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Efficacy and Mediation of a Theory-Based Physical Activity Intervention for African American Men Who Have Sex with Men: A Randomized Controlled Trial

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Abstract

Background—Few trials have tested physical-activity interventions among sexual minorities, including African American men who have sex with men (MSM).

Purpose—We examined the efficacy and mediation of the Being Responsible for Ourselves (BRO) physical-activity intervention among African American MSM.

Method—African American MSM were randomized to the physical-activity intervention consisting of three 90-min one-on-one sessions or an attention-matched control intervention and

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completed pre-intervention, immediately post-intervention, and 6 and 12 months post-intervention audio-computer-based surveys.

Results—Of 595 participants, 503 completed the 12-month follow-up. Generalized-estimating-equations models revealed that the intervention increased self-reported physical activity compared with the control intervention, adjusted for pre-intervention physical activity. Mediation analyses suggested that the intervention increased reasoned-action-approach variables, subjective norm and self-efficacy, increasing intention immediately post-intervention, which increased physical activity during the follow-up period.

Conclusions—Interventions targeting reasoned-action-approach variables may contribute to efforts to increase African American MSM's physical activity.

Clinical trial registration—ClinicalTrials.gov Identifier: NCT02561286

Keywords

Physical activity; Intervention study; Mediation analysis; African American men; Men who have sex with men; Reasoned Action Approach

Although racial and sexual disparities in life expectancy have been reduced in the last 3 decades, African American men continue to have the highest mortality rate among all racial/ethnic and gender groups in the US.[1] African American men are disproportionately affected by not only HIV,[2] but also chronic non-communicable diseases (NCDs), including cardiovascular disease, stroke, hypertension[3], and diabetes.[4] Furthermore, sexual minority group members, including African American men who have sex with men (MSM), suffer from numerous health inequalities that have been inadequately addressed in research.[5, 6] Although research has focused on HIV in African American MSM, the group accounting for the largest number of African Americans with HIV,[2] other health problems affecting African American MSM have received little research attention. Moreover, high rates of poverty and unemployment and social structural barriers, including institutional racial and sexual-orientation-based discrimination, have reduced African American MSM's access to quality health care,[6] further increasing their risk for preventable NCDs.

Despite the well-established benefits of physical activity for a range of NCDs, annualized over 2008-2010, less than one-fourth of African American men met the 2008 federal guidelines[7] for aerobic and muscle-strengthening physical activity. Although considerable research has revealed that physical-activity interventions can be efficacious,[8, 9] most of the research involved White and female participants.[10] Few trials have tested interventions specifically designed to increase African American men's physical activity,[11] and none have tested such interventions with African American MSM. Here we report the efficacy of “Being Responsible for Ourselves” (BRO), a one-on-one intervention to increase physical activity in African American MSM developed using social cognitive theory [12] and the reasoned action approach[13], integrated with extensive formative research.[14] Social cognitive theory and the reasoned-action approach were used because of their ease of application to different populations and behaviors [15] and their contributions to efficacious interventions.[16-23] Most relevant are the social-cognitive-theory variables of “outcome expectancy,” beliefs about the consequences of specific behaviors, and “self-efficacy,”

people's confidence that they can execute specific behaviors; its emphasis on skills; and its methods for increasing skills and changing behavior, including goal setting, guided practice with performance feedback, and observational learning.

The reasoned-action approach is an extension of the theory of planned behavior [24], which itself is an extension of the theory of reasoned action [25]. Most relevant are the reasoned-action approach's emphasis on the importance of salient beliefs, its tenet that such beliefs may vary from population to population and from behavior to behavior, and its methods for identifying such beliefs: namely, formative research, including focus groups. Identifying the salient beliefs in a population and then designing intervention activities to influence them can result in an intervention that is both theoretically grounded and tailored to the population. According to the reasoned-action approach, attitude, subjective norm, descriptive norm, and perceived behavioral control or self-efficacy determine intention, which in turn determines behavior. In the present study, the reasoned-action approach guided the formative research identifying population-specific beliefs regarding physical-activity attitude, subjective norm, and self-efficacy and provided the mediation model for how the theoretical variables would together affect behavior.

We randomized African American MSM to the physical-activity intervention or a HIV/STI risk-reduction intervention, which served as the attention-matched control condition. We hypothesized that the physical-activity intervention would increase the men's self-reported number of days of physical activity in the past 7 days during the 12-month post-intervention period compared with the attention-control condition, adjusting for baseline physical activity.

To better understand the intervention's effects, we also performed secondary mediation analyses.[26] Mediation analysis can reveal whether an intervention changed the hypothesized mediators and whether the hypothesized mediators predicted the outcome, and such knowledge can be used to improve the intervention. To our knowledge, only 1 mediation analysis of physical-activity interventions targeting African American adults has been published [27] and none targeting African American MSM has been published. We hypothesized that reasoned-action-approach variables would mediate the effects of the physical-activity intervention.

