Socioeconomic Status and Improvements in Lifestyle, Coronary Risk Factors, and Quality of Life: The Multisite Cardiac Lifestyle Intervention Program

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Objectives. We sought to clarify whether patients of low socioeconomic status (SES) can make lifestyle changes and show improved outcomes in coronary heart disease (CHD), similar to patients with higher SES.

Methods. We examined lifestyle, risk factors, and quality of life over 3 months, by SES and gender, in 869 predominantly White, nonsmoking CHD patients (34% female) in the insurance-sponsored Multisite Cardiac Lifestyle Intervention Program. SES was defined primarily by education.

Results. At baseline, less-educated participants were more likely to be disadvantaged (e.g., past smoking, sedentary lifestyle, high fat diet, overweight, depression) than were higher-SES participants. By 3 months, participants at all SES levels reported consuming 10% or less dietary fat, exercising 3.5 hours per week or more, and practicing stress management 5.5 hours per week or more. These self-reports were substantiated by improvements in risk factors (e.g., 5-kg weight loss, and improved blood pressure, low-density lipoprotein cholesterol, and exercise capacity; $P<.001$), and accompanied by improvements in well-being (e.g., depression, hostility, quality of life; $P<.001$).

Conclusions. The observed benefits for CHD patients with low SES indicate that broadening accessibility of lifestyle programs through health insurance should be strongly encouraged. (*Am J Public Health.* 2009;99:1263–1270. doi: 10.2105/AJPH.2007.132852)

Coronary heart disease (CHD) is the leading cause of morbidity and mortality in the United States.[1,2] Risk factors for CHD include smoking, excess weight, physical inactivity, hypertension, unfavorable lipid levels, diabetes, and stress-related factors, such as depression and hostility.[1] These risk factors are especially pronounced among persons of low socioeconomic status (SES).[3–7] Although the majority of risk factors can be prevented by making lifestyle changes that improve health habits,[8,9] it is not clear whether persons with low SES are as successful in their attempts to make lifestyle changes as their higher-SES counterparts. The low-SES environment is plagued with high-fat foods, elevated stress caused by economic hardship, and low social capital to promote health.[7,10,11] In addition, in the United States, persons with low SES are less likely to have access to preventive health services, further increasing the low-SES disadvantage. Clearly, the efficacy of a lifestyle intervention is influenced by the individual's ability to improve diet and exercise and to reduce stress. Therefore, many have questioned whether low-SES persons can adhere to intensive lifestyle programs, which have been found to be most efficacious when participants are greatly adherent.[12–17]

Two small, randomized lifestyle trials targeting multiple health behaviors (diet, exercise, and stress management) found improvements in cardiovascular risk factors and myocardial perfusion, as well as fewer clinical events, in the intervention group.[16,18,19] Since 1998, the same program has been implemented at 22 program sites participating in the ongoing insurance-sponsored Multisite Cardiac Lifestyle Intervention Program (MCLIP). The purpose of our study was to examine the relative effectiveness of the MCLIP for male and female CHD patients of lower SES when compared with those of higher SES.

METHODS

Study Population and Design

A detailed description of the design and methodology of MCLIP has been published previously.[20] Analyses for our study were based on data obtained from enrollees between January 1998 and September 2004. Staff was trained at each site in 4 states in the United States (Pennsylvania, West Virginia, Nebraska, and Illinois). Participants were members of Highmark, Inc (56%), West Virginia Public Employees Insurance Agency (13%), Mountain State BlueCross/BlueShield (5%), and other health care plans. A total of 7% of participants paid for the program themselves.

Participating sites obtained approval from their institutional review boards. Participants were referred to the program by physicians or self-referred through multiple recruitment strategies that included advertising, media publicity, and letters from their health insurance company. The company's claims database was used to identify members who had *International Classification of Diseases, Ninth Revision* (*ICD-9*)[21] codes for diabetes, coronary artery disease, myocardial infarction, stable angina, congestive heart failure, and revascularizations. These members were invited to undergo further eligibility screening.

After receiving approval from their physician, participants completed informed consent and medical records release forms, demographic and psychosocial questionnaires, and a 3-day diet diary. Medication information was collected, fasting blood was drawn, and a maximal exercise stress test was performed. Medical, behavioral, and psychosocial variables were assessed before the intervention and 3 months afterwards.

