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Predictors of Physical Activity at 1-Year in a Randomized Controlled Trial of Family Members of Patients with Cardiovascular Disease

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Abstract

Background and Objective—Recommendations for physical activity to lower risk of cardiovascular disease are widely known but not often followed. The purpose of this study was to determine the demographic, lifestyle, and psychosocial variables that predict improved physical activity among participants in a cardiovascular disease prevention lifestyle intervention trial.

Subjects and Methods—Adult family members (N=501, 66% female, 36% non-white, mean age 48 years) of cardiac patients were randomized to a 1 year special intervention that received education on physical activity, or to a control intervention. Demographics, physical activity, stage of change, and cardiovascular disease risk factors were measured systematically at baseline and 1 year (94% follow-up). Lipids were analyzed in a core laboratory. Linear regression models were adjusted for confounders.

Results and Conclusions—At baseline, 21% of participants reported exercising >3 days/week, which did not differ by group assignment. The special intervention and control intervention experienced significant increases in physical activity at 1 year with mean physical activity days/week in the special intervention significantly greater than the control intervention (2.5 vs. 2.0 days/week, p=.03). Significant predictors of increased physical activity at 1 year were group assignment (p=.03), female sex (p=.04), non-minority status (p<.01), greater readiness to change (p<.01), and baseline measurements of lower body mass index (p<.01) and waist size (p<.01), greater diet adherence (p<.01), higher high density lipoprotein-cholesterol (p<.01), lower high sensitivity C-reactive protein (p=.02), less depression (p<.01), and higher social support (p=.03). In multiple regression models, group assignment, female and non-minority status remained independent predictors of higher physical activity levels at 1 year. In conclusion, several predictors of improved physical activity levels at 1 year were documented among clinical trial participants. Racial/ethnic minorities and men were significantly less likely to make positive changes and may need more targeted efforts to improve physical activity levels.

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Keywords

physical activity; cardiovascular disease; prevention; risk factors

Introduction

Lack of physical activity is a major risk factor for cardiovascular disease (CVD), yet over one-third of adults do not meet minimum recommended physical activity levels, according to current national data[1]. According to updated recommendations from the National Institutes of Health, adults aged 18–64 should do 2 hours and 30 minutes a week of moderate-intensity, or 75 minutes a week of vigorous-intensity aerobic physical activity, or an equivalent combination of moderate- and vigorous-intensity aerobic physical activity[2].

The National Heart, Lung, & Blood Institute Family Intervention Trial for Heart Health (FIT Heart) study recently documented that a screening and lifestyle intervention was successful in improving adherence to physical activity goals in family members of hospitalized cardiac patients beyond that of a control group after 1-year[3]. However a research gap exists in understanding the predictors and barriers to adherence to physical activity guidelines in diverse populations. Previous research has pointed to the possible role of demographic factors, as well as psychosocial factors such as depression and social support in predicting physical activity behavior[4–6]. Associations between physical activity and lifestyle factors such as weight status and dietary habits have been examined in a limited number of studies with mixed results[7–9].

Physical activity has consistently been linked to a reduced risk of clinical CVD events[10,11], as well as improved quality of life[12]. Yet, the characteristics of those who succeed in improving physical activity levels in lifestyle interventions are not well-defined, and likewise it may be beneficial to identify individuals at risk of non-adherence to recommendations. The purpose of this study was to identify the demographic, lifestyle, and psychological variables that predict improved physical activity levels in an ethnically diverse population of family members of recently hospitalized cardiac patients, enrolled in a randomized controlled lifestyle intervention trial at 1-year.

Methods

Design and Participants

This was a prospective sub-study of 501 participants enrolled in the FIT Heart randomized, controlled trial. A detailed description of the design and results of FIT Heart has been published elsewhere[3]. Briefly, participants were blood relatives or cohabitants of patients hospitalized with atherosclerotic cardiovascular disease, aged 20–79 years, did not have established cardiovascular disease or diabetes, and spoke English or Spanish. Participants were randomized to either an educational special intervention (SI) or a control intervention (CIN). The SI group received education on diet and exercise including recommendations for regular physical activity and a discussion of how to overcome barriers to exercise; personalized risk factor screening and immediate feedback (including lipids); and reinforcement and follow-up throughout the year. The SI was designed to provide behavioral counseling on lifestyle factors specifically using the stage of change construct from the Transtheoretical Model of behavior change[3]. The CIN group received a brief CVD prevention message in the form of a handout. All participants received standardized assessments of diet, lifestyle, and CVD risk factors at baseline and 1 year. The study was approved by the Institutional Review Board of Columbia University Medical Center and all participants gave their informed consent prior to inclusion in the study.

