Influencing cardiovascular health habits in the rural, deep south: results of a cluster randomized trial

Laurie S. Abbott^{1*}, Elizabeth H. Slate² and Jennifer L. Lemacks³

¹College of Nursing, Florida State University, 98 Varsity Way, Tallahassee, FL 32306-4310, USA, ²Department of Statistics, Florida State University, 117 N. Woodward Ave., Tallahassee, FL 32306-4330, USA and ³Department of Nutrition and Food Systems, University of Southern Mississippi, 118 College Drive, Hattiesburg, MS 39406, USA

*Correspondence to: L. S. Abbott. E-mail: labbott@fsu.edu

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Abstract

Cardiovascular disease (CVD) is a major cause of death among people living in the United States. Populations, especially minorities, living in the rural South are disproportionately affected by CVD and have greater CVD risk, morbidity and mortality. Culturally relevant cardiovascular health programs implemented in rural community settings can potentially reduce CVD risk and facilitate health behavior modification. The purpose of this study was to examine the effects of a cardiovascular health promotion intervention on the health habits of a group of rural African American adults. The study had a cluster randomized controlled trial design involving 12 rural churches that served as statistical clusters. From the churches ($n = 6$) randomized to the intervention group, 115 participants were enrolled, received the 6-week health program and completed pretest–posttest measures. The 114 participants from the control group churches ($n = 6$) did not receive the health program and completed the same pretest–posttest measures. The linear mixed model was used to compare group differences from pretest to posttest. The educational health intervention positively influenced select dietary and confidence factors that may contribute toward CVD risk reduction.

Introduction

Cardiovascular disease (CVD) is the leading cause of mortality (220.8 per 100 000) among people

living in the United States and is responsible for more deaths than cancer and respiratory diseases combined [1]. Approximately 36.6% of the general population have been diagnosed with at least one form of CVD such as coronary heart disease, hypertension and stroke [1]. Importantly, the prevalence of CVD is disproportionately higher among African American men (46.0%) and women (47.7%) compared with Caucasian men (37.7%) and women (35.1%) [1]. Health inequities associated with CVD are especially predominant among African Americans living in the rural South [2–6]. These CVD disparities are associated with geographic and social determinants of health such as limited resources, fewer affordable health care options and lower socioeconomic status and educational levels [3, 4, 7]. National priorities outlined in Healthy People 2020 include improving overall cardiovascular health, reducing CVD mortality and morbidity, eliminating health disparities and implementing health promotion strategies for CVD risk factor reduction [8].

Major risk factors for CVD include diabetes, high plasma cholesterol levels, smoking, physical inactivity, unhealthy diet and obesity [1]. People living in disadvantaged areas of the rural South are more likely to have been diagnosed with diabetes, hypertension and obesity, and are less likely to be physically active [3, 4, 7]. Geographic and environmental challenges such as limited socioeconomic resources, safe physical activity options and access to healthy foods influence the density of CVD risk factors associated with the increased prevalence of CVD, obesity and diabetes in rural areas [3].

However, changes in health behaviors facilitate CVD risk factor modification leading to gains in life expectancy and influence improvements in related cardiovascular outcomes including reduced incidence of diabetes, hypertension and coronary heart disease [1, 3, 5].

Health promotion efforts are essential for improving cardiovascular health determinants such as health habits, knowledge and lifestyle choices among people in the rural South [5, 9]. Offering public health interventions in rural community settings such as churches can promote changes in modifiable health habits and risk factors, improve cardiovascular health outcomes, reduce morbidity and mortality, and advance health equity [5]. The collective resources and social support found within rural church settings are influential for promoting healthy lifestyle behavioral changes [10, 11]. The purpose of the study was to examine the effects of a cardiovascular health promotion intervention conducted in churches among African Americans living in rural northern Florida. The theoretical framework that guided the study was the Integrated Model of Behavioral Prediction, a health behavior model that describes the influence of psychosocial concepts such as norms, attitudes and self-efficacy on intentions to perform recommended health behaviors [11]. The motivational influences of increased knowledge, purposed intentions and adequate skills necessary to engage in recommended health behaviors are directly associated with lifestyle choices and health habit modifications [12].