Participants

A total of 869 participants (34% female) enrolled in the program; education data were missing for 84 participants, yielding a sample size of 785 for SES analyses. Because 1 of the sites declined to ask participants about their annual household income, and 26% of the participants enrolled at the remaining sites did not report income, this variable was available for only 478 participants. Thus, our primary focus was on education as an SES indicator.

Inclusion criteria. Individuals were eligible for the program if they had been diagnosed with CHD, which was defined as (1) ischemia documented with noninvasive testing, such as exercise testing, nuclear imaging, or echocardiogram; (2) cardiac catheterization demonstrating CHD; (3) a history of percutaneous coronary intervention, coronary bypass surgery, or myocardial infarction; or (4) eligibility for percutaneous coronary intervention or coronary bypass surgery.

Exclusion criteria. Patients were excluded if they were medically unstable; current smokers, or had less than a 2-month history of smoking cessation; lived an hour or more drive from the program site; had a history of substance abuse or significant psychiatric disorder; had impaired cognitive function such as dementia or delirium; had English language illiteracy; or were nonambulatory.

Lifestyle Change Program

Participants attended an on-site program twice a week for 3 months (104 hours). Each session consisted of individualized nurse case management, interactive lectures, demonstrations (e.g., cooking), 1 hour of supervised exercise, 1 hour of stress management, a meal, and 1 hour of group support.[20] Program attendance was measured by the number of sessions attended divided by the number of sessions offered.

Diet. Participants were encouraged to consume a low fat (10% of calories), plant-based, whole-foods diet, high in complex carbohydrates (75% of daily calories) and low in simple carbohydrates and protein (15% of daily calories). The diet included fruits, vegetables, grains, legumes, 1 cup of nonfat dairy, egg whites, and 1 serving of a soy product per day. Caffeine was excluded, and alcohol was limited to 1 drink per day. Sodium intake was restricted for participants who had hypertension related to sodium sensitivity, congestive heart failure, or renal disease. A low-dose multivitamin and 3 g/day fish oil (omega-3 fatty acids) supplement were recommended. A minimum of 1 personal nutrition counseling session was provided by a registered dietician.

Exercise. The exercise prescription followed the guidelines of the American College of Sports Medicine.[22] Participants were asked to exercise 3 hours per week (about 30 min/day) within their target heart rate or perceived exertion levels and to perform strength-training activities 2 times per week. Each individual's target heart rate was calculated at 45% to 80% of maximal heart rate achieved during the baseline exercise test using the Karvonen formula.[23] Most participants' exercise consisted of brisk walking. During on-site sessions, they took part in traditional cardiac rehabilitation exercise and were supervised by trained professionals.

Stress management. Stress management practices included gentle yoga poses, progressive muscle relaxation, breathing exercises, meditation, and guided imagery. Participants were asked to practice stress management techniques for 1 hour or more per day and were provided audiocassettes or CDs for home practice. On-site sessions were led by a certified stress-management specialist.

Group support. Group support sessions provided social support to facilitate adherence to the lifestyle change program. Sessions were directed by a licensed mental health professional who taught communication skills to enhance intimacy and encourage expression of feelings in a supportive environment.[24]

Measures

SES and demographic variables were measured through the use of a questionnaire. Participants reported their level of education based on 7 categories: less than 7th grade; junior high school (7th and 8th grades); partial high school (10th or 11th grade); high school graduate; partial college or specialized training; college; and graduate degree. Annual household income was based on 9 categories: $7500 or less; $7501 to $15 000; $15 001 to $25 000; $25 001 to $35 000; $35 001 to $50 000; $50 001 to $75 000; $75 001 to $100 000; and over $100 000. Participants were asked if they were married, divorced, widowed, or single; employed, not working, retired, or disabled; and to indicate their ethnic background.

Anthropometric variables and plasma lipids were assessed at both time points. Height and weight were measured with shoes and excess clothing removed on the same calibrated scale. Blood pressure was measured by a trained health professional with a calibrated sphygmomanometer according to American Heart Association practice guidelines.[25] Fasting blood samples were collected at baseline and 3 months, and analyzed by laboratories near each program site following the Clinical Laboratory Improvement Amendments of 1988.[26] Total cholesterol, high-density lipoprotein (HDL) cholesterol, and triglycerides were measured, and low-density lipoprotein (LDL) cholesterol was either measured or calculated, depending on the site. Hemoglobin A1c (HbA1c) was measured for patients with diabetes.