Method

Institutional review boards at the University of Pennsylvania and Temple University approved the study. We recruited participants in the Philadelphia area through advertising in local newspapers, through community-based organizations, through flyers posted at colleges, universities, bars, adult bookstores, through face-to-face recruitment at social events expecting a high African American MSM turnout, and through the referrals of participants. The eligibility criteria were based on the HIV/STI risk-reduction intervention, which was the primary intervention the study was funded to test.[28] Men were eligible if they were at least 18 years of age, self-identified as Black or African American, were born a male, and reported having anal intercourse with a man in the past 90 days. Eligible participants were invited to participate in “Project Being Responsible for Ourselves” (BRO)

designed to reduce health risks, including cardiovascular diseases, cancers, and STIs, including HIV. Informed consent while blind to group assignment was required for participation (ClinicalTrials.gov Identifier: NCT02561286).

Computer-generated random number sequences were used to randomly assign participants to the physical-activity intervention or the attention-matched HIV/STI risk-reduction intervention, using concealment of allocation techniques. The biostatistician generated the random assignments and the project director implemented the assignments. Participants were enrolled between April 2008 and March 2011, with all data collection completed by May 2012.

Participants who completed the pre-intervention questionnaire and attended session 1 of the intervention were enrolled in the trial. Data collectors, but not intervention facilitators or participants, were blind to group assignments. The intervention and data-collection sessions were implemented at a university research center. Participants were compensated with $25 for the pre-intervention assessment, $25 for each of the 3 intervention sessions, $25 for the immediate post-intervention assessment, and $50 for each of the 6-month and 12-month follow-up assessments.

Interventions

The physical-activity intervention was developed based on the reasoned-action approach[13] and social cognitive theory,[12] integrated with extensive formative research,[14] including focus groups and pilot testing to identify population-specific beliefs relevant to physical-activity attitude, subjective norm, and self-efficacy. It consisted of three 90-min one-on-one sessions designed to increase attitude, self-efficacy, and skills to engage in physical activity that trained facilitators implemented during 3 consecutive weeks using standardized manuals. Activities also addressed fruit-and-vegetable consumption and limiting fat. The intervention included interactive exercises, brainstorming, games, role-playing, discussions, videos, and take-home assignments that involved several behavior-change techniques enumerated in a taxonomy of such techniques designed to change physical-activity behavior.[29]

For example, the “Getting to Know You” activity was designed to provide an overview, create enthusiasm, and help the facilitator tailor the intervention to the participant by assessing his goals and reasons for participating, involvement in the targeted behaviors, the context in which the behaviors would occur, and motivation for the behaviors. It employed the provide-information-about-others'-approval-of-the-behavior and plan-social-support/social-change techniques.[29] The “Information about Health” activity used the provide-information-on-consequences-of-behavior-in-general and provide-information-about others'-behavior techniques, whereas “Where Do You Draw the Line” used the provide-information-about-consequences-of behavior-to-the-individual and barrier-identification/problem-solving techniques.[29] Participants discussed their physical activity and sedentary leisure time activity, consequences of the activities, and ways to overcome barriers to physical activity.

“Exercise – Incorporating It into My Life” focused on attitude toward physical activity, highlighting the positive consequences to the participant personally, helping him to identify

the types of physical activity that would best fit his lifestyle, with an emphasis on activities he would find enjoyable. It used several techniques,[29] including goal setting (behavior), action planning, barrier identification/problem solving, prompt self-monitoring of behavior, provide information on where and when to perform the behavior, and plan social support/social change. Participants learned about aerobic, muscle-strengthening, and flexibility-enhancing exercise, enumerated barriers to exercising regularly, and considered ways of surmounting the barriers. Sessions 1 and 2 included take-home assignments that the participants reviewed at the subsequent session. The techniques[29] used in these activities included goal setting (behavior), prompt practice, prompt review of behavioral goals, barrier identification/problem solving, and prompt rewards contingent on effort or progress toward behavior.

Consistent with 2008 federal physical-activity guidelines, we encouraged participants to engage in a combination of aerobic and muscle-strengthening activities each week: 1) at least 30 min of moderate-intensity aerobic physical activity on 5 days or at least 20 min of vigorous-intensity aerobic physical activity on 4 days and 2) muscle-strengthening activity on at least 2 days.[7] “Aerobic Workout” addressed self-efficacy and skills to engage in physical activity. Participants did moderate-intensity and vigorous-intensity aerobic exercise and muscle-strengthening exercise in concert with an exercise video, which depicted 3 levels of intensity at which the men could participate, with the lowest level exercising while sitting in a chair. The techniques[29] used included prompt generalization of target behavior, provide instruction on how to perform the behavior, and model/demonstrate the behavior. The final session included “Letter to Self” in which participants committed to implementing their physical-activity plans. It used the goal-setting and agree-behavioral-contract techniques.[29] Participants received pedometers, exercise bands, and an exercise video to facilitate their ability to exercise at home.

