseline levels of saturated fat were significantly negatively associated with BDI, after adjusting for age, sex, exercise, BMI, and exercise. Although the current study did not find a direct association between pyridoxine (B6) and the psychological health variables at baseline, it was previously observed that the CHIP intervention significantly increased pyridoxine (B6), which was associated with a decrease in BDI (Merrill, Taylor, & Aldana, 2008).

Cardiac rehabilitation programs, although not usually conducted in community settings, do offer some similarities to the CHIP intervention by offering a range of supervised exercise programs and components that address psychological well-being, smoking cessation, and dietary change. Several studies have shown that cardiac rehabilitation programs that incorporate psychosocial aspects produce better mental health quality of life outcomes (Hertzeanu, Shemesh, Aron, Aron, Peleg, Rosenthal, *et al.*, 1993; Denollet, 1993b; Linden, *et al.*, 1996; Sledge, *et al.*, 2000; Verrill, Barton, Beasley, Brennan, Lippard, & King, 2001). However, some argue that the

mechanism by which mental health and quality of life improve is by improving physical health (Laux, Newman, Queener, Rosneck, & Josephson, 2005).

## REFERENCES

- ALDANA, S. G., GREENLAW, R. L., DIEHL, H. A., ENGLERT, H., & JACKSON, R. (2002) Impact of the Coronary Health Improvement Project (CHIP) on several employee populations. *Journal of Occupational and Environmental Medicine*, 44, 831-839.
- ALDANA, S. G., GREENLAW, R. L., DIEHL, H. A., SALBERG, A., MERRILL, R. M., & OHMINE, S. D. (2006) The behavioral and clinical effects of therapeutic lifestyle change on middle-aged adults. *Preventing Chronic Disease*, 3, A05-A17.
- ALDANA, S. G., GREENLAW, R. L., DIEHL, H. A., SALBERG, A., MERRILL, R. M., OHMINE, S. D., & THOMAS, C. (2005) Effects of an intensive diet and physical activity modification program on the health risks of adults. *Journal of the American Dietetic Association*, 105, 371-381.
- ALLENDER, S., PETO, V., SCARBOROUGH, P., BOXER, A., & RAYNER, M. (2007) *Coronary heart disease statistics*. London: British Heart Foundation.
- ANDERSON, K. M., WILSON, P. W. F., ODELL, P. M., & KANNEL, W. B. (1991) An updated coronary risk profile. *Circulation*, 83, 357-363.
- BANDURA, A. (1986) *Social foundations of thought and action: social cognitive theory*. Englewood Cliffs, NJ: Prentice Hall.
- BECK, A. T., & BECK, R. W. (1972) Screening depressed patients in family practice: rapid technique. *Postgraduate Medicine*, 52, 81-85.
- BECK, A. T., RIAL, W. Y., & RICKELS, K. (1974) Short form of depression inventory: cross-validation. *Psychological Reports*, 34, 1184-1186.
- BLAZEN, D. (1989) Depression in the elderly. *New England Journal of Medicine*, 320, 164-166.
- CARNEY, R. M., & FREEDLAND, K. E. (2008) Depression in patients with coronary heart disease. *American Journal of Medicine*, 121, S20-S27.
- CARNEY, R. M., FREEDLAND, K. E., SHELINE, Y. I., & WEISS, E. S. (1997) Depression and coronary heart disease: a review for cardiologists. *Clinical Cardiology*, 20, 196-200.
- CENTERS FOR DISEASE CONTROL AND PREVENTION. (2009) Leading causes of death. Available at <http://www.cdc.gov/nchs/fastats/lcod.htm>. Accessed April 8, 2011.
- CHEN, J., CAMPBELL, T. C., & PETO, R. (1990) *Diet, life-style and mortality in China: study of the characteristics of 65 Chinese counties*. Oxford, UK: Oxford Univer. Press.
- CLARK, A. M., WHELAN, H. K., BARBOUR, R., & MACINTYRE, P. D. (2005) A realist study of the mechanisms of cardiac rehabilitation. *Journal of Advanced Nursing*, 52, 362-371.
- DENOLLET, J. (1993a) Emotional distress and fatigue in coronary heart disease: the Global Mood Scale (GMS). *Psychological Medicine*, 23, 111-121.
- DENOLLET, J. (1993b) Sensitivity of outcome assessment in cardiac rehabilitation. *Journal of Clinical Psychology*, 61, 686-695.
- DIEHL, H. A. (1998) Coronary risk reduction through intensive community-based lifestyle intervention: the Coronary Health Improvement Project (CHIP) experience. *The American Journal of Cardiology*, 82, 83T-87T.
- ENGLERT, H., DIEHL, H. A., & GREENLAW, R. L. (2004) Rationale and design of the Rockford CHIP, a community-based coronary risk reduction program: results of a pilot phase. *Preventive Medicine*, 38, 432-441.

