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Mediation of Effects of a Theory-Based Behavioral Intervention on Self-Reported Physical Activity in South African Men

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Abstract

Objective—Increasing physical activity is an important public-health goal worldwide, but there are few published mediation analyses of physical-activity interventions in low-to-middle-income countries like South Africa undergoing a health transition involving markedly increased mortality from non-communicable diseases. This article reports secondary analyses on the mediation of a theory-of-planned-behavior-based behavioral intervention that increased self-reported physical activity in a trial with 1,181 men in Eastern Cape Province, South Africa.

Method—Twenty-two matched-pairs of neighborhoods were randomly selected. Within pairs, neighborhoods were randomized to a health-promotion intervention or an attention-matched control intervention with baseline, immediate-post, and 6- and 12-month post-intervention assessments. Theory-of-planned-behavior constructs measured immediately post-intervention were tested as potential mediators of the primary outcome, self-reported physical activity averaged over the 6- and 12-month post-intervention assessments, using a product-of-coefficients approach in a generalized-estimating-equations framework. Data were collected in 2007–2010.

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Results—Attitude, subjective norm, self-efficacy, and intention were significant mediators of intervention-induced increases in self-reported physical activity. The descriptive norm, not affected by the intervention, was not a mediator, but predicted increased self-reported physical activity.

Conclusion—The results suggest that interventions targeting theory-of-planned-behavior constructs may contribute to efforts to increase physical activity to reduce the burden of non-communicable diseases among South African men.

Keywords

Mediation; Physical activity; Theory of planned behavior; South Africa; Men; Cluster-randomized controlled trial; Intervention study

Increased physical activity is an important public health goal worldwide, both in developed countries and increasingly in developing countries, as a strategy to reduce rates of chronic non-communicable diseases (NCDs), including type 2 diabetes (Jefferis et al., 2012), heart disease (Sattelmair et al., 2011; Tanasescu et al., 2002), stroke (Lee et al., 2003), and colon cancer (Boyle et al., 2012), which have been linked to physical inactivity. Even though the benefits of physical activity are well established, and resolutions to be physically active are abundant, 31% of adults worldwide are physically inactive (Hallal et al., 2012).

Although evidence suggests that physical-activity interventions can be efficacious, studies evaluating their efficacy have not been conducted in all populations that could benefit from them. The large majority of participants in physical-activity intervention trials have been White and female (Waters et al., 2011). Few trials have specifically targeted adult men (George et al., 2012) or adults in developing countries like South Africa that are undergoing a health transition involving markedly increased NCD-mortality rates, especially among men (Cecchini et al., 2010; Mayosi et al., 2009; Mayosi et al., 2012). One of the few randomized controlled trials (RCTs) of a health-promotion intervention in South Africa found that the intervention did not increase physical activity compared with a control group (Edries et al., 2013).

Many physical-activity interventions have been based upon behavior-change theories; accordingly, there is growing interest in whether the theoretical constructs the interventions targeted were mediators, variables the interventions changed that, in turn, changed behavior (Fjeldsoe et al., 2013; Lubans et al., 2008; Plotnikoff et al., 2014; Rhodes and Pfaeffli, 2010). Mediation analyses (Baron and Kenny, 1986; MacKinnon et al., 2002) of efficacious interventions can suggest ways to improve the interventions' efficacy by remediating the interventions℉ failure to change targeted constructs or their efficiency by removing ineffective components, making the resulting interventions more cost-effective. Mediation analyses of ineffective interventions are also valuable, for they can identify reasons why the interventions failed to change behavior (Baruth et al., 2010; Lubans et al., 2009).

The "Men Together Making a Difference" health-promotion intervention aimed to increase physical activity and other healthful behaviors among South African men. The efficacy of the intervention was tested in a cluster-RCT. Randomly selected neighborhoods were

randomized to the Men Together Making a Difference health-promotion intervention or a HIV/STI risk-reduction intervention, which in this article serves as an attention-matched control group. The health-promotion intervention was developed based on the theory of planned behavior (Ajzen, 1991; Armitage and Conner, 2001; Hagger et al., 2002; McEachan et al., 2011), a theory selected for its ease of adaptation to different cultures and behaviors (Jemmott, 2012) and its utility in efficacious interventions (Darker et al., 2010; Montanaro and Bryan, 2014; Plotnikoff et al., 2014; Zhang et al., 2009), including interventions in South Africa (Heeren et al., 2013; Jemmott et al., 2011; Jemmott et al., 2014c). The health-promotion intervention significantly increased self-reported adherence to physical-activity guidelines averaged over the 6- and 12-month post-intervention assessments, which was the primary outcome, compared with the attention-control group (Jemmott et al., 2014a).