The HIV/STI risk-reduction intervention served as an attention-matched control, providing a control for “Hawthorne effects,” reducing the likelihood that the physical-activity intervention's effects can be attributed to non-specific features, including special attention.[30] It was structurally similar, containing activities similar to the physical-activity intervention but focused on reducing sexual-risk behaviors.[28]

Assessments

The participants completed confidential questionnaires via audio computer-assisted self-interviewing (ACASI), which provided audio and video presentation of the questions and response options on a laptop. ACASI has been shown to increase reports of socially undesirable behaviors compared with face-to-face interviews and self-administered surveys, possibly reflecting more accurate responding.[31] Socio-demographics, physical activity, and theoretical variables were assessed pre-intervention and 6 and 12 months post-intervention. Theoretical variables were also assessed immediately post-intervention.

Physical Activity—Physical activity was assessed with 3 items the Centers for Disease Control and Prevention[32] developed concerning the number of days on which people did vigorous-intensity aerobic activities for at least 20 min, moderate-intensity aerobic activities

for at least 30 min, and muscle-strengthening activities in the past 7 days, items that have been used to test intervention effects on physical activity in trials with a diversity of populations [18, 20, 21, 33]. The primary outcome was a weighted average of the number of days on which participants reported engaging in 20 min of vigorous-intensity activity, 30 min of moderate-intensity activity, and muscle-strengthening activity, in the past 7 days. The 2008 physical activity guideline[7] requires 20 min of vigorous-intensity activity on at least 4 days or 30 min of moderate-intensity activity on at least 5 days and engaging in strength-building activity on 2 or more days, in the past 7 days. Accordingly, the weighted average was calculated by assigning different weights for the 3 behaviors as follows:

$$\left(\frac{\text{days of vigorous activity}+\text{days of moderate activity}}{2}*5+\text{days of strength building activity}*2\right)/7$$

In a prospective study, baseline scores on this weighted index significantly predicted pedometer-assessed minutes of moderate-to-vigorous physical activity and steps over the subsequent 29 days [33]. Secondary outcomes included the number of days of vigorous-intensity activity, the number of days of moderate-intensity activity, and the number of days of muscle-strengthening activity. In addition, the number of days of aerobic physical activity was calculated by averaging the number of days of vigorous-intensity activity and moderate-intensity activity.

Theoretical Variables—We assessed 4 theoretical variables regarding physical activity addressed in the intervention. Attitude toward exercising was the mean of 5 items (α=.91) the participants rated on 5-point scales: how *bad/good*, *foolish/wise*, *unpleasant/pleasant, dangerous/safe*, and *harmful/beneficial* it is to exercise for 30 minutes at least 6 times a week in the next 6 months. The subjective norm toward exercising was the mean of 3 items (α=.93) the participants rated on 5-point scales (1 for “Strongly disagree” to 5 for “Strongly agree”) indicating whether “most people who are important to me would *think it is okay for me to/think I should/want me to/* exercise for 30 minutes at least 6 times a week in the next 6 months.” Self-efficacy to exercise was the mean of 2 items (α=.88) that participants rated on a 5-point scale (1 for “Strongly disagree” to 5 for “Strongly agree”): “I am confident that I can overcome obstacles that might prevent me from exercising for 30 minutes at least 6 times a week in the next 6 months” and “I am sure that I can exercise for 30 minutes at least 6 times a week in the next 6 months.” Intention to exercise was the mean of 3 items (α=.94) participants rated on a 5-point scale (1 for “Strongly disagree” to 5 for “Strongly agree”): “I plan to exercise for 30 minutes at least 6 times a week in the next 6 months,” “I will try to exercise for 30 minutes at least 6 times a week in the next 6 months,” and “My goal is to exercise for 30 minutes at least 6 times a week in the next 6 months.” Also assessed was the descriptive norm toward exercise, which, though not targeted by the intervention, is a reasoned-action approach variable.[13, 34] It was assessed with1 item: “How many of your 5 closest friends exercise for 30 minutes at least 6 times a week?” Possible responses were: 1 (“Almost none”), 2 (“About one-quarter”), 3 (“About half”), 4 (“About three-quarters”), to 5 (“Almost all”).