- ENGLERT, H., GREENLAW, R. L., DIEHL, H. A., ALDANA, S. G., & WILICH, S. N. (2007) The effect of community-based coronary risk reduction: the Rockford CHIP. *Preventive Medicine*, 44, 513-519.
- GOULD, K. L., ORNISH, D. M., SCHERWITZ, L., BROWN, S., EDENS, R. P., HESS, M. J., MULLANI, N., BOLOMEY, L., DOBBS, F., ARMSTRONG, W. T., MERRITT, T., PORTS, T., SPARLER, S., & BILLINGS, J. (1995) Changes in myocardial perfusion abnormalities by positron emission tomography after long-term intense risk factor modification. *Journal of the American Medical Association*, 274, 894-901.
- GREEN, L. W., & KREUTER, N. W. (1999) *Health promotion planning: an educational and ecological approach*. Mountain View, CA: Mayfield.
- HENDELMAN, D., MILLER, K., BAGGETT, C., DEBOLD, E., & FREEDSON, P. (2000) Validity of accelerometry for the assessment of moderate intensity physical activity in the field. *Medicine & Science in Sports & Exercise*, 32(Suppl. 9), S442-S449.
- HERTZEANU, H. L., SHEMESH, J., ARON, L. A., ARON, A. L., PELEG, E., ROSENTHAL, T., MOTRO, M., & KELLERMAN, J. J. (1993) Ventricular arrhythmias in rehabilitated and non-rehabilitated post-myocardial infarction patients with left ventricular dysfunction. *American Journal of Cardiology*, 71, 24-27.
- HOFFMANN, A., PFIFFNER, D., HORNING, R., & NIEDERHAUSER, H. (1995) Psychosocial factors predict medical outcome following a first myocardial infarction. *Coronary Artery Disease*, 6, 147-152.
- KANNEL, W. B., & GORDON, T. (1980) Cardiovascular risk factors in the aged: the Framingham Study. In S. G. Haynes & M. Feinleib (Eds.), *Second Conference on the Epidemiology of Aging*. (U.S. Department of Health & Human Services NIH Publication No. 80-969) Washington, DC: U.S. Government Printing Office. Pp. 65-89.
- KARLSSON, J., TAFT, C., SJOSTROM, L., TORGERSON, J. W., & SULLIVAN, M. (2003) Psychosocial functioning in the obese before and after weight reduction: construct validity and responsiveness of the Obesity-related Problem Scale. *International Journal of Obesity and Related Metabolic Disorders*, 27, 617-630.
- KHAW, K. T. (1997) Healthy aging. *Behavioral Medical Journal*, 5, 412-418.
- KNIGHT, R. G. (1984) Some general population norms for the short form Beck Depression Inventory. *Journal of Clinical Psychology*, 40, 751-753.
- LAUX, J. M., NEWMAN, I., QUEENER, J., ROSNECK, J., & JOSEPHSON, R. (2005) Cardiac rehabilitation intervention and quality of life indicators: a validation estimate of Ware's model. *Ohio Journal of Science*, 105, 66-73.
- LAVIE, C. J., & MILANI, R. V. (2006) Adverse psychological and coronary risk profiles in young patients with coronary artery disease and benefits of formal cardiac rehabilitation. *Archives of Internal Medicine*, 166, 1878-1883.
- LAWLOR, D. A., & HOPKER, S. W. (2001) The effectiveness of exercise as an intervention in the management of depression: a systematic review and meta-regression analysis of randomized controlled trials. *British Medical Journal*, 322, 763-767.
- LETT, H. S., DAVIDSON, J., & BLUMENTHAL, J. A. (2005) Nonpharmacologic treatments for depression in patients with coronary heart disease. *Psychosomatic Medicine*, 67, S58-S62.
- LICHTMAN, J. H., BIGGER, J. T., JR., BLUMENTHAL, J. A., FRASURE-SMITH, N., KAUFMANN, P. G., LESPÉRANCE, F., MARK, D. B., SHEPS, D. S., TAYLOR, C. B., FROELICHER, E. S., AMERICAN HEART ASSOCIATION PREVENTION COMMITTEE OF THE COUNCIL ON CARDIOVASCULAR NURSING, AMERICAN HEART ASSOCIATION COUNCIL ON CLINICAL CARDIOLOGY, AMERICAN HEART ASSOCIATION COUNCIL ON EPIDEMIOLOGY AND PREVENTION,