Methods

The study had a cluster randomized design with churches located in two rural counties in northern Florida serving as the clusters. Individuals within clusters typically share similar characteristics that may induce related outcomes, a dependence called intraclass correlation [13]. The sample size was calculated using an intraclass correlation value ($r=0.02$) comparable with that used in other health promotion studies reported by Murray and Blitstein [14] and a medium standardized effect

size ($d=0.50$) utilized by Fahs et al. [15]. The sample size needed for a power of 80% was at least 100 participants for each of two groups containing a minimum of five participating churches, allowing for 10% attrition.

The research methods and program materials were approved by the institutional review board at the affiliated university. The initial recruitment phase involved contacting the pastors of churches located in a rural, southeastern area, and explaining the purpose and procedures. The pastors who permitted the study to be conducted on church grounds provided signed letters of cooperation. The participating churches were randomized using a table of five-digit random numbers. Church assignment in either the intervention (even parity) or control (odd) group was determined using random number sequences while ensuring a parity imbalance no greater than two.

The second recruitment phase involved identifying people within each church who would be willing to participate in the study. The pastor or designated church representative made the announcement about the study, and potential participants attended the designated session. The eligibility criteria for participating in the study were (i) men and women who self-identified as African American, (ii) at least 24 years of age and (iii) able to read, write and understand English. Information about the study was provided to volunteers, and all questions were answered. The participants provided informed consent prior to enrolling in the study. A pretest–posttest strategy was used to observe the intervention effect of a culturally relevant cardiovascular health promotion program among the African American participants recruited from the randomized rural churches. Participants in churches randomized to the intervention group received the health promotion program over a 6-week period, and those in churches randomized to the control group received no information during the 6 weeks from pretest to posttest. During the initial session prior to signing informed consent forms, potential control group participants were notified that the pastors of each church could choose to have the program delivered in the church after the conclusion of the study. Each

participant in both groups received a \$20 gift card incentive for their participation at the final data collection period.

Intervention

The cardiovascular health promotion *With Every Heartbeat is Life* curriculum was developed by the National Heart, Lung, and Blood Institute (NHLBI) as a culturally relevant cardiovascular health program for use among African American populations [16; http://www.nhlbi.nih.gov/files/docs/resources/heart/aa_manual.pdf]. Using feedback from the representatives of participating churches, the curriculum was tailored for delivery over 6 weeks with sessions lasting about 90 min each. The manualized program was delivered within each intervention church ($n=6$) by the same public health nurse researcher who has a specialty in cardiovascular risk reduction. The weekly topics addressed major CVD risk factors such as diabetes, hypertension, diet, elevated serum cholesterol, excessive weight, physical inactivity and smoking.

Measures

The 'My Health Habits' instrument developed by the NHLBI was used to measure cardiovascular health habits or behaviors [17]. This measure was designed specifically for use with the *With Every Heartbeat is Life* intervention, although the validity and reliability had not been quantified. The data were collected by a nurse researcher at baseline and after the 6th week session for the intervention group, and at baseline and 6 weeks later for the control group. The instrument included 21 items for measuring food-related cardiovascular health habits, physical activity level, alcohol and tobacco use, and confidence in performing heart healthy activities. The items were evaluated using a classification method adapted from a previous study using an earlier, yet similar, version of the instrument published for use with the *With Every Heartbeat is Life* program materials [18]. The health habit categories are (i) CVD food-related risk factor behaviors, (ii) physical activity, (iii) alcohol and tobacco use and (iv) confidence. The items within each category are

described in the following paragraphs. Item responses were scored so that higher values represented greater frequency of positive health habits. For example, a question asked participants about how often they baked or grilled foods instead of frying them had options for frequency (1 = Never or almost never; 2 = Sometimes; 3 = Most of the time; 4 = All of the time). An overall summary for the 'My Health Habits' instrument was obtained by summing the item responses over all categories.

CVD food-related risk factor behaviors

The 12 items in the 'My Health Habits' section measured cardiovascular health habits related to food and drinks. The survey included questions about produce consumption and food preparation such as grilling, baking or frying foods and draining the fat after cooking meat. Other items collected information about habits associated with drinking sugar-sweetened and alcoholic beverages, processed meats and sodium, and food containing dietary fat.