Measurements

Physical activity was assessed using standardized questions which have been adapted from the Behavioral Risk Factor Surveillance System (BRFSS) survey questionnaire and validated[13]. The questions collected data about the number of days per week participants engaged in physical activity, as well as the number of minutes per day. The following questions were included: "At least once a week, do you engage in any regular physical activity (brisk walking, jogging, bicycling, etc.) long enough to work up a sweat?", "If yes, how many days per week do you engage in physical activity that works up a sweat?", "For each time you engage in physical activity, how many minutes do you exercise for?"

Demographics were assessed using standardized questionnaires. Systolic and diastolic blood pressure was measured in the Columbia University Clinical and Translational Science Award (CTSA) Center using a standard protocoland standard definitions of hypertension were used[14, 15]. Height, weight, and waist circumference were measured and BMI was calculated according to NHLBI clinical guidelines[16]. Adherence to the National Cholesterol Education Program Adult Treatment Panel III therapeutic lifestyle changes (TLC) diet[17] was assessed using the **M**eats, **E**ggs, **D**airy, **F**ried foods, fat **I**n baked goods, **C**onvenience foods, fats added at the **T**able, and **S**nacks (MEDFICTS) dietary questionnaire that quickly identifies non-adherence to saturated fat and cholesterol dietary goals and has been previously validated in this population[18] (score range =0–216; score of <40 is consistent with adherence to the TLC diet).

Social support was measured using the Enhancing Recovery in Coronary Heart Disease Patients (ENRICHD) Social Support Inventory (ESSI), a 7-item, self-report measure used in the ENRICHD clinical trial[19]. Participants' readiness to change was measured using questions adapted from a validated staging algorithm to classify stage of change for reducing saturated fat consumption[204]. Level of depressive symptoms was assessed by the Beck Depression Inventory–Second Edition (BDI- II) (score range 0–63) [21, 22].

Laboratory Procedures

Venous fasting blood samples were collected at baseline and 1 year on all subjects and stored at -70^0 up to 2 weeks then analyzed in the Columbia University CTSA Biomarker Laboratory certified by the CDC lipid quality control program. Plasma total cholesterol, high density lipoprotein cholesterol (HDL-C), triglycerides, and glucose were determined spectrophotometrically on a Hitachi 912 chemical analyzer. Plasma low density lipoprotein cholesterol (LDL-C) was assessed using a direct homogeneous enzymatic colorimetric assay. The enzymatically amplified sandwich type ELISA CRP was used for the measurement of high sensitivity-C-reactive protein (hs-CRP).

Data Management and Statistical Analyses

All data were collected on standardized forms and double entered into a Microsoft Access database then exported to SAS version 9.1 (SAS Institute, Inc., Cary, NC) for purposes of statistical analysis. Participant characteristics are described using means ± standard deviations for continuous variables and number and percentages for categorical variables. Mean physical activity levels (days per week and minutes per exercise session) overall and by gender and race/ethnicity at baseline and 1 year were analyzed using the *t*-test. Descriptive data on physical activity participation (yes/no) are presented as proportions and differences in proportions were assessed using chi -square statistics. Potential predictors of physical activity at baseline and 1 year were assessed using linear regression, with CVD risk factors as the independent variables. Predictors of physical activity at 1-year were adjusted by baseline levels of physical activity. Associations between participant demographics, lifestyle and psychosocial risk factors, and physical activity days per week at 1-year were assessed using linear regression to adjust for age, sex, race/ethnicity, and education. Statistical significance was set at $p < .05$.

Results

The mean age of participants in the study was 48 years; approximately 66% were female, and 36% were racial/ethnic minorities (Table 1). Almost two-thirds of participants were overweight or obese, consistent with national prevalence data, and the majority did not adhere to a low saturated fat diet or meet recommended physical activity goals.

Table 2 shows that at baseline, a little over half of participants answered "yes" to the question, "at least once per week do you engage in physical activity long enough to work up a sweat?" Overall, the mean number of days per week of physical activity at baseline was 1.76, and the mean number of minutes per exercise session was 25.6, which did not vary significantly by group assignment. At baseline, males reported exercising significantly more minutes per session than females (31.8 vs. 24.0), and whites reported exercising significantly more days per week (2.0 vs. 1.40) and minutes per session (29.8 vs. 20.1) than racial/ethnic minority participants. At 1-year, females reported exercising significantly more days per week than males (2.4 vs. 1.7). Non-whites reported exercising significantly less days per week (1.9 vs. 2.5) and minutes per session (20.5 vs. 33.2) than whites at 1-year. Mean physical activity days per week in the SI group were significantly greater than the CIN group at 1-year (2.5 vs. 2.0 days).