Exercise tolerance was assessed by maximal treadmill or cycle ergometry testing when treadmill testing was contraindicated.[22] Peak workload was recorded for each participant in metabolic equivalents, which are measurement units of energy expenditure and equivalent to approximately 3.5 mL of oxygen consumed/min/kg body weight.

Currently prescribed medications were documented at baseline, including lipid-lowering, antihypertensive, vasodilating (e.g., nitrates), and anticoagulant and antiplatelet medications.

Depressive symptoms (Center for Epidemiologic Studies depression scale),[27] hostility (Cook–Medley Scale),[28] psychological stress,[29] and health related quality of life (QOL; determined using the Medical Outcomes Study Short-Form 36-Item Health Survey)[30] assessments have been described elsewhere.[20,31,32] Adherence to the lifestyle recommendations (diet, exercise, and stress management) were based on self-reports.

Statistical Analyses

Education was grouped into 4 categories: high school or less, partial college or specialized training, college degree, and graduate degree. Baseline education group and gender effects were analyzed by analysis of variance (ANOVA) for continuous variables and χ^2 for categorical variables. ANOVAs for repeated measures tested the effects of the 4 education groups, gender, time (baseline and 3 months), and their interactions on lifestyle behaviors, risk factors, and psychosocial factors. Bonferroni's adjustments were used to correct for multiple comparisons. To increase confidence in our findings by educational group, all analyses were repeated with annual household income as an indicator of SES. Four categories were created: $25 000 or less, $25 001 to $50 000, $50 001 to $75 000, and more than $75 000.[32–35] We also repeated the analyses excluding data from the participants who paid for the program themselves. Results that differed are so indicated. Demographic characteristics were categorized for analyses as follows: "not married" included divorced, widowed, and single; "not working" included unemployed, disabled, and retired (74% of the "not working" participants were retired); and "White" consisted of "non-Hispanic White." Spearman correlation measured the association between education and income.

Baseline characteristics of those missing education data were compared with those who had education data by ANOVAs for continuous variables and χ^2 for categorical variables. Similar analyses were run for participants missing income data and those missing 3-month data (lost to follow-up). Statistical analyses were performed with SPSS 12.0 (SPSS Inc, Chicago, IL) and SAS 9.1 (SAS Institute Inc, Cary, NC).

RESULTS

Of the 785 participants with education data, 282 (36%; 39% female, 29 participants had less than a high school education) had a high school education or less, 143 (18%; 48% female) had partial college or specialized training, 213 (27%; 24% female) had completed a college degree, and 147 (19%; 23% female) had completed a graduate degree. Of the 478 participants with income data, 103 (22%; 53% female) had an income of $25 000 or less, 175 (37%; 38% female) between $25 001 and $50 000, 98 (21%; 32% female) between $50 001 and $75 000, and 64 participants (13%; 19% female) made more than $75 000. Overall, women were significantly overrepresented in the lower education and income groups ($P<.05$). Education and annual household income were positively correlated ($r=0.45$; $P<.05$).

Baseline Characteristics

Overall, participants were aged 31 to 89 years (mean=60 years) and 79% were married. Characteristics by education group and gender are presented in Table 1. There were no statistically significant age differences between the groups. Main effects for education group indicated that participants with less education were more disadvantaged than were those with higher education (e.g., less likely to work, more likely to be past smokers, exercised less, had lower exercise capacity, higher dietary fat intake and triglycerides, reported more hostility; all P values $<.05$). Main effects for gender indicated that women were less likely to be married and to have been revascularized than were men. They exercised less and had lower exercise capacity, higher body mass index (BMI; weight in kilograms divided by height in meters squared), but lower total cholesterol: HDL cholesterol ratios than did men. They also reported more depression, stress, and lower QOL with regard to physical functioning, but lower hostility than men. No SES by gender interactions were noted, except that women with a graduate degree were less likely to be on lipid-lowering medication compared with all the other groups. Analyses substituting income for education and excluding data from self-pay patients showed a similar pattern of findings (data not shown).

