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Outcomes of a pilot, intervention study for young adults at risk for cardiovascular disease based on their family history

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Abstract

Background—Lifestyle choices have a significant impact on cardiovascular disease (CVD) risk. Interventions to promote a heart-healthy lifestyle in young adults at long-term high-risk for CVD are needed to decrease the burden of CVD. However, few interventions with this purpose have been developed.

Objective—Examine the effect of a pilot intervention in young adults with a family history of CVD that used three-generation pedigrees, risk factor information, and counseling on heart disease knowledge, perceived CVD risk, and intention to engage in a heart-healthy lifestyle.

Methods—A pre-post test design, with within-group analysis, was used to examine the effect of the intervention. A paired T-test and Wilcoxon Signed Ranks Tests were used to examine the changes in heart disease knowledge, perceived risk, and behavioral intention from baseline to post-intervention. Cohen's *d* were calculated to examine the effect of the intervention on study measures. Additionally, Spearman's Rho was used to examine the associations between post-intervention perceived risk, post-intervention behavioral intention, and family history.

Results—The sample for the pilot study included 15 mostly Caucasian, mostly female, healthy young adults between the ages of 18-25 years old. The intervention was effective at increasing CVD knowledge ($p=0.02$) and had a medium effect on perceived risk and intention to engage in a heart-healthy lifestyle (Cohen's *d* from .48-.58). There were significant associations between post-intervention perceived risk and post-intervention intention to exercise and the participants' family history of coronary heart disease ($r=.62$, $p=.014$ and $r=.55$, $p=.035$, respectively).

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Conflicts of interest

The authors declare that there are no conflicts of interest.

Conclusions—Interventions are needed to increase individuals' aware of their long-term CVD risk and to improve their ability to make lifestyle changes. Although this intervention was only tested in a small sample, it shows promise to improve heart disease knowledge, perceived lifetime CVD risk, and may effect longer-term risk for CVD.

Keywords

Pilot study; cardiovascular diseases; family history; risk assessment; primary prevention

Introduction

In the United States, cardiovascular disease (CVD) results in one death every 40 seconds.¹ Despite the declining death rate from CVD and coronary heart disease (CHD) since the mid-1980s, CVD still accounts for 31.9% of all deaths and CHD, alone, causes one in every six deaths in the United States.¹ The estimated total direct (health expenditures) and indirect (lost productivity from morbidity and premature mortality) cost of CVD and stroke in the United States in 2010 exceed \$315 billion.¹ It is safe to conclude that the burden of CVD remains high.

CVD risk is influenced by behavioral, environmental, and genetic components. Family history (FH), defined as the medical history of first- and second-degree relatives that may predispose the individual to specific diseases or medical conditions, reflect shared genes, environments, learned habits and behaviors, and the complex interactions between these factors.² A FH of CVD is an independent, nonmodifiable risk factor for CVD, with premature CVD in first-degree relatives representing the greatest inherited risk.³⁻⁵ Several retrospective, epidemiologically studies have estimated the odds ratio for a lifetime cardiovascular (CV) event to be 2.6 to 4.1 for individuals with a first-degree relative who had a premature CV event.^{3,5}

Lifestyle choices have a significant impact on an individual's lifetime CVD risk. Adherence to the Dietary Approaches to Stop Hypertension (DASH) diet significantly reduces CVD, CHD, stroke and heart failure risk.⁶ A systematic review and meta-analysis on observational prospective studies found that a DASH-like diet reduces CVD, CHD, stroke risk by 20%, 21%, 19%, respectively.⁶ The INTERHEART study, a large case-control study with nearly 30,000 subjects from 52 countries, found that the population attributable risk of physical inactivity for myocardial infarction is 12.2%.⁷ Multiple studies have shown that overweight and obesity increases an individual's risk for CVD/CHD and mortality.⁸⁻¹⁰ For example, Wilson and colleagues reported that the relative risk for CVD increased by 20% among overweight males and females. In obese males the relative risk for CVD increased to 46% and in obese females the relative risk increased to 64%. However, modest sustained lifestyle changes can significant reduce CVD morbidity and mortality.¹¹