The validity of the measures of the theoretical variables was established in a separate prospective study on African American men,[35] with 91% retained at 3-month follow-up. Attitude, $r(201) = .46$, $p < .001$, subjective norm, $r(201) = .58$, $p < .001$, descriptive norm, $r(201) = .39$, $p < .001$, and self-efficacy, $r(201) = .62$, $p < .001$, were correlated with intention to exercise at baseline, which was correlated with higher odds of meeting the physical-activity guideline at 3-month follow-up, odds ratio (OR) = 1.69, 95% CI: [1.20, 2.40].

Statistical Analysis

An a priori statistical power analysis, described elsewhere,[28] was performed to determine sample size to test the HIV risk-reduction intervention's efficacy, which was the primary purpose of the trial. Using the sample size ($N = 594$) that power analysis suggested and assuming a two-tailed test, $\alpha = .05$, and 20% attrition, the estimated power is 80% to detect a Cohen's $d = 0.25$ difference in the physical-activity intervention compared with the control intervention. We used chi-square and logistic regression to analyze attrition. We tested the physical-activity intervention's efficacy compared with the control intervention using generalized-estimating-equations (GEE) models,[36, 37] adjusting for longitudinal repeated measurements and the baseline measure of the outcome. We report estimated mean differences and corresponding 95% confidence intervals for the outcomes. We used robust standard errors and specified an independent working correlation matrix. The models included intervention (physical-activity, attention-control), follow-up time (2 categories representing 6- and 12-month follow-up), and baseline measure of the outcome. Models assessing whether the intervention's efficacy differed between the 2 follow-ups included intervention, time, baseline measure of the outcome, and the Intervention × Follow-up-Time interaction.

We used multilevel structural equation modeling (SEM) in Mplus Version 7 for Windows,[38] adjusting for longitudinal repeated outcome measurements,[39] to perform serial multiple-mediation analyses. This method uses maximum likelihood estimates with robust standard errors (MLR) with the assumption that data are missing at random.[38, 40] MLR estimates are robust to nonnormality and nonindependence of observations.[38] In these analyses, the putative mediators (i.e., attitude, subjective norm, descriptive norm, self-efficacy, and intention) were from the immediate-post intervention assessment. Model 1, based on the reasoned-action approach,[13] had paths from the intervention to immediate post-intervention attitude, subjective norm, descriptive norm, and self-efficacy, a path from each of them to immediate post-intervention intention, a path from intention to physical activity, and a path from self-efficacy to physical activity. Attitude, subjective norm, descriptive norm, and self-efficacy were allowed to correlate with each other. All the dependent variables in the SEM model were continuous; accordingly, Mplus estimated all path coefficients with linear regression. The regression models predicting intention and physical activity adjusted for the intervention, and the model predicting each theoretical variable adjusted for the corresponding baseline of the variable. All regression models adjusted for baseline physical activity. In addition, we compared Model 1 to an alternative, Model 2, that deleted the direct path from self-efficacy to the outcome, using the Satorra-Bentler scaled chi-square difference test (TRd).[41] Mplus calculated the indirect effect

through each theoretical path using the product-of-coefficients approach [26, 42] with 3 coefficients (i.e., the hypothesized mediator on the intervention, the intention on the hypothesized mediator, and physical activity on the intention). We used the bootstrap method (bootstrap=2000) with maximum likelihood estimators.[43] Significant mediation was determined by testing whether the product's corresponding bias-corrected bootstrap asymmetric 95% confidence interval (ACI) contained zero. We performed all analyses using an intention-to-treat model with participants analyzed based on their intervention assignment regardless of the number of intervention or data-collection sessions attended.

Results

Figure 1 shows the flow of participants through the trial. Table 1 presents the participants' baseline socio-demographic characteristics by intervention condition. The participants were 18 to 69 years of age (mean = 41.6; SD = 10.7). About 41% self-identified as gay, 41% self-identified as bisexual, 8% self-identified as straight, and 10% said they were on the “down low” (having sex with men and perhaps women, but being secretive about same-sex sexual behavior). Only 28% were employed and 48% had completed high school. About 30% of participants said they were HIV positive. About 44% were alcohol dependent, 17% were drug dependent, and 52% had spent time in jail or prison. About 20% met the 2008 federal physical-activity guideline.

Attendance at the 3 intervention sessions was excellent: 594 or 99.8% attended Session 1; 561 or 94% attended Session 2; and 554 or 93% attended Session 3. A high percentage of participants reported completing take-home assignment 1 (483/554 or 87%) and 2 (500/554 or 90%), with a higher percentage of control (251/273 or 91.9%) compared with physical-activity (232/281 or 82.6%) participants reporting completing assignment 1, χ^2 (1, N = 554) = 10.90, r = .14, p = .001. On average, the facilitators reported completing 98% (SD = 6%) of the intervention activities. High percentages of participants completed the post-intervention assessments: 553 or 93% completed the immediate post-test; 505 or 85% completed the 6-month follow-up; 503 or 84% completed the 12-month post follow-up; and 538 or 90.4% attended at least 1 of the 2 follow-ups. The physical-activity and control conditions did not differ in the percentage attending at least 1 follow-up.