Changes in Lifestyle Behaviors, Coronary Risk, and Psychosocial Factors

To begin, it should be noted that attendance of the intervention sessions was uniformly high, ranging from 88% for women with a college degree to 94% for women with a high school degree, with the remaining groups falling in between this range. As expected, when defining SES by income groups, attendance was similarly high, ranging from 92% (for women in the >$75 000 and for men in the ≤$25 000 income categories) to 95% (for women in the ≤$25 000 and for men in the $50 001–$75 000 income categories). There were no significant group differences.

Health behaviors, coronary risk factors, and psychosocial variables at baseline and 3 months are shown in Table 2. Because there were no significant interactions between SES group and gender for these variables, the results are shown for both genders combined.

Main effects for time revealed significant improvements in coronary risk factors: weight, systolic blood pressure and diastolic blood pressure, total cholesterol, LDL cholesterol, triglycerides, HbA1c (for diabetics), depression, perceived stress, hostility, and QOL (all $P<.05$). As expected in the context of a low-fat diet, HDL cholesterol levels were reduced[36]; however, the greater reduction in total cholesterol relative to the reduction in HDL cholesterol resulted in a more beneficial total cholesterol-to-HDL ratio. A similar pattern of results was observed when income group was used as a factor (data not shown).

Time effects were modified by education group for some variables, as indicated by significant time-by-education interactions. Improvements for dietary fat intake, hours per week of exercise, exercise capacity, and stress management were especially pronounced for those with lower education ($P<.05$). After Bonferroni adjustments, however, the education-by-time interaction for fat intake was no longer statistically significant, indicating the same improvements (10% calories from fat) across all SES groups. Significant education-by-time interactions remained after Bonferroni adjustments for hours per week of exercise, indicating greater improvements for participants with a high school diploma or less compared with those with a graduate degree. A similar finding was observed for exercise capacity and stress management, indicating greater improvements among participants with lower education compared with those with higher education. However, these latter 2 findings were no longer statistically significant after excluding data from the self-pay participants.

Overall, by the end of the 3-month intervention, participants reported reducing dietary fat to 10% calories from fat, increasing stress management to 5.5 hours per week or more, exercising to 3.5 hours per week or more, and improving exercise capacity to more than 10 metabolic equivalents, across all educational and income levels.

Participants With Missing Education and Income Data Analyses

Participants who did not report education at baseline (n=84) were less likely to be working (67.5% vs 42.4%), had higher BMI (31.2 kg/m^2 vs 29.1 kg/m^2), higher hostility scores (9.5 vs 8.3), were more likely to be never smokers (79.0% vs 51.9%), and less likely to be prescribed beta blockers (46.7% vs 33.0%) compared with those with education data ($P<.05$,

TABLE 1—Demographic Characteristics, Medical History, Health Behaviors, Coronary Risk Factors, and Psychosocial Factors at Baseline Among Nonsmoking Coronary Heart Disease Patients: Multisite Cardiac Lifestyle Intervention Program, United States, 1998–2004