The primary purpose of this article is to report secondary analyses to identify the theory-of-planned-behavior constructs that mediated the intervention's effects. According to the theory of planned behavior (Ajzen, 1991), attitude toward the behavior, subjective norm regarding the behavior, and perceived behavior control or self-efficacy to perform the behavior (Bandura, 1997; Fishbein and Ajzen, 2010) determine intention, and intention determines behavior. Research suggests that descriptive norms should be included along with subjective norms as a predictor of intention (Fishbein and Ajzen, 2010; Rivis and Sheeran, 2003). We hypothesized that theory-of-planned-behavior constructs, particularly attitude toward physical activity, subjective norm regarding physical activity, and self-efficacy for physical activity, which the intervention targeted, would mediate the intervention's effects on self-reported adherence to physical-activity guidelines. In addition, consistent with the structural model the theory of planned behavior specifies, we hypothesized that intention would mediate the effects of the other theoretical constructs on self-reported adherence.

Methods

The University of Pennsylvania's Institutional Review Board (IRB) #8, the designated IRB under the federalwide assurance of the University of Pennsylvania and the University of Fort Hare, approved this study, which was conducted in Eastern Cape Province, South Africa, where more than 98% of the residents are Black Africans whose first language is isiXhosa. We identified 206 neighborhoods defined as geographical clusters tied to census data in the catchment area, created 103 matched pairs of neighborhoods similar on population size and the percentage isiXhosa-speaking, married, male, unemployed, and living in informal dwellings, and randomly selected 22 pairs.

In a cluster-RCT, we used computer-generated random number sequences to randomize the neighborhoods within pairs to the health-promotion intervention or an attention-matched control intervention, using concealment of allocation techniques designed to minimize bias in assignment. The biostatistician conducted the computer-generated random assignments, and the project director implemented the assignments. We enrolled the neighborhoods during a 25-month period beginning in November 2007, with all data collection completed by December 2010.

As described in more detail elsewhere (Jemmott et al., 2014b), we recruited men at different hours of the day and days of the week at a variety of venues (e.g., taxi ranks, streets, marketplaces, shebeens [informal drinking establishments]) to reach a diversity of men. At the time of recruitment, potential participants and recruiters were blind to the neighborhood's randomized intervention condition, and recruiters followed a common, standardized scripted protocol. Eligibility criteria were based on the HIV/STI risk-reduction intervention (Jemmott et al., 2014b), which was the primary intervention the trial was designed to test. Men aged 18 to 45 years living in a selected neighborhood, reporting sex in the previous 3 months, not reporting plans to relocate beyond a reasonable distance from the study site within the next 15 months, and either having a photo ID or being willing to have their picture taken for identification purposes, were eligible. We enrolled men who completed the baseline questionnaire and returned the subsequent week for intervention session 1. We conducted data-collection and intervention sessions at the University of Fort Hare in East London and provided transportation to the sessions.

Interventions

We developed the interventions based on the theory of planned behavior (Ajzen, 1991) and extensive formative research (Wainberg et al., 2007), including 15 focus groups and 4 pilot tests of the interventions with the target population, as well as the social cognitive theory (Bandura, 1986). The theory of planned behavior guided the formative research to elicit the population-specific beliefs relevant to attitude, subjective norm, and perceived behavioral control or self-efficacy and provided the structural model for how the theoretical constructs would together affect behavior. The social cognitive theory suggested strategies to increase self-efficacy and skill required to perform a behavior, including guided practice with performance accomplishments providing reward and observational learning or vicarious experience, for instance, through having participants view specially designed videos depicting men similar to them engaging in the targeted behaviors.

Each intervention consisted of six 75-min modules, with 2 modules delivered during each of 3 sessions in 3 consecutive weeks. Each intervention was highly structured and implemented in a small group of 9 to 15 men led by a male facilitator using standardized manuals. We translated the interventions into isiXhosa, back-translated them from isiXhosa to English, pilot tested them in isiXhosa, and delivered them in isiXhosa in the trial. Each intervention included interactive exercises, games, brainstorming, role-playing, take-home assignments, group discussions, and videos, produced specifically for the interventions, filmed in authentic township settings, including a shebeen.

We designed the health-promotion intervention to increase knowledge, attitudes, perceived behavioral control or self-efficacy (Fishbein and Ajzen, 2010), and skills to practice healthful behaviors, including increasing physical activity and fruit-and-vegetable consumption and limiting fat and alcohol intake, behaviors linked to risk of heart disease, hypertension, stroke, diabetes, and certain cancers—leading causes of morbidity and mortality among South Africans (Alberts et al., 2005; Asfaw, 2006; Joubert et al., 2007; Schneider et al., 2007). Each session began with "Circle of Men," an activity designed to increase the subjective norm in which the men could express their thoughts and feelings in a

fellowship of Xhosa men where age, education, or profession did not matter, but a bond as brothers was important. A brainstorming activity, also designed to affect the subjective norm, explored what it means to be a man and how men together can make a difference in protecting themselves, their families, and their communities against health problems. A powerful activity, “Diseases that Impact South African Men and Their Home,” addressed attitudes toward health behaviors by illuminating the devastating effect health problems can have on home and family. Participants used their creativity to construct the best house they could fashion from shoeboxes and contact paper. Then, to their surprise, the facilitator directed them to destroy it with a brick bearing the label “heart disease,” “stroke,” “hypertension,” or “diabetes.”