Baseline measures of the weighted average number of days of physical activity, the average number of days of aerobic physical activity, the number of days of vigorous-intensity activity, the number of days of moderate-intensity activity, and the number of days of muscle-strengthening activity in the past 7 days, did not predict attending at least 1 follow-up. The only baseline sociodemographic characteristics that predicted attending at least 1 follow-up were age, housing stability, and HIV status. Older men were more likely to return than were younger men, OR = 1.04 (95% CI: 1.01, 1.06), p = .002. Men with stable housing (92%) were more likely to return, χ^2 (1, N = 593) = 6.87, r = .11, p = .009, than were those with unstable housing (85%). Men who said they were HIV positive (98%) were more likely to return, χ^2 (1, N = 593) = 16.47, r = .17, p < .001, than those who said they were HIV negative (87%).

Intervention Effects on Physical Activity

Table 2 presents the descriptive statistics for physical activity outcomes by intervention condition and assessment period. Table 3 presents estimated intervention effects unadjusted and adjusted for baseline outcome. The physical-activity intervention increased the weighted average number of days of overall physical activity and the average numbers of days of aerobic physical activity, vigorous-intensity activity, and moderate-intensity activity compared with the control intervention, after adjusting for baseline outcome measures and follow-up time. The physical-activity intervention, however, did not affect muscle-strengthening activity. The Intervention × Follow-up-Time interactions were nonsignificant, indicating that the intervention's efficacy did not differ at 6-month compared with 12-month follow-up for any outcome. In addition, the intervention's efficacy did not differ by participants' age, monthly income, stability of housing, or HIV status (analyses not shown).

Mediation of Intervention Effects on Physical Activity

Table 4 shows the bivariate correlation matrix among the putative mediators assessed immediately post intervention. In the mediation analyses, Model 1 (χ^2 [28]=98.95, $p < .001$; CFI = 0.96; TLI = 0.92; RMSEA = 0.05 [90% CI: 0.037 - 0.057]; SRMR = 0.06) and Model 2 (χ^2 [29] = 101.14, p < .001; CFI = 0.96; TLI = 0.92; RMSEA = 0.05 [90% CI: 0.04 - 0.06]; SRMR = 0.06) had acceptable model fit indices.[44, 45] Model 1 did not fit the data better than Model 2, the simplified model, TRd = 0.82, $p = .366$; hence, being parsimonious, Model 2 is the better model. Figure 2 showing Model 2 indicates that the intervention increased subjective norm and self-efficacy regarding physical activity, which were associated with increased intention, which, in turn, was associated with increased physical activity. The product of the 3 coefficients was 0.02 (95% ACI: 0.01, 0.04) for the mediation path of subjective norm and 0.03 (95% ACI: 0.01, 0.07) for the mediation path of self-efficacy, suggesting the intervention significantly increased physical activity by increasing subjective norm and self-efficacy. The 95% ACIs for the products of coefficients indicated the paths through attitude and descriptive norm were nonsignificant. In addition, the intervention had a direct effect on intention, and the product of the 2 coefficients for the direct path through intention (i.e., from intervention to intention and from intention to the outcome) was significant, 0.04 (95% ACI: 0.01, 0.08).

To test whether the intervention had a direct effect on physical activity, unmediated by the theoretical variables, we compared Model 2 with and without a direct effect from the intervention to physical activity.[46] The difference was not significant, TRd = 1.71, $p = .191$, indicating that allowing a direct effect from the intervention to the outcome did not improve the fit compared with the model without the direct effect, confirming the theoretical variables completely mediated the intervention's effect.

Discussion

The physical-activity intervention, compared with the control intervention, increased aerobic activity, including vigorous and moderate intensity activity combined and considered separately, but not muscle-strengthening activity. This may reflect the fact that at baseline men in the physical-activity and control interventions were close to the recommended

frequency of 2 times per week for muscle-strengthening exercise, at 1.75 and 1.76 respectively, whereas they were far from the recommended frequency of 5 times per week for aerobic exercise, 2.33 and 2.40 respectively. Thus, they needed a greater increase in aerobic activity as opposed to muscle-strengthening activity to reach recommended amounts of both types of activity. The fact that the participants, MSM, were close to meeting the muscle-strengthening guideline at baseline may reflect gay and bisexual men's desire to appear physically attractive and masculine.[47] Although studies have tested physical-activity interventions with African American adults[27, 48] and adolescents,[49] to our knowledge, this is the first RCT to test such an intervention with African American MSM and the first to identify mediators of a physical-activity intervention's effects in African American men.