The American Heart Association (AHA) has shifted its emphasis from the treatment of CVD to the prevention of risk factors in order to sustain a state of good health.¹² This shift prompted the 2020 AHA Goals with a new focus on prevention, control of risk, improved quality of life, and health promotion rather than treatment of disease.¹² Interventions aimed at health promotion in a currently healthy, but at-risk for CVD during their lifetime,

population are consistent with these goals. However, new approaches to communicate lifetime CHD/CVD risk in a population that is at low short-term (5-10 years) risk, but at high-risk for developing CVD during their lifetime are needed.¹³

According to Valdez and colleagues, FH has the potential to become a screening tool to identify people at increased risk for chronic diseases.^{14(p82)} Pedigrees documenting FH consolidate multiple pieces of health related data, allowing invisible knowledge to become visible.^{15,16} In keeping with the AHA's 2020 emphasis on CVD prevention, we designed an innovative pilot study focused on FH and three-generation pedigrees that highlighted CVD risk factors and emphasized health promotion in young adults. For this study, the three-generation pedigrees included the proband and his or her siblings (the first generation), the proband's parents, aunts and uncles (the second generation), and the proband's grandparents (the third generation).

The purpose of this paper is to report the outcomes of a brief behavioral intervention in young adults with a FH of CVD. Specifically, we examined if the intervention would result in higher: 1) heart disease knowledge; 2) perceived lifetime CVD risk; and 3) intention to engage in a health promoting lifestyle to reduce long-term CVD risk. Additionally, the associations between perceived lifetime CVD risk, intention to engage in a health promoting lifestyle, and participants' FH were examined.

Methods

Design

The study used a pre-post test design to test a two-session behavioral intervention designed to increase heart disease knowledge, perceived lifetime CVD risk, and intention to engage in a heart-healthy lifestyle in 15 young adults. Measures were taken at baseline and after completion of the intervention, approximately two weeks later. The study was approved by the university's institutional review board.

Intervention

The intervention was fully-scripted and delivered to all the participants by the principal investigator (PI). It consisted of four components delivered in two sessions: 1) the collection of FH information to create a three-generation pedigree and a blood sample for lipid levels during Session One; 2) verification of FH information by discussing FH with relatives between Sessions One and Two; 3) delivery of lifetime CVD risk information based on FH and CVD risk factors during Session Two; and 4) brief behavioral counseling to promote CV risk reducing lifestyle during Session Two.

The CV risk information delivered in Session Two was based on: 1) a detailed review of the three-generation pedigree with an emphasis on the inheritance patterns of CVD and CVD risk factors within the participant's family; 2) general risk information (low, moderate, high) based on first- and second-degree relatives; 3) odds ratios for lifetime CVD risk based only on first-degree relatives; 4) review of the participant's low-density lipoprotein cholesterol (LDL-C) and high-density lipoprotein cholesterol (HDL-C) and comparing his or her results

to the Adult Treatment Panel III recommendations;¹⁷ and 5) short-term risk based on the “Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack”.¹⁸

Each participant received brief counsel about increasing physical activity and eating a heart-healthy diet, guided by three AHA pamphlets: “Controlling your risk factors;” “Just move!;” and “Making healthy food and lifestyle choices.” After each topic was reviewed, the participant repeated two or three tips or strategies that had been discussed to either to improve their lifestyle or to help maintain their current, healthy practices.

Protect Motivation Theory (PMT) provided the theoretical framework for the intervention. In PMT, the cognitive process of coping appraisal, an individual's perception of the effectiveness of action at preventing a negative outcome along with the individual's perceived self-efficacy to perform that action, must outweigh the threat appraisal, the individual's perceived vulnerability for a negative outcome and the perceived severity of the outcome.¹⁹ Factors such as the cost (time, effort, money) of the action influences coping appraisal, while the aspects of the negative behavior that are enjoyed influences threat appraisal.¹⁹

The intervention provided the participant with multiple messages targeting threat appraisal of CVD. Theoretically, by telling the interventionist about his or her family members with CVD, some of which may have died because of CVD, the participant's perceived vulnerability for CVD and the perceived severity of CVD increases. This message, increased personal vulnerability for CVD and increased severity of CVD, should be re-enforced when talking to family members with CVD and further re-enforced each time they are presented with information revealing their own personal risk of developing CVD.