	High School Diploma or Less		Partial College or Specialized Training		College Degree		Graduate Degree	
	Men (n = 172)	Women (n = 110)	Men (n = 74)	Women (n = 69)	Men (n = 162)	Women (n = 51)	Men (n = 113)	Women (n = 34)
Demographics								
Gender, %	61[w]	39[w]	52[w]	48[w]	76[x]	24[x]	77[x]	23[x]
Age, y, mean ±SD	60 ±9	62 ±9	58 ±10	59 ±9	58 ±9	59 ±10	59 ±7	59 ±11
Married,[a] %	86	66	88	58	90	86	91	71
Employed,[b,d] %	42[w]	38[w]	69[x]	48[x]	71[x]	61[x]	71[x]	75[x]
Ethnicity, % White	95	94	95	97	96	96	93	94
Medical history								
Previous revascularization,[a,b] %	81[w]	72[w]	93[x]	81[x]	86[w,x]	73[w,x]	82[w]	62[w]
Past smoker,[b,d] %	62[w]	49[w]	64[w]	51[w]	36[x]	45[x]	45[y]	32[y]
Diabetes mellitus, %	32	32	28	32	23	33	25	29
Type 2 diabetes, %	89	83	95	86	87	82	85	100
Medications[e]								
Lipid lowering,[c] %	77[w]	85[w]	81[w]	84[w]	84[w]	80[w]	84[w]	54[x]
Beta blockers, %	65	70	65	53	74	63	71	58
ACE inhibitors, %	40	42	51	35	33	40	38	27
Nitrates, %	24	24	28	27	25	17	14	19
Anticoagulants/antiplatelet agents,[a] %	81	78	88	80	86	74	80	62
Health behaviors								
Stress management, hr/wk, mean ±SD	0.3 ±1.0	0.4 ±1.2	0.3 ±1.0	0.5 ±1.4	0.3 ±0.9	0.6 ±1.4	0.4 ±1.2	0.3 ±0.8
Exercise,[a,b] hr/wk, mean ±SD	1.7 ±2.3[w]	0.8 ±1.3[w]	1.9 ±1.8[w,x]	1.1 ±1.3[w,x]	1.9 ±1.9[w,x]	1.6 ±1.7[w,x]	2.2 ±2.4[x]	1.5 ±1.9[x]
Dietary fat,[b] % kcal from fat, mean ±SD	27 ±11[w]	26 ±12[w]	22 ±11[x]	24 ±10[x]	24 ±13[w,x]	27 ±10[w,x]	23 ±11[w,x]	26 ±13[w,x]
Coronary risk factors								
BMI,[a,b] kg/m², mean ±SD	32 ±6[w]	33 ±8[w]	31 ±6[w,x]	32 ±7[w,x]	30 ±5[x]	31 ±8[x]	30 ±5[w,x]	32 ±6[w,x]
Blood pressure, mm Hg, mean ±SD								
Systolic	134 ±17	132 ±19	132 ±20	132 ±18	130 ±18	134 ±15	131 ±18	125 ±17
Diastolic	78 ±10	76 ±10	77 ±11	77 ±9	78 ±11	77 ±10	78 ±10	74 ±9
Cholesterol, mg/dL, mean ±SD								
Total[a]	170 ±40	191 ±47	171 ±44	196 ±51	166 ±37	195 ±50	160 ±36	192 ±44
LDL[a]	95 ±30	104 ±37	95 ±40	108 ±35	94 ±32	106 ±40	91 ±30	114 ±34
HDL[a]	38 ±10	48 ±12	39 ±12	47 ±14	39 ±11	50 ±15	41 ±11	49 ±14
Total cholesterol:HDL cholesterol[a]	4.7 ±1.4	4.2 ±1.6	4.7 ±1.5	4.4 ±1.5	4.5 ±1.6	4.1 ±1.4	4.1 ±1.2	4.1 ±1.3
Triglycerides[b]	194 ±137[w]	191 ±120[w]	186 ±95[w,x]	196 ±131[w,x]	167 ±90[w,x]	180 ±89[w,x]	157 ±100[x]	157 ±92[x]
Exercise capacity, METs[a,b]	9.1 ±2.9[w,y]	7.0 ±2.3[z]	9.1 ±2.9[w,x,y]	7.7 ±2.4[y,z]	10.1 ±3.2[w,x]	7.4 ±2.5[z]	10.3 ±2.9[x]	7.8 ±2.4[y,z]
HbA1c,[a,e] %	7.4 ±1.9	8.1 ±1.7	7.3 ±1.8	7.6 ±1.7	7.3 ±1.5	7.5 ±1.8	6.9 ±1.2	8.2 ±2.1
Psychosocial factors								
Mean CES depression score[c] ±SD	13 ±10[w,x]	13 ±9[w,x]	11 ±9[x]	16 ±10[w]	11 ±14[x]	10 ±7[x]	11 ±9[x]	12 ±10[w,x]
Mean Cook–Medley hostility score[a,b] ±SD	10 ±5[w]	7 ±5[w]	9 ±5[w,x]	7 ±5[w,x]	8 ±4[x]	7 ±5[x]	8 ±5[x]	7 ±3[x]
Mean perceived stress scale score[a] ±SD	15 ±7	16 ±8	14 ±8	17 ±9	14 ±7	15 ±7	13 ±7	15 ±8
Mean QOL–physical component score[a] ±SD	44 ±10	40 ±10	44 ±11	39 ±11	44 ±10	41 ±12	45 ±9	41 ±9
Mean QOL–mental component score ±SD	47 ±12	46 ±13	46 ±14	45 ±12	45 ±13	50 ±10	47 ±13	45 ±12

Note. ACE = angiotensin-converting enzyme; BMI = body mass index; LDL = low-density lipoprotein; HDL = high-density lipoprotein; MET = metabolic equivalent; HbA1c = percentage glycated hemoglobin; CES = Center for Epidemiologic Studies; QOL = quality of life. *P* values were calculated with ANOVA for continuous variables and with χ^2 analysis for dichotomous variables. Gender-specific values (%) are given for categorical data. Superscripts that differ ([w,x,y,z]) denote significant mean differences for comparisons involving more than 2 groups ($P<.05$, Bonferroni adjusted). Superscripts that are similar ([w,x,y,z]) denote similar means for comparisons involving more than 2 groups ($P<.05$, Bonferroni adjusted).

