Psychosocial mediators of a faith-based physical activity intervention: implications and lessons learned from null findings

Meghan Baruth1*, Sara Wilcox1, Steve Blair1, Steve Hooker2, Jim Hussey3 and Ruth Saunders4

1Department of Exercise Science, 2Department of Exercise Science and Prevention Research Center, 3Department of Epidemiology and Biostatistics and 4Department of Health Promotion, Education and Behavior, University of South Carolina, Columbia, SC 29208, USA

*Correspondence to: M. Baruth. E-mail: stritesk@mailbox.sc.edu

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Abstract

Mediation analyses in faith-based physical activity (PA) interventions targeting African-American adults are lacking. The purpose of this study was to examine the psychosocial mediators of a faith-based PA intervention with African-American adults. Churches were randomly assigned to receive immediate or delayed (1-year later) training in PA program implementation. A subsample of participants from randomly selected churches took part in telephone surveys at baseline and at 1 year. The primary outcome was percentage of participants meeting PA recommendations. MacKinnon’s product of coefficients was used to test for mediation. Participants (n = 418) from 20 churches completed the baseline and 1-year follow-up surveys. There were no statistically significant changes in PA behavior at 1 year. The intervention had a marginally significant effect on increasing the amount of instrumental church support received by church members. However, none of the psychosocial variables tested were found to be significant mediators of the intervention. Mediation analyses provided insight into potential reasons as to why the Health-e-AME intervention did not change PA. The intervention did not successfully change the targeted mediators hypothesized to change PA. Potential reasons for these shortcomings as well as issues to address in future faith-based studies are discussed.

Introduction

Physical activity (PA) intervention research has advanced significantly in the past decade [1]. Despite this growth, much work remains in understanding how behavioral interventions work [2]. Behavioral interventions are designed to change theoretical constructs, or mediators, thought to be related to an outcome [3]. Most intervention studies use theory as the basis for selecting mediators the intervention will target [3]. Studying mediators allows researchers to better understand how PA interventions exert their effects and why interventions are or are not effective [4]. Exploring potential mediating variables may assist researchers in understanding which variables are most critical for increasing PA, which may lead to the development of more targeted interventions [5].

Mediation analyses are becoming more common in PA intervention research [5–14]. For example, Napolitano et al. [9] found that behavioral processes mediated the relationship between two types of intervention arms and PA, whereas cognitive processes, decisional balance and self-efficacy did not. Miller et al. [6] found that self-efficacy and partner support were mediators of PA change among mothers with young children. Lewis et al. [14] found partial support for self-efficacy and behavioral processes as mediators of PA change in a tailored intervention; however, decisional balance and cognitive processes were not. Pinto et al. [8]
found that behavioral processes and decisional balance were mediators of motivational readiness for change at 6 weeks, but not 8 months, in a physician-based exercise counseling intervention. Exercise pros and cons and self-efficacy were not mediators at either time point. Although a number of studies have examined psychosocial mediators of PA change, the results are inconsistent, making it unclear which mediators may be most important for changing PA behaviors. Mediation analyses have not been conducted in faith-based PA interventions specifically. Additional studies will provide insight into how faith-based PA interventions exert their effects on PA behaviors. Social support, processes of change, self-efficacy, decisional balance and PA enjoyment are theoretical constructs most frequently examined as mediators of PA change [5]. Because the church has traditionally been an important organizing structure and source of support in the African-American community [15], faith-based studies may also consider measuring and testing the unique role of church-based PA support as a potential mediator of PA change.

The Health-e-AME initiative was a theory-based PA intervention targeting African Methodist Episcopal (AME) churches in the state of South Carolina. Results from the intervention found no significant changes in PA. Among participants in the immediate intervention group, 29, 28 and 25% met PA recommendations at baseline, 1 year and 2 years [16]. The purpose of this study was to examine the mediating effects of psychosocial variables on PA in a sample of African-Americans participating in the Health-e-AME PA initiative. More specifically, we examined whether self-efficacy, exercise enjoyment and church support mediated the relationship between intervention group assignment and PA at the 1-year follow-up. We hypothesized that all three variables would be significant mediators of PA change.