Likewise, the intervention provided messages designed to increase coping appraisal. The behavioral counseling focused on evidence-based lifestyle changes shown to reduce CVD morbidity and mortality.¹¹ Specifically, discussing the lifestyle changes aimed to increase the participant's knowledge of the response efficacy of a healthy lifestyle and their own perceived self-efficacy to make the needed lifestyle changes.

Protocol

Recruitment—A convenience sample of university students at two major universities in the Northwest were targeted for enrollment. At one of the universities, the sample was recruited through advertisements posted throughout the campus, a university sponsored website which advertised research studies seeking healthy participants, and by word-of-mouth. At the second university, recruitment pamphlets were placed in the waiting room of the student health center.

The inclusion criteria were: ages 18-25 years; able to speak, read, and write English; and having at least one family member with CVD or CVD risk factors. Exclusion criteria were: being pregnant; having a personal history of congenital heart defects; already being diagnosed with hypertension, dyslipidemia, or diabetes; or the inability to gather family medical history. All potential participants were screened over the phone by the PI. Written informed consent was obtained during the first session prior to any data collection.

Intervention Session One—The participant was instructed to fast for 12-hour prior to attending the first session. Blood pressure and height and weight were measured, and a blood sample was obtained for total cholesterol, LDL-C, HDL-C, and triglycerides levels. The blood sample was analyzed in a College of American Pathologists and the Clinical Laboratory Improvement Amendments accredited laboratory where spectrophotometric analysis was used to obtain the lab values.

Next a FH focusing on CVD risk factors and CVD was collected by interview. Family members included in the FH were siblings, parents, aunts and uncles, and grandparents. FH information was recorded using Progeny Clinical (Progeny Software, LLC, 2011). A draft pedigree was printed and given to the participant. Next, he or she was instructed to verify the three-generation pedigree with as many family members as possible between Session One and Session Two.

Intervention Session Two—In the beginning of this session, the pedigree was reviewed in detail and updated with any corrected or new medical health information. As part of the detailed review, the pattern of inheritance of CVD/CHD was highlighted and lifetime CVD risk information based on the participant's FH was given. Next, the participant's lab tests results were reviewed. This information, along with information obtained in Session One, was used to estimate the participant's short-term CHD risk using the "Risk Assessment Tool for Estimating Your 10-year Risk of Having a Heart Attack".¹⁸ Then the participant received counseling on increasing their physical activity and eating a healthy diet.

The feasibility and acceptability findings from the study have been previously published.²⁰ To briefly summarize the findings, the recruitment strategy successfully enrolled eligible study participants but needs to be modified to include additional sites in future trials; the intervention was monitored for dosage and fidelity; the intervention and study questionnaires were well received and completion rates were 99% for study measures; and there was no attrition between Session One and Session Two.²⁰

Study measures

The main study outcomes included: 1) change in heart disease knowledge; 2) change in perceive lifetime CVD risk, and 3) change in intention to engage in a health promoting lifestyle. Additionally, the relationships between post-intervention perceived risk, post-intervention intention to engage in a healthy lifestyle, and FH were examined.

Three measures were taken at baseline and after Session Two to assess the intervention. The Heart Disease Facts Questionnaire (HDFQ) assessed heart disease knowledge and was modified for the study. The original HDFQ is a 25-item questionnaire developed to tests knowledge of major risk factors for the development of CHD.²¹ The HDFQ is readable to an average 13-year old and has adequate internal consistency, with a Kuder–Richardson-20 formula of 0.77.²¹ It included 10 items regarding the increased risk for developing CHD in individuals with diabetes.^{21,22} Because a current diagnosis of diabetes was part of the exclusion criteria, the questions related to diabetes were removed resulting in a 15-item questionnaire.