[a]Significant gender main effect ($P<.05$).

[b]Significant education group main effect ($P<.05$).

[c]Significant interaction of education group by gender ($P<.05$).

[d]One site failed to collect information on employment status, history of cigarette smoking, and medication; therefore, data are shown for 88% of the participants with a high school diploma or less (n = 248), 89% of the participants with some college or technical school education (n = 127), 89% of the participants with a college degree (n = 189), and 90% of graduate-degree participants (n = 132).

[e]For participants with diabetes only.

TABLE 2—Health Behaviors, Coronary Risk Factors, and Psychosocial Factors at Baseline and 3 Months Among Men and Women Nonsmoking Coronary Heart Disease Patients: Multisite Cardiac Lifestyle Intervention Program, United States, 1998–2004

	High School Diploma or Less		Partial College or Specialized Training		College Degree		Graduate Degree	
	Baseline (n = 282), Mean ±SD	3 Months (n = 266), Mean ±SD	Baseline (n = 143), Mean ±SD	3 Months (n = 141), Mean ±SD	Baseline (n = 213), Mean ±SD	3 Months (n = 202), Mean ±SD	Baseline (n = 147), Mean ±SD	3 Months (n = 142), Mean ±SD
Health behaviors								
Stress management,[a,b,d] h/wk	0.3 ±1.0[w]	6.4 ±2.1[x]	0.4 ±1.2[w]	6.2 ±1.9[x,y]	0.3 ±1.1[w]	5.7 ±2.2[y]	0.4 ±1.2[w]	6.0 ±2.1[x,y]
Exercise,[a,b] h/wk	1.4 ±2.1[w]	3.8 ±1.4[y]	1.5 ±1.6[w,x]	3.7 ±1.3[y]	1.9 ±1.9[w,x]	3.7 ±1.7[y]	2.1 ±2.3[x]	3.9 ±1.5[y]
Dietary fat,[a,b,d] % kcal from fat	27 ±11[w]	9 ±3[x]	23 ±11[w]	9 ±3[x]	25 ±12[w]	9 ±3[x]	24 ±12[w]	9 ±3[x]
Coronary risk factors								
Weight,[a] kg	93 ±21	88 ±19	91 ±19	87 ±18	91 ±18	86 ±17	93 ±19	88 ±18
BMI,[b,c] kg/m^2	32 ±7	30 ±6	32 ±6	30 ±6	30 ±6	29 ±5	30 ±6	29 ±5
Blood pressure, mm Hg								
Systolic[a]	133 ±18	122 ±16	132 ±19	121 ±15	131 ±17	121 ±14	130 ±18	121 ±15
Diastolic[a]	77 ±10	71 ±9	77 ±11	72 ±9	78 ±10	71 ±9	77 ±10	71 ±8
Cholesterol, mg/dL								
Total[a,c]	177 ±41	154 ±41	182 ±49	159 ±44	172 ±42	151 ±36	167 ±41	144 ±38
LDL[a]	99 ±32	84 ±33	101 ±39	85 ±34	97 ±35	83 ±29	96 ±33	77 ±30
HDL[a]	42 ±12	38 ±11	43 ±13	38 ±11	42 ±11	37 ±9	43 ±12	38 ±10
Total cholesterol:HDL cholesterol[a]	4.4 ±1.4	4.2 ±1.2	4.5 ±1.6	4.3 ±1.3	4.4 ±1.6	4.2 ±1.3	4.1 ±1.2	4.0 ±1.2
Triglycerides[b,c]	190 ±126	166 ±91	191 ±115	179 ±102	169 ±89	161 ±79	158 ±99	149 ±81
Exercise capacity,[a,b,d] METs	8.5 ±2.8[w]	10.4 ±3.0[z]	8.5 ±2.6[w,x]	10.3 ±2.9[z]	9.4 ±3.2[x,y]	11.4 ±3.3[z]	9.8 ±3.0[y]	11.2 ±3.5[z]
% HbA1c[a,e]	7.6 ±1.7	6.8 ±1.2	7.8 ±1.8	6.9 ±1.5	7.5 ±1.6	6.6 ±0.8	7.3 ±1.6	6.5 ±0.9
Psychosocial factors								
CES depression score[a]	13 ±10	8 ±8	13 ±10	7 ±7	11 ±7	7 ±7	11 ±9	7 ±6
Cook-Medley hostility score[a,c]	9 ±5	7 ±5	8 ±5	7 ±5	8 ±4	7 ±4	8 ±4	6 ±4
Perceived stress scale score[a]	16 ±8	10 ±6	15 ±8	10 ±7	15 ±7	10 ±6	17 ±7	10 ±5
QOL-physical component score[a]	42 ±10	47 ±10	42 ±11	48 ±9	43 ±11	48 ±10	45 ±9	49 ±9
QOL-mental component score[a]	47 ±13	54 ±9	46 ±12	53 ±11	46 ±12	51 ±12	47 ±12	52 ±11