**Methods**

The methods of the Health-e-AME PA initiative have been described in detail elsewhere [16, 17] and are summarized below. The Health-e-AME faith-based PA initiative was a 3-year PA program implemented in AME churches throughout the state of South Carolina from 2002 to 2005. The Health-e-AME program used a community-based participatory research approach in which a planning committee consisting of church leaders, church lay members and university staff worked together to develop, implement and evaluate the program. The main goals of the intervention were to increase moderate-intensity PA, the number of church members meeting PA recommendations and the progression in stage of readiness for PA change.

**Research design**

The Health-e-AME program used a group randomized design. Randomization occurred at the conference level. Three conferences, and all churches within them, were randomized to the immediate intervention group (i.e. received the intervention beginning in Year 1) and three conferences were randomized to the delayed intervention group (i.e. received the intervention beginning in Year 2). Because both groups received the intervention during an overlapping period (i.e. after the 1-year follow-up), analyses in this study only used baseline and 1-year follow-up data.

**Evaluation**

The entire seventh Episcopal District of the AME Church (∼500 churches) was invited to participate in the Health-e-AME initiative; however, only a subsample of churches was needed for program evaluation. Twenty of the 43 invited churches agreed to participate in program evaluation and submitted all information required for participation.

The Health-e-AME program was evaluated using telephone surveys, conducted at baseline and at 1- and 2-year follow-ups (baseline and 1-year follow-up data were used for this study). A randomly selected cohort of individuals from the evaluation churches were chosen to participate in the telephone surveys. To be eligible to take part in the survey, participants had to be at least 18 years of age and report attending church services at least twice per
The participant before the telephone survey took place. See Wilcox et al. [17] for the telephone survey sampling flow chart and response rates.

**Intervention**

Each church generally sent two individuals to attend a training session in how to deliver the Health-e-AME program to their congregation. A variety of intervention activities were developed to reach church members at various stages of readiness for change according to the transtheoretical model [18]. Detailed descriptions of the intervention activities are described elsewhere [16, 17]. Churches were free to choose and implement activities and programs that they thought were best suited to the needs and interests of their congregation.

Formative research guided the development of the intervention activities [17, 19]. Intervention activities and programs suggested by church members as ‘fun or enjoyable’ were chosen as components to implement. For example, church members suggested offering age-appropriate PA programs at the church (e.g. walking programs), as well as educational activities focusing on nutrition and health conditions [19]. Church members also suggested offering less intense programs (e.g. chair exercises) so that individuals with medical conditions/restrictions could take part in the intervention in an appropriate and enjoyable manner. In an effort to make PA more enjoyable, activities such as the chair exercise and aerobics were set to familiar gospel music, and PA opportunities were offered during church activities and meetings (e.g. 10-min exercise CD).

To help increase self-efficacy, the intervention emphasized gradual changes in PA. For example, churches offering walking programs encouraged their members to start slow and gradually increase their intensity and distance. Pastor modeling for PA was also encouraged, as church members noted that pastor support for the program as well as pastor participation in activities were motivators for PA [19]. Pastors, along with their spouses, were encouraged to take part in intervention activities at their church.

Church support for PA was emphasized in numerous intervention activities. Churches were encouraged to provide inserts with PA information in the worship bulletin, to post PA information on the church bulletin board, to offer opportunities at the church for PA (e.g. walking programs and aerobics) and to offer encouragement for PA via pastor sermons. Church support was also encouraged through exercise ‘buddies’ (e.g. walking groups) and through an 8-week, group-based, volunteer-led behavior change program.

**Measures**

Participants taking part in program evaluation completed each of the following measures at both baseline and at the 1-year follow-up.