The mediation analyses suggested that the intervention's effects on physical activity were occasioned by its effects on subjective norm and self-efficacy, which affected intention, and by the intervention's direct effect on intention. The intervention did not have a direct effect on physical activity, suggesting these theoretical variables completely mediated the intervention's effect. The present results are largely in accord with results of a study targeting South African men [50] which found that self-efficacy, intention, and subjective norm mediated an intervention's effects on self-reported physical activity whereas descriptive norm did not. Several other studies, though not all [51], have suggested that self-efficacy[16, 17, 52-54] and intention [55-57] mediated the effects of physical-activity interventions in several populations, including white and African American adolescent girls, mothers with young children, healthy adults age 50 years and older, Canadian breast-cancer survivors, older Dutch adults. Unlike the present study, the South African men study found that attitude mediated the intervention's efficacy, but the present study's finding is consistent with other reports of scant evidence for mediation by attitude in physical-activity intervention trials.[55, 57]

This study has both strengths and limitations. Among the strengths are its RCT design and dose- and modality-equivalent control intervention, the use of mediation analysis, the large sample, and the excellent retention with a hard-to-reach target population, African American MSM. A strength of the mediation analysis is the measurement of the putative mediators immediately post-intervention before participants had a chance to change their behavior, a rare design feature in mediation analyses [58] ensuring that changes in putative mediators temporally preceded changes in physical-activity outcomes. An important limitation is the use of self-reported behavior, which is vulnerable to socially desirable responding. A limitation of employing a multifaceted intervention to address relevant theoretical variables hypothesized to mediate behavior change is that we are unable to discern the relative importance of the different intervention components. Another limitation stems from the fact that the trial was funded to test the HIV risk-reduction intervention and accordingly only limited data regarding the physical activity intervention could be collected. Moreover, the results may not generalize to MSM who are not from Philadelphia or who are not offered payment for attending intervention sessions. Finally, consistent with the reasoned-action approach,[13] the discordance between the 5 days per week of moderate physical activity referenced in the outcome measure and the 6 days per week referenced in the theoretical

variable measures may have reduced the size of the correlations between the theoretical variables and the outcome.

Despite these limitations, the findings have implications for interventions to increase African American MSM's physical activity. Specifically, the findings highlight the promise of the reason-action approach in designing physical-activity interventions for African American MSM in that its theoretical variables, including intention, subjective norm, and self-efficacy, mediated the intervention's effects.

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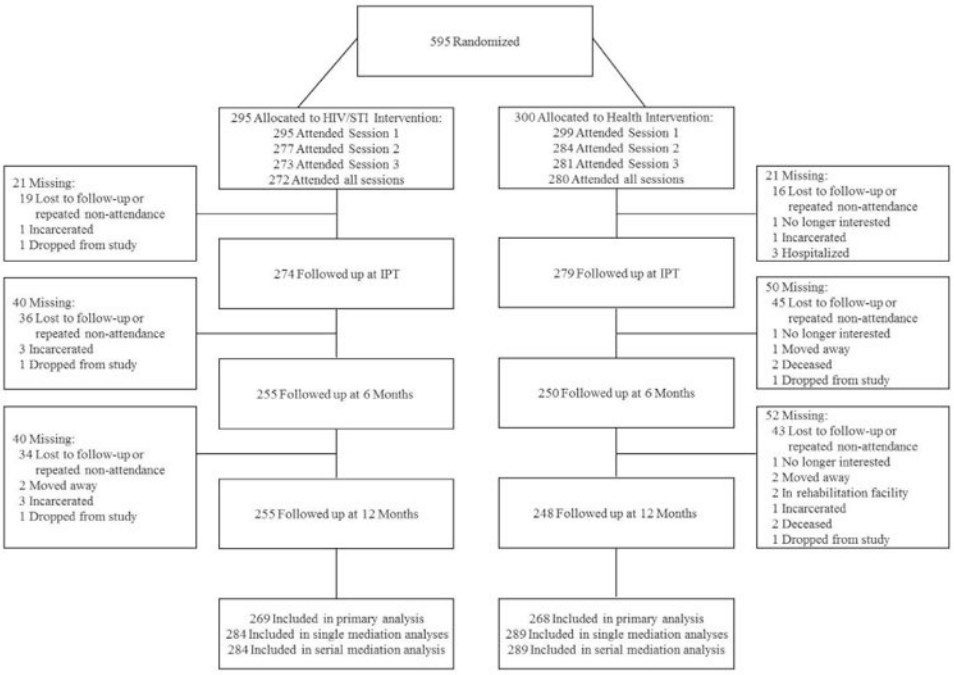