Physical activity

One item asked participants how many days per week they engaged in physical activity for at least 30 minutes or longer. The 7-point scale provided points that increased with the days per week (0 = None; 1 = 1 day; 2 = 2 days; up to 7 = 7 days).

Alcohol and tobacco use

The 'My Health Habits' instrument included four items for measuring alcohol and tobacco use. There were two items about smoking habits. The questions about smoking were related to how often (i) the participant typically smokes (1 = Every day; 2 = Some days; 3 = Not at all) and (b) asks others not to smoke in the home (1 = Never or almost never; 2 = Sometimes; 3 = Most of the Time, etc.). The instrument included two items about alcohol intake. The first question asked how often alcohol was ingested (1 = Every day or Almost Every Day; 2 = A Few Times a Week, 3 = About Once a Month, etc.). The second question involved the number of drinks consumed during those occasions (1 = Four

or More Drinks; 2 = Three Drinks; 3 = Two Drinks, etc.).

Confidence

The 'My Health Habits' instrument included four items that measured confidence in cooking heart healthy foods, reading food labels, recognizing signs of heart attack and getting blood pressure checked yearly. The answer options included a 4-point scale (1 = Not confident; 2 = Somewhat confident; 3 = Confident; 4 = Very confident).

Data analysis

The sociodemographic characteristics of the participants were described using frequencies, averages and standard deviations. The 'My Health Habits' outcomes were analyzed using a repeated measures linear mixed model (LMM) including random effects for participant and church and fixed effects for study group assignment, time and the time-by-group interaction using the mixed procedure in IBM SPSS Statistics, version 22. Analyses were conducted using the intention-to-treat data set that included all participants according to the randomized assignment of their church. All of the participants were included in the analyses since those who withdrew from the study without completing the posttest contribute to likelihood-based estimation in LMM. The results from the LMMs are summarized using point estimates and 95% confidence intervals for the change from pretest to posttest for each study group and the effect of the time-by-group interaction. The *P* values for the interaction is also provided. Confidence intervals and *P*-values are not adjusted for multiplicity.

Results

There were 12 participating churches in the study that were randomized to intervention (*n* = 6) and control (*n* = 6) groups. The intervention group participants (*n* = 115) received the *With Every Heartbeat is Life* curriculum. The church pastors of control group participants (*n* = 114) had the option of

receiving the intervention after study completion. However, none requested that the intervention be implemented when notified about the results of the study. The sociodemographic analysis revealed no marked differences between groups regarding age, gender or employment status (Table I). However, both groups had a greater percentage of women (71%) in the total sample than men (29%).

The 'My Health Habits' instrument was used to collect individual participant responses from both the intervention and control groups at both pretest and posttest data collection periods. There were statistically significant (*P* < 0.001) overall group differences from baseline to postintervention. Furthermore, the analysis of the specific cardiovascular health habits within each category showed statistically significant intervention effects on most of the health habit variables measured as well as associated improvements from pretest to posttest within the intervention group (Table II).

CVD food-related risk factor behaviors

There were significant improvements in food-related behaviors associated with cardiovascular health such as consuming more servings of fruit each day (*P* = 0.024) and eating more vegetables than meat during a meal (*P* = 0.024). The participants were also more likely to read the nutrition facts on food labels when shopping for food (*P* = 0.001) and drain the melted fat after cooking meat (*P* = 0.027). Although there was not a statistically significant improvement for sugary soda consumption, there were positive changes for consuming other beverages with sugar (*P* = 0.019). There were significant improvements for reduced high-fat dairy product intake (*P* = 0.013).

The other food-related findings were that changes in health habits such as daily consumption of vegetables, baking or grilling meat rather than frying it and eating processed meat such as hotdogs or bologna were not significantly improved (Table II). There were no statistically significant health behavior improvements for substituting low-fat condiments such as mayonnaise or dressing for products containing higher fat content.