**Sociodemographic and health-related variables**

Participants were asked to report their age, gender, race and highest grade or year of education completed. Participants also rated their general health status on a scale from 1 (excellent) to 5 (poor).

**Physical activity**

The Behavioral Risk Factor Surveillance System (BRFSS) PA module was used to assess PA. This telephone-administrated survey assesses occupational activity, moderate and vigorous PA and walking. Three questions were used to assess both moderate- and vigorous-intensity PA participation. Participants were asked if they performed activities in the specific intensity (yes/no), as well as frequency (days/week) and duration (hours and minutes/day). The percentage of participants meeting the Centers for Disease Control and Prevention–American College for Sports Medicine PA recommendations, that is 30 min of moderate PA on at least 5 days per week or 20 min of vigorous PA on at least 3 days, was calculated. A study comparing the BRFSS to an objective measure of PA showed an 80% agreement in classifying participants as meeting or not meeting these PA recommendations [20].

**Church support**

Church support for PA was measured with five items, all of which were created specifically for this study because existing scales were not available.
The items were designed to capture aspects of church support that the intervention targeted (i.e. encouragement and support from members to be active and increased opportunities to be active). Using a four-point response scale ranging from strongly disagree to strongly agree, participants reported whether people at church encouraged them to exercise and whether the importance of PA or exercise was emphasized at their church. Using a two-point response scale (yes/no), participants were asked if in the last year, any members of the church encouraged them to join a PA program, if any member of the church who is not a family member told them to be more physically active and which PA programs the church offered.

Because of the inconsistent response options among items, all support items were dichotomized to score total support. If the response was ‘strongly agree’, ‘agree’ or ‘yes’, the support item was coded as 1. If the response was ‘strongly disagree’, ‘disagree’ or ‘no’, the support item was coded as 0. If the participant reported any programs being offered by his/her church, the response was coded as ‘yes (1)’. If no programs were reported, the response was coded as ‘no (0)’. A mean total support score was calculated by adding scores from all items and dividing by the number of items included. A higher score indicates greater church support. The internal consistency for the present study was 0.72.

Church support was further categorized according to its domain. Instrumental church support was assessed with the single item asking which PA programs the church offered. Emotional church support was assessed with the remaining four items. Both domains of church support were scored using the same methods described above for overall church support (i.e. dichotomized and using the mean). The internal consistency for the present study for emotional church support was 0.68.

**Self-efficacy**

Self-efficacy for overcoming barriers to regular PA (i.e. barriers efficacy) was measured using a five-item scale of Marcus et al. [21]. Using a seven-point scale ranging from ‘not at all confident’ to ‘very confident’, participants were asked how confident they were that they could participate in regular exercise in different situations. A mean self-efficacy score was calculated by adding scores from all items and dividing by the number of items included. A higher score indicated greater self-efficacy. The internal consistency for the present study was 0.73.

**Exercise enjoyment**

Exercise enjoyment was measured using a five-item modified version of the PA enjoyment scale [22]. On a scale from 1 to 5, participants were asked how much they enjoy exercise when they are doing it by answering the following five bipolar statements: hate–enjoy, bored–interested, no fun–a lot of fun, very unpleasant–very pleasant and feel bad physically–feel good physically. A mean exercise enjoyment score was calculated by adding scores from all items and dividing by the number of items included. A higher score indicated greater exercise enjoyment. The internal consistency for the present study was 0.89.

**Body mass index**

Participants reported their height (in feet and inches) and weight (in pounds) without shoes. To calculate body mass index (BMI), weight in kilograms (kg) was divided by height in squared meters (m²).

**Statistical analyses**

Frequencies, means and standard deviations were calculated for key survey variables. Chi-square analyses for categorical variables and one-way analyses of variance (ANOVA) for continuous variables were conducted to examine baseline differences between intervention groups on key survey variables. Because the study design randomized conferences of churches and not participants, mixed-model analyses of covariance using SAS PROC MIXED and SAS PROC GLIMMIX were used to account for the multilevel nature of the data set (SAS version 9.2; SAS Institute, Inc., Cary, NC, USA). Conference and church were treated as nested random effects. Kenward–Roger
adjustments for the denominator degrees of freedom were used in all models [23].