In univariate assessment of the association between physical activity and CVD risk factors using logistic regression (Table 3), significant predictors ($p<.05$) of a physically active lifestyle at baseline were non-minority status, lower BMI and waist circumference, better adherence to diet, higher HDL-C, lower hs-CRP, less depression and a greater readiness to make behavioral changes. Other variables tested that were not significant were age, education, marital status, smoking status, blood pressure, and other lipids.

Significant predictors ($p<.05$) of physical activity at 1-year (Table 4) were similar to those at baseline and additionally included being in the SI group, being female, and having a higher social support level.

As shown in Table 5, multivariable regression analysis revealed that group assignment (SI group), being female, and non-minority status were independent predictors of higher physical activity levels at 1-year. No significant interactions by groupxgender or groupxethnicity were found.

Discussion

We have identified several demographic, lifestyle, and psychological factors that predicted higher levels of physical activity at 1 year in the context of a randomized, controlled trial of family members of hospitalized cardiac patients. Assignment to the SI group, female sex, non-minority status, greater readiness to make behavioral changes, baseline measurements of lower BMI and waist size, greater adherence to a heart-healthy diet, higher HDL-C, lower hs-CRP, less depression, and higher social support were all associated with higher physical activity levels among participants in the trial. Group assignment, female sex, and non-minority status remained independent predictors of higher physical activity levels after 1 year. These findings were uniform across sub-groups of the SI and CIN (gender and ethnicity).

Our study lends support to previous work that recognizes the importance of understanding behavioral stage of change in influencing physical activity patterns[23, 24]. According to the Transtheoretical Model, individuals typically move along five major stages of change when taking on a new behavior: pre-contemplation, contemplation, preparation, action, and maintenance[25]. Participants who were randomized to the SI group at baseline received stage-matched behavioral counseling by trained staff as part of the lifestyle intervention. Assignment to the SI group predicted higher physical activity levels at 1-year, as did an indication of a greater readiness to make behavioral changes. This finding suggests that tailoring a lifestyle intervention to a participant's stage of change may be beneficial in promoting physical activity. Tailoring is important because incremental improvements in physical activity as little as ½ day per week has been shown to be associated with an enhanced lipid profile[3].

Consistent with research from the Diabetes Prevention Program (DPP) lifestyle intervention trial[26], a greater readiness to change and lower depression scores correlated with higher physical activity levels (at baseline). We have previously shown a link between psychosocial factors such as depression and level of social support with physical activity in cross-sectional analyses of this population[27]. Depression and lack of social support may act as barriers for individuals in finding time to exercise or practice other self-care/preventive health behaviors.

In regards to gender differences, contrary to our findings, the DPP showed that being male was an independent predictor of physical activity at 1-year, despite similar enrollment rates of females in our studies (66% vs. 65%). Several other studies have also found higher vigorous activity levels among men than women, discordant with our results[28, 29]. One possibility for the different result is that our study population consisted of a large percentage of female caregivers of patients who had recently suffered a cardiac event, and they may have been more motivated to be physically active than other female groups. Females in our population were also slightly younger than those in other samples (mean age of 48 years).

It has been well-documented that healthy people are more likely to be physically active than those with medical conditions[30, 31]. Our study showed that participants with more favorable cholesterol and inflammation profiles at baseline, as well as those with lower BMI and waist circumferences, were more physically active one year later compared with those who were not as healthy. The overweight and those with hyperlipidemia are two populations that could particularly benefit from increases in regular physical activity.

There are limitations of our study that should be considered. Physical activity was assessed using a questionnaire designed for use as part of a national surveillance system, as opposed to a research tool. However the BRFSS is a validated questionnaire and therefore this should not differentially impact population comparisons within this study[32]. Multiple comparisons were evaluated and it is possible that some findings are due to chance. This study was limited to a fairly healthy population of English and Spanish speakers and the results may not generalize to other populations.