Table I. Sociodemographic characteristics of the sample

Demographic variable	Intervention group (<i>n</i> = 115)				Control group (<i>n</i> = 114)			
	<i>n</i>	%	<i>M</i>	SD	<i>n</i>	%	<i>M</i>	SD
Age (years)			59.03	12.91			56.56	13.49
Race								
African American	115	100			114	100		
Gender								
Male	31	27.0			35	30.7		
Female	84	73.0			79	69.3		
Educational level								
Did not finish high school	21	18.3			22	19.3		
Graduated from high school/GED	28	24.3			45	39.5		
Attended some college	32	27.8			23	20.0		
Graduated from college	23	20.0			14	12.3		
Earned a graduate/professional degree	11	9.6			10	8.8		
Employment status								
Full-time	46	40.0			53	46.5		
Part-time	7	6.1			6	5.3		
Retired	41	35.7			33	28.9		
Not employed	21	18.3			22	19.3		

Entries provided are counts (*n*) and percentages (%) except for age. *M*, average; SD, standard deviation.

Physical activity

Participation in the intervention did not induce a statistically significant difference ($P=0.163$, Table II) regarding physical activity, described in days spent being physically active at home or at work for at least 30 min. There were changes in the mean number of days per week that participants in the intervention group reported being active from baseline ($M=2.843$) to postintervention ($M=3.827$). Although the differences were not as large, the mean number of days reported by the control group increased from baseline ($M=2.561$) to posttest ($M=3.127$).

Alcohol and tobacco use

There were no statistically significant results for the measured alcohol and tobacco items (Table II). The mean scores of the intervention group at baseline ($M=4.3$) and postintervention ($M=4.4$) for how often participants drink alcoholic beverages were within the ranges of 'Only on Special Occasions' (4 points) and 'Never' (5 points). Regarding how often the participant smokes, the mean scores of

the intervention group at baseline ($M=2.8$) and postintervention ($M=2.9$) indicated that the results were nearest to the 'Not at All' (3 points) option value. Similarly, the mean scores for asking others not to smoke in the home at baseline ($M=6.1$) and postintervention ($M=6.4$) fell within the 'All of the Time' (4 points) and 'No one ever smokes in my home' (8 points) ranges. The results for the control group were similarly consistent.

Confidence

There were significant group differences postintervention regarding confidence in cooking heart healthy foods ($P=0.010$), reading food labels ($P=0.004$) and recognizing heart attack symptoms ($P=0.001$). The intervention effect for confidence in getting blood pressure checked yearly was not significant ($P=0.158$). The mean scores for the intervention group at pretest ($M=3.64$) and posttest ($M=3.83$) indicated a slight increase, and the mean scores for the control group at pretest ($M=3.61$) and posttest ($M=3.65$) remained relatively stable. The mean scores suggest that participants in both