The MacKinnon et al. [24–26] product of coefficients test was used to test for mediation. Each potential mediator was first tested separately in a single mediator model. These models include two analysis of covariance (ANCOVA) models. The first model regressed the mediator on intervention group assignment, controlling for the mediator at baseline (α coefficient). The second model regressed PA (meeting PA recommendations) on intervention group and the mediator, controlling for PA and the mediator at baseline (β coefficient). Gender, age, BMI, health status and education (high school graduate or less versus at least some college) were entered as covariates in both models. To assess the magnitude of the effect, asymmetric confidence limits based on the distribution of the product were constructed using the PRODCLIN program [27]. If the confidence interval did not include zero, the mediating effect was considered statistically significant [25, 28]. Those variables found to be statistically significant were tested simultaneously in a multiple mediator model. Figure 1 depicts our hypothesized mediation model.

**Results**

As reported elsewhere [17], 571 participants completed the baseline telephone survey. Of the total sample, 71% were women, 49% were married, 50% had at least some college education, 62% had household incomes of at least $25 000, 76% were overweight or obese and 28% met PA recommendations. The mean age was 54 ± 17 years and the mean BMI was 28.6 ± 5.5 kg m⁻². Descriptive statistics for each mediator at baseline and follow-up are shown in Table I. There were no statistically significant differences between intervention groups on the sociodemographic variables at baseline. However, all measures of church support were significantly higher in the immediate intervention group at baseline compared with the delayed intervention group. A total of 418 (73%) participants completed the 1-year follow-up survey. Participants lost at the 1-year follow-up were significantly younger than those retained [16].

**Mediation**

Table II shows the α and β coefficients, standard errors and the asymmetric confidence limit for each potential mediator. In examining the first mediation model, there was a marginally significant relationship between assignment to the immediate intervention group and instrumental support (P = 0.08).

In examining the second mediation model, the β path, none of the potential mediators were significantly related to meeting PA recommendations at the 1-year follow-up.

Tests for mediation found that none of the hypothesized mediators were statistically significant mediators of PA change in the Health-e-AME intervention, as the asymmetric confidence limits for each variable included zero.

**Discussion**

This study examined whether church support, self-efficacy and exercise enjoyment mediated the effects of a faith-based PA intervention. Although the Health-e-AME intervention did not significantly increase PA levels, mediation analyses can still be important in identifying potential strengths and weaknesses of the intervention, which may lead to the development of more effective interventions in the future. We found, however, that none of the psychosocial variables that were tested mediated the relationship between the intervention group and meeting PA recommendations. Despite these findings, this study offers some valuable insight into the Health-e-AME initiative and “lessons learned” to consider when developing future faith-based PA interventions.

The Health-e-AME intervention resulted in a marginally significant increase in the amount of instrumental PA support reported by church members. Instrumental support was operationalized as PA programs provided at church, and therefore addressed opportunities for PA. This change is promising, as the intervention specifically included
a variety of program components that targeted instrumental support, such as walking programs, chair exercises, praise aerobics and PA breaks during church meetings or events. Providing opportunities for church members to engage in PA, especially at church functions, may be helpful in increasing PA levels, given the high level of church involvement for many AME members (service, bible study and choir practice). Such opportunities may also allow PA to be performed in a culturally relevant manner, for example with gospel music, which may further encourage church members to actively take part. We caution against over-interpreting this finding, however, given the number of variables that were examined and the fact that the change was only marginally significant.