- AMERICAN HEART ASSOCIATION INTERDISCIPLINARY COUNCIL ON QUALITY OF CARE AND OUTCOMES RESEARCH, & AMERICAN PSYCHIATRIC ASSOCIATION. (2008) Depression and coronary heart disease: recommendations for screening, referral, and treatment: a science advisory from the American Heart Association Prevention Committee of the Council on Cardiovascular Nursing, Council on Clinical Cardiology, Council on Epidemiology and Prevention, and Interdisciplinary Council on Quality of Care and Outcomes Research: endorsed by the American Psychiatric Association. *Circulation*, 118, 1768-1775.
- LINDEN, W., STOSSEL, C., & MAURICE, J. (1996) Psychosocial interventions for patients with coronary artery disease: a meta-analysis. *Archives of Internal Medicine*, 156, 745-752.
- McKENZIE, J. F., & SMELTZER, J. L. (2001) *Planning, implementing, and evaluating health promotion programs: a primer*. Boston: Allyn & Bacon.
- MERRILL, R. M., & ALDANA, S. G. (2009) Improving overall health status through the CHIP intervention. *American Journal of Health Behavior*, 33, 135-146.
- MERRILL, R. M., ALDANA, S. G., GREENLAW, R. L., DIEHL, H. A., SALBERG, A., & ENGLERT, H. (2008) Can newly acquired healthy behaviors persist? An analysis of health behavior decay. *Preventing Chronic Disease*, 5, 1-13.
- MERRILL, R. M., TAYLOR, P., & ALDANA, S. G. (2008) Coronary Health Improvement Project (CHIP) is associated with improved nutrient intake and decreased depression. *Nutrition*, 24, 314-321.
- MILANI, R. V., & LAVIE, C. J. (2007) Impact of cardiac rehabilitation on depression and its associated mortality. *American Journal of Medicine*, 120, 799-806.
- MILANI, R. V., & LAVIE, C. J. (2009) Reducing psychosocial stress: a novel mechanism of improving survival from exercise training. *American Journal of Medicine*, 122, 931-938.
- MIZUNO, C., YOSHIDA, T., & UDO, M. (1990) Estimation of energy expenditure during walking and jogging by using an electro-pedometer. *Annals of Physiological Anthropology*, 9, 283-289.
- ORNISH, D., BROWN, S. E., SCHERWITZ, L. W., BILLINGS, J. H., ARMSTRONG, W. T., PORTS, T. A., McLANAHAN, S. M., KIRKEEIDE, R. L., BRAND, R. J., & GOULD, K. L. (1990) Can lifestyle changes reverse coronary heart disease? The lifestyle heart trial. *Lancet*, 336, 129-133.
- PENEDO, F. J., & DAHN, J. R. (2005) Exercise and well-being: a review of mental and physical health benefits associated with physical activity. *Current Opinions in Psychiatry*, 18, 189-193.
- RUMSFELD, J. S., MACWHINNEY, S., MCCARTHY, M., JR., SHROYER, A. L. W., VILLANUEVA, C. B., O'BRIEN, M., MORITZ, T. E., HENDERSON, W. G., GROVER, F. L., WETHI, G. K., & HAMMERMEISTER, K. E. (1999) Healthy-related quality of life as a predictor of mortality following coronary artery bypass graft surgery. *Journal of the American Medical Association*, 281, 1298-1303.
- SCOGIN, F., BEUTLER, L., CORBISHLEY, A., & HAMBLIN, D. (1988) Reliability and validity of the short form Beck Depression Inventory with older adults. *Journal of Clinical Psychology*, 44, 853-856.
- SIEMINSKI, D. J., COWELL, L. L., MONTGOMERY, P. S., PILLAI, S. B., & GARDNER, A. W. (1997) Physical activity monitoring in patients with peripheral arterial occlusive disease. *Journal of Cardiopulmonary Rehabilitation*, 17, 43-47.