Note. BMI = body mass index; LDL = low-density lipoprotein; HDL = high-density lipoprotein; MET = metabolic equivalent; HbA1c = percentage glycated hemoglobin; CES = Center for Epidemiologic Studies; QOL = quality of life. *P* values were calculated with ANOVA for continuous variables. Superscripts that differ ([w,x,y,z]) denote significant mean differences for comparisons involving more than 2 groups ($P<.05$, Bonferroni adjusted). Superscripts that are similar ([w,x,y,z]) denote similar means for comparisons involving more than 2 groups ($P<.05$, Bonferroni adjusted).
[a]Significant time main effect ($P<.05$).
[b]Significant interaction of education group by time ($P<.05$).
[c]Significant education group main effect ($P<.05$).
[d]The interaction for education group by time was no longer significant when data from the 7% self-pay participants were excluded.
[e]For participants with diabetes only.

for all). However, by 3 months, these participants had similar improvements in all outcome variables except triglycerides (no change). Participants without income data reported exercising more, consuming fewer calories from fat, had lower BMI, lower perceived stress, were less likely to be prescribed angiotensin-converting enzyme inhibitors, were more likely to have never smoked, and were less likely to have diabetes than were those with income data. However, they were more likely to have been revascularized, and more likely to have higher HbA1c (if diabetic) compared with those with income data ($P<.05$, for all). By 3 months, participants without income data reported smaller improvements in dietary fat intake, exercise, stress management, BMI, systolic blood pressure, total cholesterol, LDL cholesterol, and triglycerides (although still statistically significant), and similar improvements in the remaining variables when compared with those with income data. Thus, participants without income data appeared to improve somewhat less than those with income data.

Lost to Follow-Up Analyses

Forty participants (4.6%) did not complete the 3-month follow-up. Participants who did not complete the follow-up had higher BMI (33.2 ±

7.3 vs 30.9 ±6.0; $P < .05$) at baseline. There were no other baseline differences in education, income, or any of the remaining variables.

DISCUSSION

As expected, there were group differences in health behaviors, coronary risk factor profile, and QOL at baseline, favoring those with higher SES. However, by 3 months, participants with low SES showed similar attendance and adherence to the program guidelines and achieved similar clinical improvements as their higher-SES counterparts.

The finding indicating an adverse cardiac profile with respect to demographic characteristics (unemployment), health behaviors (sedentary lifestyle, high-fat diet, past smoking), coronary risk factors (BMI, plasma lipid levels, exercise capacity), and psychosocial factors (depression, hostility, perceived stress) among those with low SES at baseline is in agreement with previous studies.[4,7,37] However, there were no SES differences in QOL at study entry. There were also few differences in medications at baseline, which indicates that participants were receiving similar medical attention.