The lack of program effects on the mediators may be partly explained by inadequate program implementation, as results from our process evaluation revealed that implementation was quite low, particularly for intervention programs that required more time and effort to implement [29]. Only 45% of the immediate intervention churches implemented the eight steps to fitness program, 18% implemented praise aerobics, 50% implemented the Exercise Your Faith for 10 CD and 64% implemented chair exercises [29]. Insufficient program implementation likely contributed to the lack of changes in the targeted mediators. For example, formative work guided the choice of action-oriented PA programs to be ones that most members would like to do, and the inclusion of gospel mediators.
music (e.g. praise aerobics, chair exercises and the Exercise Your Faith for 10 CD) was designed to enhance enjoyment of these PA programs. A majority of churches did not implement these programs, thus preventing members from being exposed to enjoyable PAs. The same may be true for other hypothesized mediators. The Health-e-AME intervention used a ‘train-the-trainer’ approach, where university staff trained lay church members to organize and implement the PA-related programs in his/her congregation. Individuals assuming this role had varying levels of experience and knowledge in health behavior change and program implementation. Similar to this study, a faith-based intervention targeting PA,
healthy eating and colorectal screening [Wellness for African Americans Through Churches Project (WATCH)] by Campbell et al. [30] found no changes in health behaviors in the lay health advisor arm. Follow-up analyses found that program implementation was very low, as only 10% of participants in this group reported talking to a lay health advisor about health. Finally, the lack of change for exercise enjoyment in this study may also be due in part to a ceiling effect. Participants in the intervention group reported high levels of exercise enjoyment at baseline (4.24/5), leaving little room for further improvements.

The size of the project (∼300 churches were trained), and the number of available staff members, made it unfeasible to provide comprehensive technical assistance and support to individual churches. With the exception of a few booster training sessions, which were not well attended, churches received minimal university support (largely by mail) after the initial 1-day intervention training. It is evident that churches needed more hands-on support; future faith-based studies should aim to provide ongoing support at the individual, cluster or district church level. Because university staffing may be inadequate in such large-scale projects, it may be useful to pay a selected number of church members with appropriate backgrounds in program implementation to assist churches via ongoing technical support throughout the intervention. An ongoing intervention built from the Health-e-AME project (the Faith, Activity and Nutrition program) is addressing this shortcoming by providing churches with technical assistance calls on a monthly basis to problem solve and overcome any barriers the church is facing in program implementation.

Mediation analyses allowed us to examine both the action theory (how the intervention changes the mediator, $\alpha$ path) and the conceptual theory (how the mediating variable affects the outcome variable, $\beta$ path) aspects of the Health-e-AME intervention. In instances where the intervention/program does not change the outcome, as in this study, these types of analyses may help to identify and understand which aspect failed [31]. Simply concluding that the intervention was not successful is neither practical nor helpful for improving future interventions. Research and theoretical models typically concentrate on conceptual theory, focusing on which variables are related to behavior change [32]. However, it is also important to consider action theory, as it compels researchers to think about how a program can change intervening variables [32]. The degree to which the proposed program components can realistically change the targeted mediating variables may be the most critical part of program design [31]. With the exception of instrumental support, there was evidence that the intervention did not successfully change the targeted mediating variable(s). If the intervention does not change the variable(s) hypothesized to change the targeted behavior, it is not likely that the outcome variable(s) will change [3]. It is possible, of course, that the intervention did change the variables, but the measures used to assess the mediating variables were not reliable or valid enough to detect change for the targeted population [3]. It is also possible that we did not assess the appropriate mediators; the true mediators that lead to changes in PA in this population and setting may not yet be identified. Although we would have liked to have measured