Table II. Comparison of study outcomes for intervention and control groups

Variable	Control group ^a		Intervention group ^b		Intervention effect ^c		
	Δ_C	95% CI	Δ_I	95% CI	<i>B</i>	95% CI	<i>P</i>
Overall	0.735	(−0.125, 1.595)	3.711	(2.826, 4.596)	2.976	(1.74, 4.21)	0.000
CVD food-related risk factor behaviors							
Daily fruit	0.078	(−0.067, 0.223)	0.317	(0.169, 0.466)	0.239	(0.032, 0.446)	0.024
Daily veg.	0.119	(−0.027, 0.266)	0.295	(0.145, 0.445)	0.176	(−0.034, 0.386)	0.100
Veg./meat	0.071	(−0.096, 0.237)	0.346	(0.176, 0.517)	0.275	(0.037, 0.514)	0.024
Bake/grill	0.087	(−0.045, 0.219)	0.205	(0.070, 0.341)	0.118	(−0.071, 0.307)	0.219
Labels	0.037	(−0.131, 0.205)	0.452	(0.280, 0.624)	0.415	(0.174, 0.656)	0.001
Drain fat	0.140	(−0.035, 0.314)	0.422	(0.244, 0.601)	0.282	(0.033, 0.532)	0.027
Soda	0.090	(−0.044, 0.225)	0.277	(0.138, 0.415)	0.187	(−0.007, 0.380)	0.059
Drinks	−0.080	(−0.232, 0.073)	0.181	(0.025, 0.337)	0.261	(0.043, 0.479)	0.019
Processed	0.023	(−0.127, 0.173)	0.123	(−0.030, 0.277)	0.146	(−0.114, 0.315)	0.357
Sodium	0.096	(−0.075, 0.267)	0.275	(0.099, 0.450)	0.179	(−0.066, 0.423)	0.152
Dairy	0.051	(−0.173, 0.276)	0.457	(0.228, 0.686)	0.406	(0.085, 0.727)	0.013
Condiment	0.006	(−0.263, 0.275)	0.179	(−0.096, 0.453)	0.173	(−0.211, 0.557)	0.376
Physical activity							
Exercise	0.566	(0.156, 0.976)	0.983	(0.563, 1.40)	0.417	(−0.170, 1.00)	0.163
Alcohol and tobacco use							
Smoke	−0.001	(−0.057, 0.055)	0.011	(−0.047, 0.069)	0.012	(−0.069, 0.092)	0.769
AskSmoke	0.182	(−0.290, 0.655)	0.255	(−0.229, 0.738)	0.072	(0.748, 0.604)	0.834
Alcohol	−0.031	(−0.172, 0.110)	0.060	(−0.085, 0.206)	0.091	(−0.111, .294)	0.375
Amount	0.066	(−0.217, 0.349)	0.140	(−0.151, 0.431)	0.074	(−0.332, 0.480)	0.720
Confidence							
Cooking	0.140	(−0.051, 0.332)	0.500	(0.305, 0.696)	0.360	(0.086, 0.633)	0.010
Labels	−0.013	(−0.204, 0.178)	0.395	(0.199, 0.590)	0.407	(0.134, 0.681)	0.004
Symptoms	0.239	(0.045, 0.433)	0.733	(0.534, 0.931)	0.494	(0.216, 0.771)	0.001
Yearly BP	0.048	(−0.089, 0.186)	0.189	(0.049, 0.330)	0.141	(−0.055, 0.338)	0.158

^a Δ_C is the pretest to posttest change for the control group as estimated from the LMM.

^b Δ_I is the pretest to posttest change for the intervention group as estimated from the LMM.

^c*b* is the estimate of the effect of the intervention, i.e. the estimate of the coefficient for the interaction between time (pretest to posttest) and study group in the LMM (also, $b = \Delta_I - \Delta_C$).

groups were confident (3 points) and very confident (4 points) about obtaining a yearly blood pressure reading.

Discussion

The prevalence of CVD is projected to increase (by 10%) in relation to detrimental social and environmental health habits such as physical inactivity, unhealthy dietary practices and the lack of preventive health services [2]. Knowledge gaps regarding CVD risk factor prevention should be targeted through health policy initiatives and educational public health programs among at-risk populations

[19, 20]. The availability of primary and secondary prevention services within rural and remote populations, especially those that are historically and persistently underserved, may facilitate national health equity efforts. Culturally tailored interventions that address multiple modifiable CVD risk factors such as smoking, hypertension, serum blood glucose and cholesterol levels and obesity are crucial for bridging cardiovascular health knowledge gaps, reducing CVD risk and improving life expectancy [5, 21].

The results of comparable studies implemented within rural community settings among African American participants indicate that educational

nutritional health interventions can influence positive health outcomes. For example, two similar studies concluded that an educational nutrition intervention in combination with a community garden had positive results [22, 23]. In another study by Scarinci *et al.* [24], a culturally relevant diet and exercise intervention improved dietary intake among rural, southern African Americans. However, interventions that target multiple CVD risk factors, health habits and lifestyle choices are imperative for reducing overall CVD mortality and morbidity [5, 21].

The study had a relatively low attrition rate (13%; $n = 16$) among both the intervention ($n = 12$) and the control ($n = 4$) groups. Underserved rural populations are difficult to reach and are known to have low participation and retention rates in community health interventions and research [24, 25]. However, engaging at-risk groups in health promotion, risk reduction programs can potentially foster overall and cardiovascular health through improvements in modifiable risk factors. The results of this analysis suggest that educational cardiovascular health promotion interventions implemented in community settings can promote beneficial changes in cardiovascular health habits among African Americans living in the rural South. The educational content and interactive activities positively influenced dietary risk behaviors associated with serum cholesterol and blood sugar levels such as consuming larger servings of vegetables than meat, draining the excess fat after cooking meat, drinking fewer sugary drinks and consuming low-fat dairy products.