To assess perceived lifetime CVD risk, an 11-point visual analogue scale (VAS) was used. A mark between numbers 0 and 4 was interpreted as low perceived risk. A mark on line number 5 was interpreted as uncertainty of risk. A mark between numbers 6 and 10 was interpreted as high perceived risk.²³ In a recent study by Jones and colleagues, the scale had a five-week test-retest reliability of .79 (Jones, Weaver, & Friedmann, 2007).²⁴

Behavioral intention to exercise and eat a healthy diet during the next six weeks was assessed using a six-item questionnaire with three questions for exercise and three questions for eating a healthy diet. It consisted of a modified version of an exercise intention questionnaire by de Bruijin and Rhodes²⁵ and a healthy eating intention questionnaire by Armitage and Conner.²⁶ Each question used a 7-point Likert scale. The mean score of the three questions for exercise and the three questions for eating a healthy diet were used as a composite score. A composite score less than 4 was interpreted as low intention to engage in the activity and a score of greater than 4 was interpreted as high intention to engage in the activity. Both intention questionnaires have been used in a sample of young adults with a Cronbach's alphas between .86 and .92.^{25,26} In this study, the Cronbach's alpha for the six-item questionnaire was slightly lower, but still acceptable, at .75.

Statistical Analysis

Data analysis was conducted using SPSS 21.0 (IBM, 2012). A paired T-test was used to determine the difference in baseline and post-intervention HDFQ scores. The non-parametric Wilcoxon Signed Ranks Test was used to determine differences between baseline and post-intervention scores on the VAS for perceived lifetime CVD risk and the behavioral intention questionnaire. To adjust for multiple comparisons and prevent a Type 1 error, we used the Bonferroni correction. For the analysis of the effect of the intervention on perceived lifetime CVD risk, an adjusted alpha level of .016 was used (adjusted for three comparison). For the analysis of the impact of the intervention on intention to engage in a healthy lifestyle, an adjusted alpha level was .0125 (adjusted for four comparison). The standardized mean difference, or Cohen's d, were calculated to determine the effect of the intervention on the outcome measures; a Cohen's d of 0.5 is interpreted as a medium effect and a Cohen's d of .8 is interpreted as a large effect.²⁷ The associations between post-intervention perceived risk, post-intervention intention to engage in a healthy lifestyle, and FH were examined using Spearman's Rho.

Results

Participants

The sample (N=15) of young adults was, on average 20.8±2.2 years old (mean ± standard deviation), female (n=13, 86.7%), and Caucasian (n=10, 66.7%; Table 1). Based on body mass index, 12 (80%) had a normal weight, two (13.3%) were underweight, and one (7.7%) was obese. Ten (66%) exercised 3 times a week. None of the participants reported smoking in the last 30 days. Besides FH, only 13.3% (2 out of 15) of participants had an additional CVD risk factor. Both of these participants had low HDL-C. Although two different universities were used to recruit participants, all participants came from a single university.

At baseline, heart disease knowledge was high (average percent of correct answers was $93.7 \pm 7.7\%$) and perceived CVD risk was low (4.3 ± 1.8 , range 2-7). Seven participants reported their perceived risk as low (score < 5), four as uncertain (score of 5), and four participants reported their perceived risk as high (score > 5). Generally, the participants intended to exercise (mean score of 4.9 ± 1.2 , range 3-7) and eat a healthy diet (mean score of 5.7 ± 1.1 , range 3-7) during the next six weeks.

Study outcomes

Heart disease knowledge—The change in percentage of correct answers on the HDKQ between baseline and after the intervention (Table 2) indicated that knowledge was increased significantly ($p=0.022$, 95% confidence interval of the difference 0.8-9.01%). Post-intervention, seven participants (46.7%) had higher heart disease knowledge scores and the remaining eight had no change in their score. Baseline scores indicated that participants were quite knowledgeable about CVD and risk factors at the time of study entry. Nonetheless, the intervention was effective at increasing heart disease knowledge in those with lower scores at baseline.

Perceived lifetime CVD risk—After the intervention, most participants reported a higher lifetime risk for CVD compare to baseline ($Z=1.97$, $p=.048$; Table 2), with a medium effect size ($d=.56$). After the intervention, only three reported their perceived risk as low, five report their risk to be uncertain, and seven participants reported their perceived risk as high. When accounting for the adjustment for multiple comparisons, this finding was not statistically significant.