Figure 1. Flow Diagram of Participants through Trial

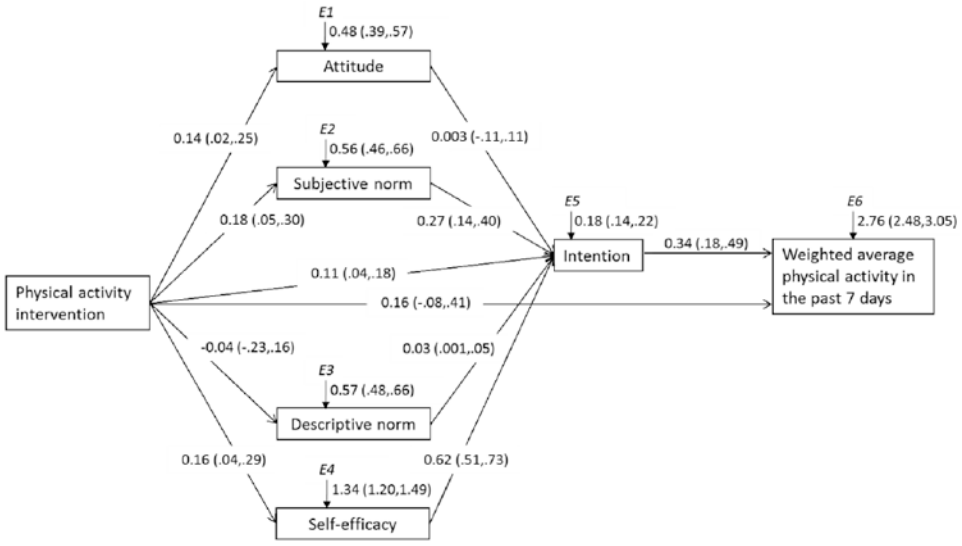

Figure 2. Structural Equation Model of the Effect of the Intervention on Theoretical Constructs and Weighted Average Physical Activity, African American Men, Philadelphia, PA 2008-2011

Note. Estimates are unstandardized indices: CFI=0.960, TLI=0.921, 0.0 Efficacy and Mediation coefficients (95% ACI) from ordinary least square regressions (bootstrap=2000). Goodness, RMSEA = 0.047 (90% CI: 0.037, 0.057), chi-square=101.136 (DF=29, P=0.000) 33 Goodness-of-Fit 0.000), SRMR=0.064

Table 1

Baseline Socio-demographic Characteristics of Participating African American Men by Intervention Condition, Philadelphia, PA, 2008-2011.

Characteristic	Total	Health Intervention	HIV/STI Intervention
No.	595	300	295
Mean (SD) Age (years)	41.6 (10.7)	41.8 (10.6)	41.4 (10.8)
No. (%) Employed	169/593 (28.5%)	80/298 (26.8%)	89/295 (30.2%)
No. (%) Completed high school	287/593 (48.4%)	137/298 (46.0%)	150/295 (50.8%)
No. (%) Monthly income			
Less than $ 400	219/593 (36.9%)	112/298 (37.6%)	107/295 (36.3%)
$ 400 - $ 850	212/593 (35.8%)	98/298 (32.9%)	114/295 (38.6%)
$ 851 or more	162/593 (27.3%)	88/298 (29.5%)	74/295 (25.1%)
No. (%) Stable housing	463/593 (78.1%)	233/298 (78.2%)	230/295 (78.0%)
No. (%) Sexual self-identity			
Gay	241/593 (40.6%)	113/298 (37.9%)	128/295 (43.4%)
Straight	45/593 (7.6%)	25/298 (8.4%)	20/295 (6.8%)
Bisexual	245/593 (41.3%)	121/298 (40.6%)	124/295 (42.0%)
On the down low [a]	62/593 (10.5%)	39/298 (13.1%)	23/295 (7.8%)
No. (%) Ever tested for HIV	569/593 (96.0%)	285/298 (95.6%)	284/295 (96.3%)
No. (%) HIV positive	168/569 (29.5%)	85/285 (29.8%)	83/284 (29.2%)
No. (%) Met the 2008 physical activity guideline	118/593 (19.9%)	61/298 (20.5%)	57/295 (19.3%)
No. (%) Alcohol dependent [b]	264/593 (44.5%)	121/298 (40.6%)	143/295 (48.5%)
No. (%) Drug dependent [c]	99/593 (16.7%)	47/298 (15.8%)	52/295 (17.6%)
No. (%) Ever in jail or prison	307/593 (51.8%)	159/298 (53.4%)	148/295 (50.2%)
Mean (SD) Days in jail or prison	1107.6 (97.9)	1165.1 (140.9)	1045.8 (135.6)

[a] Participants self-reported sexual identity by choosing gay, straight, bisexual or on the down low from a list following a lead “I consider myself sexually as…” In formative survey research with African American MSM in Philadelphia ($N = 217$) prior to the trial, we inquired about the meaning of the down low. The respondents said that being on the down low meant having sex with men and perhaps with women, but being secretive about same-sex sexual behavior.