In addition to a generally worse clinical baseline profile for those with less education, being female appeared to add to the disadvantage. Regardless of SES, women had higher BMI, exercised less, had lower exercise capacity, had lower physical QOL, and were less likely to be married. These gender differences are consistent with those reported by others.[38–43]

Despite their relative disadvantage at baseline, participants with low SES had similar attendance and reported similar improvements in all targeted health behaviors when compared with those with higher SES. They even exceeded their higher-SES counterparts in absolute increases in hours of exercise over the 3-month follow-up. Furthermore, low-SES participants were as likely as were those with higher SES to meet the program's behavioral guidelines after 3 months. On average, regardless of their SES, participants reported consuming a low-fat diet (10% fat), exercised 3.5 hours per week or more, and practiced stress management for 5.5 hours per week or more.

The reported improvements in lifestyle were validated by changes in coronary risk factors (e.g., reported reductions in dietary fat intake by plasma total and LDL cholesterol reductions, reported increases in exercise by improved exercise capacity). Most importantly, participants with low SES evidenced similar improvements in all coronary risk factors and QOL compared with those with higher SES. For example, high- and low-SES participants alike showed significant reductions in body weight (–5.1 kg), systolic blood pressure (–10 mm Hg), and total cholesterol (–23 mg/dL). Furthermore, significant improvements in HbA1c were observed among patients with diabetes, regardless of educational level or gender.

Our findings indicating similar improvements in behavior and clinical outcomes across SES groups contradict the notion that low-SES participants may be less able or willing to make behavior changes.[7,37,44] One reason for our encouraging findings may be that 93% of the participants in our study were enrolled in health insurance plans that covered the full costs of the lifestyle intervention. Excluding data from the self-paying individuals (7%) did not alter these findings. The importance of affordable health care, including preventive services, for all has been receiving increasing attention recently.[45,46] With respect to cardiac rehabilitation, insurance coverage has been shown to be a major factor in participation.[47,48] Generally, in the United States, those with high SES are more likely to be enrolled in health plans than are their lower-SES counterparts, confounding equal access to health care with SES. Interestingly, a recent study of CHD patients in an equal-access health care system (Norway), who participated in a cardiac rehabilitation program, supports this interpretation. In that study, SES (as measured by household income) was unrelated to the ability to make and maintain cardioprotective lifestyle changes with respect to diet and exercise.[14]

Limitations

Our results may not be generalizable to less-than-high-school educated, non-White, illiterate populations or those lacking health care coverage or living in other regions of the United States. Only 4% of our sample had less than a high school education. Those with less than a high school education generally do poorly in lifestyle interventions.[5,49,50] However, one study of CHD patients ranging widely in terms of education (19% had <high school education) found no correlation between number of years of education and adherence to a lifestyle intervention.[44] Similarly, non-White and illiterate persons have worse outcomes in such interventions.[50,51] Only 5% of our sample was non-White, and illiterate persons were excluded, thus limiting generalizability of our findings.

Another limitation is that our primary focus was on years of education as an indicator of SES. Although this indicator is strongly related to cardiovascular disease risk factors[52] and is the most widely used measure of SES,[33] additional indicators of SES in the entire sample would have been desirable. However, when we repeated our analyses by annual household income, a similar pattern of findings emerged. This may not be surprising, considering the high positive correlation of income with education in this study. Finally, the length of follow-up was only 3 months, the typical duration of cardiac rehabilitation programs. In our previous studies, employing the same intervention, improvements in clinical profile, and selected psychological variables were maintained through 1-year follow-up[31,32,40] and 5-year follow-up.[16,53] Whether the observed improvements in this study extend beyond 3 months, particularly for those of lower SES, still needs to be determined.

Conclusions

Patients with CHD clearly benefited from their enrollment in this insurance-sponsored lifestyle intervention. They were able to make comprehensive lifestyle changes with clinically and statistically significant improvements in risk factors and QOL, regardless of SES and gender. This finding indicates that insurance coverage of a comprehensive lifestyle intervention can benefit CHD patients at all SES levels. Fortunately, the importance of having equal access to lifestyle interventions has now been recognized by the US government (i.e., US Centers for Medicare and Medicaid Services) for Medicare beneficiaries with CHD.[54] ■

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Contributors

S.R. Govil conducted the data analyses and drafted the article. G. Weidner conceptualized the study, supervised the analyses, led the writing, and served as the research mentor. T. Merritt-Worden assisted with the study. D. Ornish originated the Multisite Cardiac Lifestyle Intervention Program. All authors assisted in drafting the article.

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Human Participant Protection

Participating sites obtained approval from their institutional review boards and all patients consented to study participation.

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