- SJOSTEN, N., & KIVELA, S. L. (2006) The effects of physical exercise on depressive symptoms among the aged: a systematic review. *International Journal of Geriatric Psychiatry*, 21, 410-418.
- SLEDGE, S. B., RAGSDALE, K., TABB, J., & JARMULKI, N. (2000) Comparison of intensive outpatient cardiac rehabilitation to standard outpatient care in veterans: effects on quality of life. *Journal of Cardiopulmonary Rehabilitation*, 20, 383-388.
- STEER, R. A., BECK, A. T., & GARRISON, B. (1985) Applications of the Beck Depression Inventory. In N. Sartorius & T. A. Ban (Eds.), *Assessment of depression*. New York: Springer-Verlag. Pp. 121-142.
- STEER, R. A., BECK, A. T., RISKIND, J., & BROWN, G. (1986) Differentiation of depressive disorders from generalized anxiety by the Beck Depression Inventory. *Journal of Clinical Psychology*, 40, 475-478.
- TOOBERT, D. J., STRYCKER, L. A., GLASGOW, R. E., BARRERA, M., & BAGDALE, J. D. (2002) Enhancing support for health behavior change among women at risk for heart disease: the Mediterranean Lifestyle Trial. *Health Education Research*, 17, 574-585.
- VERRILL, D., BARTON, C., BEASLEY, W., BRENNAN, M., LIPPARD, M., & KING, C. (2001) Quality of life measures and gender comparisons in North Carolina cardiac rehabilitation programs. *Journal of Cardiopulmonary Rehabilitation*, 21, 37-46.
- WARE, J. E., GANDEK, B., & THE IQOLA PROJECT GROUP. (1994) The SF-36® Health Survey: development and use in mental health research and the IQOLA Project. *International Journal of Mental Health*, 23, 49-73.
- WARE, J. E., & KOSINSKI, M. (2001) *SF-36 Physical and mental health summary scales: a manual for users of Version 1*. (2nd ed.) Lincoln, RI: Quality Metric.
- WARE, J. E., KOSINSKI, M., & DEWEY, J. E. (2000) *How to score version two of the SF-36 Health Survey*. Lincoln, RI: Quality Metric.
- WARE, J. E., SNOW, K. K., KOSINSKI, M., & GANDEK, B. (1993) *SF-36® Health Survey manual and interpretation guide*. Boston, MA: New England Medical Center, The Health Institute.
- WEIGHILL, V. E., & BUGLASS, D. (1984) Weight change and psychological state in obese women. *Appetite*, 5, 95-102.
- YUSUF, S., HAWKEN, S., OUNPUU, S., DANS, T., AVEZUM, A., LANAS, F., MCQUEEN, M., BUDAJ, A., PAIS, P., VARIGOS, J., LISHENG, L., & INTERHEART STUDY INVESTIGATORS. (2004) Effect of potentially modifiable risk factors associated with myocardial infarction in 52 countries (the INTERHEART study): case-control study. *Lancet*, 364, 937-952.

Accepted August 24, 2011.