### Table II. Mediation effects of Health-e-AME intervention on PA

<table>
<thead>
<tr>
<th>Potential mediator variables</th>
<th>Treatment to mediator $\alpha$ coefficient (standard error)</th>
<th>Mediator to outcome $\beta$ coefficient (standard error)</th>
<th>Asymmetric confidence limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Church support</td>
<td>-0.111 (0.063)</td>
<td>0.428 (0.433)</td>
<td>-0.180, 0.041</td>
</tr>
<tr>
<td>Instrumental church support</td>
<td>-0.205 (0.109)*</td>
<td>-0.194 (0.291)</td>
<td>-0.073, 0.187</td>
</tr>
<tr>
<td>Emotional church support</td>
<td>-0.080 (0.065)</td>
<td>0.586 (0.411)</td>
<td>-0.171, 0.028</td>
</tr>
<tr>
<td>Self-efficacy</td>
<td>-0.176 (0.160)</td>
<td>0.204 (0.113)</td>
<td>-0.127, 0.024</td>
</tr>
<tr>
<td>Exercise enjoyment</td>
<td>-0.062 (0.100)</td>
<td>0.388 (0.190)</td>
<td>-0.117, 0.050</td>
</tr>
</tbody>
</table>

$^*P = 0.08.$
a greater number of potential mediating variables based on the underlying theory, we aimed to keep the survey relatively short to enhance the completion and response rates. The shortcomings described can be addressed in the future in hopes of improving program outcomes.

Mediation analyses in the PA literature tend to focus on the same accepted set of variables (e.g., self-efficacy and social support). Depending on the target population and setting, it may be beneficial to test other unique variables that could potentially have a significant impact on changing the targeted behavior. The church is an important source of support for African-Americans [15], and pastors and other church leaders in the AME church have a significant influence on the behaviors of their congregation. Future faith-based PA studies should include church support as a potential mediator of PA change, as it may hold great promise in changing PA levels, particularly among African-Americans.

Very few faith-based interventions, particularly those targeting PA behaviors, have conducted mediation analyses to determine how the intervention changed the targeted behaviors. Mediation analyses for Body and Soul [33], a faith-based intervention targeting fruit and vegetable consumption in African-American churches, found that social support and self-efficacy were significant mediators of change in fruit and vegetable intake. Although these variables were not significant mediators in our study, the importance of these variables in faith-based PA interventions with African-Americans should not be discounted, as this is the first mediation study conducted for this setting and population. Although the behavior targeted in Body and Soul was not PA, social support and self-efficacy may be important for changing a number of health-related behaviors in faith-based interventions.

There are several limitations to this study. First, the items used to assess church support had differing response options, with some measured on a Likert scale and others dichotomous. As a result, in order to combine items for a scale, we were forced to dichotomize some of our items, which can result in reduced statistical power. Second, instrumental church support was measured with a single item. Therefore, this type of support may not have been adequately or reliably assessed. Third, PA was assessed with a self-report measure which may be subjected to self-report biases. The BRFSS was used in this study because of its brevity and because it allowed for comparisons with state and national data. However, this measure was designed for surveillance purposes and thus may not be sensitive to change. Fourth, the high attrition rate, which was associated with younger age, may limit the generalizability of our findings. Finally, temporal precedence, which is necessary for mediation [34, 35], was not established in this study, as the mediators and PA were measured simultaneously.

Faith-based interventions, especially those using a train-the-trainer approach with lay church members who have competing responsibilities, such as jobs and families, may take significantly more time to put into place. These types of interventions also involve organizational change, which also takes time and can be challenging to put into place; 1 year may not be sufficient time to implement multiple intervention programs and thus produce effects on mediators/outcomes. Additional mediation studies in faith-based interventions targeting PA need to be conducted to better understand which variables are most essential for faith-based PA interventions with African-Americans. Null and significant study findings contribute equally to the ‘big picture’ of the effectiveness of behavioral interventions. Future faith-based studies can learn from and address our shortcomings in hopes of developing interventions that can more successfully influence program outcomes.

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Conflict of interest statement

None declared.

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1. Marcus BH, Williams DM, Dubbert PM et al. Physical activity intervention studies: what we know and what we need to know: a scientific statement from the American Heart Association Council on Nutrition, Physical Activity, and Metabolism (Subcommittee on Physical Activity); Council on Cardiovascular Disease in the Young; and the Interdisciplinary Working Group on Quality of Care and Outcomes Research. Circulation 2006; 114: 2739–52.