[b] Based on a score of 2 or greater on the CAGE (Cutting down, Annoyance by criticism, Guilty feeling, and Eye-openers) questionnaire.

[c] Based on a score of 3 or greater on the TCUDS (Texas Christian University Drug Screen) questionnaire.

Table 2

Physical Activity by Intervention Condition and Assessment Period, African American Men, Philadelphia, PA, 2008-2011.

Variable	Baseline	6-Month	12-Month
Mean (SD) weighted average physical activity [a] in the past 7 days (days)			
Health Intervention	2.17 (0.10)	2.53 (0.11)	2.59 (0.12)
HIV/STI Intervention	2.22 (0.10)	2.43 (0.12)	2.19 (0.11)
Mean (SD) average aerobic physical activity [b] in the past 7 days (days)			
Health Intervention	2.33 (0.11)	2.75 (0.13)	2.82 (0.13)
HIV/STI Intervention	2.40 (0.11)	2.59 (0.13)	2.30 (0.12)
Mean (SD) vigorous-intensity activity in the past 7 days (days)			
Health Intervention	2.15 (0.12)	2.72 (0.13)	2.71 (0.13)
HIV/STI Intervention	2.15 (0.12)	2.50 (0.13)	2.17 (0.12)
Mean (SD) moderate-intensity activity in the past 7 days (days)			
Health Intervention	2.52 (0.14)	2.79 (0.14)	2.93 (0.14)
HIV/STI Intervention	2.65 (0.13)	2.68 (0.14)	2.43 (0.13)
Mean (SD) strength-building activity in the past 7 days (days)			
Health Intervention	1.75 (0.12)	1.95 (0.12)	2.02 (0.13)
HIV/STI Intervention	1.76 (0.11)	2.04 (0.13)	1.93 (0.12)

Note.

[a] The weighted average physical activity in the past 7 days was calculated as $(\frac{\text{days of vigorous activity}+\text{days of moderate activity}}{2}*5+\text{days of strength building activity}*2)/7$

[b] The average aerobic physical activity was calculated by averaging the number of days for vigorous-intensity activity and moderate-intensity activity.

Table 3

GEE Empirical Significance Tests for the Intervention Effects on Physical Activity Unadjusted for Baseline Prevalence and Adjusted for Baseline Prevalence, African American Men, Philadelphia, PA, 2008-2011.

	Unadjusted for Baseline		Adjusted for Baseline	
Outcome	**Estimate (95% CI)**	**P value**	**Estimate (95% CI)**	**P value**
Weighted average physical activity [a] in the past 7 days	0.24 (-0.03, 0.51)	.077	0.25 (0.01, 0.49)	.041
Average aerobic activity [b] in the past 7 days	0.34 (0.05, 0.63)	.022	0.35 (0.08, 0.61)	.010
Vigorous-intensity activity in the past 7 days	0.38 (0.08, 0.68)	.013	0.36 (0.09, 0.63)	.009
Moderate-intensity activity in the past 7 days	0.30 (-0.01, 0.62)	.055	0.33 (0.04, 0.62)	.027
Strength-building activity in the past 7 days	0.002 (-0.28, 0.29)	.991	0.01 (-0.24, 0.26)	.942

Note. The GEE model included intervention (physical activity versus control), follow-up time (6 versus 12 month), and baseline of the outcome (the latter excluded from the unadjusted model). Estimate is mean difference (physical activity intervention – control intervention) and CI is confidence interval.

[a] The weighted average physical activity in the past 7 days was calculated as

$$\left(\frac{\text{days of vigorous activity}+\text{days of moderate activity}}{2}*5+\text{days of strength building activity}*2\right)/7$$

[b] The average aerobic physical activity was calculated by averaging the number of days for vigorous-intensity activity and moderate-intensity activity.

Table 4

Pearson product-moment correlations (significance probabilities) among theoretical variables measured immediately post-intervention, African American Men, Philadelphia, PA 2008-2011.

Construct	1	2	3	4	5
1. Attitude	1.00				
2. Subjective norm	.783 (<.0001)	1.00			
3. Descriptive norm	.124 (.003)	.181 (<.0001)	1.00		
4. Self-efficacy	.701 (<.0001)	.717 (<.0001)	.271 (<.0001)	1.00	
5. Intention	.659 (<.0001)	.730 (<.0001)	.274 (<.0001)	.839 (<.0001)	1.00