Intention to engage in a health-promoting lifestyle—Post-intervention, the participants' expressed a higher intention to engage in exercise ($Z=2.09$; $p=.036$) and to eat a healthy diet ($Z=1.85$, $p=.064$; Table 2). The intervention had a medium effect on intention to exercise and intention to eat a healthy diet, $d=.58$ and $d=.48$ respectively. These results were not statistically significant after adjustment for multiple comparisons.

Relationships between perceived risk, behavioral intention, and FH

Post-intervention perceived risk and post-intervention intention to exercise were both positively correlated with the total number of first- and second-degree relatives, with CHD ($r=.62$, $p=.014$ and $r=.55$, $p=.035$, respectively, Figure 1). The correlation between post-intervention intention to eat a healthy diet and the number of relatives with CHD was not significant.

Discussion

To our knowledge, this is the first intervention to evaluate FH using three-generation pedigrees with currently healthy, young adults at long-term high-risk for CVD with the purpose of increasing perceived risk and intention to engage in a heart-healthy lifestyle.²⁸ Overall, the intervention was associated with increased heart disease knowledge and had a medium effect on lifetime CVD risk and intention to engage in a heart-healthy lifestyle.

In our study, we found the participants' heart disease knowledge to be relatively high at baseline. Contrary to our findings, Tamragouri and colleagues' study of 224 college freshman found heart disease knowledge to be low.²⁸ Our sample was considerably smaller and consisted of both undergraduate and graduate students who self-selected themselves for the study based on their understanding of CVD and CVD risk factors. These factors could help to explain the different findings between the two studies.

Only a few studies have examined perceived lifetime cardiovascular disease risk in young adults. Consistently, these studies have reported an increased perceived CVD risk for individuals who report a FH of CVD compared to individuals without a FH of CVD^{29,30} and the positive correlation between perceived risk and the number of reported relatives with heart disease.³¹ However, our findings were only significant when both first- and second-degree relatives with CVD were included. This is most likely due to the ages of the first-degree relatives and the fact the CVD is relatively uncommon in young and middle-aged adults.³² In our study, only one participant had a first-degree relative with diagnosed CHD, whereas, 12 had second-degree relatives with diagnosed CHD.

Additionally, we found that the number of first- and second-degree relatives with CHD was correlated with intention to exercise, but not with intention to eat a healthy diet. The association between a FH of CVD and behavior changes has been inconsistent, with some studies reporting that a FH of CVD can improve screening practices and health promoting behaviors,^{33,34} while others report no or negative associations such as a higher smoking rate among individuals with a FH of CVD.^{35,36} However, all of these studies were observational. Interventions are needed to increase individuals' ability to make lifestyle changes through the use of strategies such as eliciting family information using three-generation pedigrees.

In this study, two participants reported a discrepancy between their actual risk and perceived risk during the post-intervention assessment. One participant, who was obese, had multiple first- and second degree relatives with hypertension. The participant's blood pressure and lipid levels were within the recommended range. So, despite her family history and increased body weight, she perceived her lifetime CVD risk to be very low (1 out of 10). The other participant expected her LDL-C level to be elevated. Her lipid panel revealed that her LDL-C met the current recommendations, but her HDL-C was low. Given her family history and low HDL-C, she was at an increased long-term CVD risk. However, she focused only on her LDL-C level and her current, healthy lifestyle and did not recognize the long-term risks.

Multiple studies, including the Family Healthware Impact Trial and Dallas Heart Study, have found a significant discrepancy between perceived CVD risk and actual CVD risk.^{30,37-43} Various factors, including male gender,^{30,39-41} higher perceived health,^{38,42} younger age,^{30,40} and less knowledge of FH⁴³ have been associated with incorrectly low perceived lifetime CVD risk. Efforts, such as this pilot intervention study, must be made to better deliver accurate risk information to individuals to lessen this discrepancy, which may lead to behavior change.