Health benefits also included consuming more servings of produce and reading food labels more often when shopping for food. The intervention group participants also developed more confidence toward reading food labels, cooking healthy meals and recognizing symptoms of a heart attack. During three of the six intervention sessions, participants were given copies of food labels and asked questions using guided exercises. Healthy cooking strategies were discussed in-session, and each participant was given a heart healthy recipe booklet containing culturally relevant foods and handouts about portion

control and heart healthy substitutions for traditional, unhealthy ingredients. Intervention strategies that may have helped participants develop more confidence in recognizing signs of a heart attack included watching a video recommended in the program manual that described heart attack symptoms and using role play scripts included in the curriculum to enhance symptom recognition and identification of when to seek emergency medical services. Comparatively, there were no significant improvements between groups regarding confidence in obtaining annual blood pressure readings. The intervention ($M = 3.64$) and control ($M = 3.61$) group means for confidence (Maximum score = 4) were high at baseline and slightly higher for both groups ($M = 3.83$ and $M = 3.65$) at the second data collection period, signifying there was little room for improvement.

Participation in the intervention had no significant effect on some of the measured variables. For example, there were no statistically significant results for exercise, specified as days per week participant was physically active for at least 30 min. The intervention included a session on physical activity, and the topic was integrated within other sessions such as diabetes and hypertension. The results showed greater improvements from baseline among the intervention group participants; however, the mean of days spent exercising also increased among the control group. A factor worth mentioning is that the weather may have contributed to the increased time exercising at posttest within both groups. The timing of the pretest at baseline occurred during the cooler, late winter months when people are more likely to be indoors, and the subsequent posttest data were collected in the warmer, early summer months when people are typically more active. Similar findings were reported by Scarinci *et al.* [24] regarding improved dietary habits at follow-up, but lack of sustainability for engagement in physical activity. The findings of another study were that although both Caucasian and African Americans preferred health changes related to diet and exercise, African Americans were less likely to engage in increased physical activity than Caucasians [2].

The 'My Health Habits' instrument included one item that measured how often participants asked others not to smoke in the home that may have influenced ambiguous responses. The answer options that (i) 'no one ever smokes in my home' and (ii) they 'always ask people not to smoke in the home' were similar in meaning that smoking is not allowed in the home. Additionally, the ceiling effect may have been a factor for the results between groups for tobacco smoke and use of alcohol variables. The high pretest scores for these variables indicated that very few of the participants drank alcoholic drinks, smoked tobacco or tolerated smoking by others in personal living spaces, and so had virtually no room for improvement. It would be interesting to test the effect of the intervention on alcohol and tobacco use among rural groups not having church affiliations, such as neighborhoods, that may have higher self-reported baseline levels of these substance use risk factors.

Although the findings showed positive improvements in cardiovascular health habits, there were some limitations. The study was implemented in two rural counties where close-knit familial and friendship bonds increased the plausibility of cross-contamination between research study groups. The unique characteristics of this population may challenge replication of these results in other studies. A limitation was that the sample included larger percentages of female participants in both the intervention (73%) and control (69%) compared with males (27% and 31%, respectively). This result supports the conclusions of other studies that engaging African American men in health research efforts can be particularly challenging [26]. An additional factor was that since the study examined intervention effects from subjective, self-reported data obtained from pretest to posttest. Future research efforts could involve testing the sustainability of the improved cardiovascular health habits over longer intervals of time and the inclusion of biometric screening components such as blood pressure and weight to ascertain objective results. More research is also needed to understand the influences of race and ethnicity on health risk behaviors as well as strategies for risk reduction [2]. The attainment of

health equity goals involving at-risk rural populations requires multi-disciplinary efforts targeting multiple disease risk factors and promoting healthy behaviors among individuals, families and communities.

Conflict of interest statement

None declared.

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