In conclusion, we showed that family members of cardiac patients in a lifestyle intervention trial were more likely to adhere to physical activity recommendations after 1 year of the family member being hospitalized with CVD if they were female, non-minority, and assigned to the SI group. Higher physical activity levels were also significantly associated with other lifestyle and psychosocial factors, including stage of change, less depression, higher social support, healthy weight, and better adherence to diet. These results may provide insight for physicians, exercise physiologists, and other healthcare providers working with patients and their families to improve lifestyle and reduce CVD risk. Racial/ethnic minorities and men were significantly less likely to make positive changes and may need more targeted efforts to improve physical activity levels. Our findings also suggest that healthcare providers working with patients and their families to increase physical activity levels should attempt to address potentially modifiable barriers to physical activity, including stage of change, depression, and lack of social support at the beginning of a lifestyle intervention program. In particular, healthcare providers can use specific counseling techniques to assist patients in moving through the stages of change and thus becoming more physically active. Future research should evaluate how changes to these modifiable variables in a lifestyle intervention program affect physical activity outcomes.

Summary and Implications

- This study was an exploration of physical activity predictors in the context of a year-long, randomized controlled trial among family members of patients with cardiovascular disease.
- Several demographic, lifestyle, and psychological factors predicted success in promoting physical activity.
- Healthcare providers should address potential modifiable barriers to physical activity, such as depression, lack of social support, and stage of change, at the beginning of lifestyle and educational intervention programs.

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Table 1

Characteristics of Participants at Baseline (N = 501)

Characteristic	%	Mean (± SD)
Age ≥ 50	48	48 ± 14
Non-Hispanic white	65	-
Female	66	-
> High school education	62	-
Employed/Student	73	-
Married/Living with Someone	67	-
Group Assignment: Control	50	-
Current Smoker	9	-
Saturated Fat ≥10% kcals/day	59	
Overweight (BMI ≥ 25 kg/m^2)	64	28 ± 6
Waist Circumference > 40 in. (Men) or > 35 in. (Women)	37	36 ± 6
Depression (BDI Score > 10)	33	8 ± 8
Physical Activity ≤ 3 days/week	78	2 ± 2

Note: BMI = Body Mass Index, BDI = Beck Depression Inventory.

Table 2

Mean Physical Activity Levels at Baseline and 1-Year, by Gender and Race/Ethnicity

Baseline				
Overall	**Male**	**Female**	**White**	**Non-white**
56.3% “yes”	62.9%	53.0%*	62.3%	45.5%*
1.76 mean days	1.97	1.7	2	1.40*
25.6 mean minutes	31.8	24.0*	29.8	20.1*

1-Year				
Overall	**Male**	**Female**	**White**	**Non-white**
68.3% “yes”	63.5%	70.6%	76.4%	54.0%*
2.26 mean days	1.9	2.4*	2.5	1.9*
28.6 mean minutes	30.0	27.9	33.2	20.5*

[1] At least once a week, do you engage in any regular physical activity (brisk walking, jogging, bicycling, etc.) long enough to work up a sweat?

[2] If yes, how many days per week do you engage in physical activity that works up a sweat?

[3] For each time you engage in physical activity, how many minutes do you exercise for?

* $p<.05$

Table 3

Significant Predictors of Physical Activity at Baseline

	Physical Activity Days per Week
	***B* (p-value)**
Non-white	−0.55 (<.01)
BMI (kg/m2)	−0.05 (<.01)
Waist Circumference (inches)	−0.05 (<.01)
Medficts Diet Score	−0.01 (0.01)
HDL-Cholesterol (mg/dL)	0.02 (<.01)
hs-CRP (mg/L)	−0.12 (<.01)
Depression Score	−0.05 (<.01)
Stage of Change (Pre-contemplation through Maintenance 1–5)	0.20 (0.01)

Note: Non-significant variables tested were age, education, marital status, smoking, blood pressure, and other lipids.

Table 4

Significant Predictors of Physical Activity at 1-Year

	Physical Activity Days per Week
	***B* (p-value)**
Group Assignment	0.44 (0.03)
Male	−0.43 (0.04)
Social Support	0.05 (0.03)
Non-white	−0.60 (<.01)
BMI (kg/m2)	−0.05 (<.01)
Waist Circumference (inches)	−0.09 (<.01)
Medficts Diet Score	−0.01 (<.01)
HDL-Cholesterol (mg/dL)	0.02 (<.01)
hs-CRP (mg/L)	−0.10 (0.02)
Depression Score	−0.03 (0.01)
Stage of Change (Pre-contemplation through Maintenance1–5)	0.20 (<.01)

Table 5

Multivariable Linear Regression: Predictors of Physical Activity at 1-Year

	B **(p-value)**
Age	−0.002 (.76)
Gender	−0.46 (.03)*
Ethnicity	−0.64 (<.01)*
Group Assignment	0.45 (.02)*

Note: No significant interactions by groupxgender or groupxethnicity;

*p<.05