Given that almost half of all college students are physically inactive and those with low activity levels are at increased risk for metabolic syndrome and obesity, the need for interventions targeting this population are essential.^{44,45} Colleges and universities represent a unique setting where interventions using FH has a screening tool to identify those at long-term high risk could potentially benefit a large number of at-risk individuals. Counseling tailored to the resources available to the students (specific food choices at dining halls, exercise facilities, smoking cessation resources) can help to maximize the impact of these interventions.

For future considerations, the timing of the intervention may be essential. Kip and colleagues examined data from the longitudinal, epidemiological Coronary Artery Risk Development in Young Adults (CARDIA) study and found that there were no positive changes in CVD risk factors, including smoking status, weight, LDL-C and HDL-C levels, blood pressure, and physical activity, in young adults who had a first-degree relative experience a myocardial infarction or stroke during the previous 5 years.³⁶ Their findings suggest that a CV event in a first-degree relative is not sufficient to promote long-term behavior changes. When such an event occurs, approaches that emphasize how the event influence the individual's personal risk for future CV events may be needed to result in sustained behavior change.

Limitations

This study was limited by its design, and sample homogeneity, and small size. The study was limited in the use of a single group. Because the study used a single group design, there are multiple threats to validity that were not controlled, including history and test effects. Future research is needed using a more rigorous experimental design to control these threats to internal validity. Moreover, the study examined short-term perceived risk and intention to engage in a heart-healthy lifestyle, not actual changes. The study sample was limited to mostly Caucasian female participants who were either enrolled in college, had a college degree, or were pursuing advanced degrees. Therefore, the generalizability of the study to other populations is limited. Most importantly, these findings are from a small pilot study. Although these findings are promising, the study was underpowered for examining outcomes and the results should be interpreted with caution.

Conclusions

The intervention was effective at increasing heart disease knowledge and had a medium effect on increasing perceived risk and intention to engage in a heart-healthy lifestyle. Given the effect size of the intervention on the study variables, a larger sample could have resulted in more statistically significant findings. Nonetheless, the intervention shows promise to improve heart disease knowledge, perceived lifetime CVD risk, and may effect longer-term risk for CVD. Additional refinement and testing of the intervention with a larger, more diverse sample is warranted. Furthermore, the findings from this study should encourage clinicians to collect FHs and address long-term CVD risk in young adult patients who are at low short-term but high long-term risk for CVD.

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Figure 1.
Correlations between post-intervention perceived risk, post-intervention intention to exercise, and the number of relatives with coronary

Table 1

Baseline characteristics of study participants (N=15)

Characteristics	Mean $\pm$ SD	Range
Sociodemographics		
Age (years)	20.8 $\pm$ 2.2	18-25
Gender, female	86.7%	
Ethnicity, Caucasian	66.7%	
Anthropometry		
BMI (kg/m ²)	21.9 $\pm$ 3.4	16-30.9
Blood pressure (mmHg)		
Systolic	110.6 $\pm$ 11.9	90-138
Diastolic	82 $\pm$ 3.9	70-82
Lipids (mg/dL)		
Total cholesterol	168.9 $\pm$ 35.4	109-245
LDL-C	93.5 $\pm$ 23.4	58-132
HDL-C	55.0 $\pm$ 13.7	39-86

SD, standard deviation; BMI, body mass index; LDL-C, low-density lipoprotein cholesterol; HDL; high-density lipoprotein cholesterol

Table 2

Study outcomes, baseline to post-intervention

Variable	Baseline	Post-Intervention	p	95% CI of the difference
Heart disease knowledge (mean±SD)				
Percentage of correct answers on modified HDFQ	93.7±7.8	98.7±3.7	.022 ^a	0.8-9.027
Perceived lifetime CVD risk (mean±SD)				
Based age, race/ethnicity, sex, lifestyle, and family history (0-10)	4.3±1.8	5.3±1.8	.048	0.018-1.982
Intention to engage in a health promoting lifestyle, (mean±SD)				
Exercise, composite score	4.9±1.2	5.5±1.3	.036	0.358-1.283
Eat a healthy diet, composite score	5.7±1.1	6.0±1.1	.064	-0.037-0.529

SD: standard deviation; HDFQ: Heart Disease Facts Questionnaire; CI: Confidence Interval; CVD: cardiovascular disease

^aRemained significant after adjusted for multiple comparisons