A video magazine, “The Subject is: Health,” designed to influence attitude and self-efficacy regarding physical activity and other healthful behaviors, included a storyline about Khusela, a man approximately 40 years of age, just home from the hospital after a stroke, who makes healthful behavior changes with the help of his family and friends. Khusela addressed beliefs and barriers regarding physical activity identified in focus groups, including lack of will power, interest, time, and physical ability and how men can exercise in their township neighborhood and home. Another character, Phil, a younger man, informed by a nurse that he is at increased risk for hypertension and heart disease is shown with a couple of friends going for a run through the township, saying how at first he could run for only 10 minutes but now runs for 45 minutes. He talks about how running has helped him lose weight, clear his head from stress, and feel better. The video depicted men doing a variety of physical activities, including aerobic exercises (running, football, boxing, and aerobics) and strength-building exercises (push-ups, weight lifting, crunches, and squats).

We encouraged participants to engage in a combination of aerobic and strength-building exercises each week: (1) at least 30 min of moderate-intensity aerobic activity on 5 days or at least 20 minutes of vigorous-intensity aerobic activity on 4 days and (2) strength-building activity on at least 2 days (Department of Health and Human Services, 2008). Participants built self-efficacy and skills during the sessions by engaging in moderate-intensity and vigorous-intensity aerobic, strength-building, and flexibility-increasing physical activities in concert with an exercise video. The exercise video depicted three levels of intensity at which the men could participate depending on their degree of fitness, with the lowest level involving exercising while sitting in a chair. Because self-efficacy is confidence in the ability to perform a behavior, despite obstacles, an important element of the intervention was brainstorming, termed “coping planning” in a behavior-change technique taxonomy (Michie et al., 2013), to identify the participants’ barriers to exercising, commonly including lack of motivation, interest, time, and physical ability, and concrete ways they could surmount them.

The HIV/STI risk-reduction intervention served as an attention-matched control, providing a control for “Hawthorne effects,” reducing the likelihood that the health-promotion intervention’s effects can be attributed to non-specific features, including group interaction and special attention (Cook and Campbell, 1979). Also implemented by male facilitators, it was structurally similar, containing activities similar to the health-promotion intervention but focused on reducing sexual-risk behaviors (Jemmott et al., 2014b).

The facilitators were 17 men aged 25 to 53 years (mean = 38.9), bilingual in English and isiXhosa, having at least a high school diploma, including 7 who had at least a bachelor's degree, and having previously implemented life skills or HIV curricula. We randomly assigned them to six 8-hour days of training to implement 1 of the 2 interventions; hence, randomizing facilitators' characteristics across interventions (Jemmott et al., 1998). During the training, the trainers demonstrated the intervention activities and stressed the importance of implementation fidelity. Facilitators learned their intervention and practiced implementing it, with feedback.

Measures

We employed audio computer-assisted self-interviewing (ACASI), which provided audio and video presentations of the questions and response options on a computer, to collect data before, immediately post-intervention, and 6 and 12 months post-intervention. The measures, which had been pilot tested with over 250 men, were available in isiXhosa (following translation and back translation from English), English, and a combination of isiXhosa (audio) and English (visual).

Physical activity was assessed with 3 items the Centers for Disease Control and Prevention (Centers for Disease Control and Prevention, 2001) developed concerning the number of days on which people participate in vigorous-intensity aerobic physical activity for at least 20 minutes, moderate-intensity aerobic physical activity for at least 30 minutes, and strength-building physical activity in the previous 7 days. The *a priori* primary outcome was a binary variable (El-Bassel et al., 2011; Jemmott et al., 2011) indicating whether participants met the guideline of engaging in strength-building activity on 2 or more days and engaging in either 20 minutes of vigorous-intensity activity on at least 4 days or 30 minutes of moderate-intensity activity on at least 5 days (Department of Health and Human Services, 2008).

Table 1 includes the items comprising the measures of potential mediators and the corresponding coefficient alphas. Each measure was previously used in a prospective study with African American men (Jemmott and Heeren, 2009), 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].

The participants also completed measures of HIV sexual-risk behaviors (Jemmott et al., 2014b) and theoretical mediators of such behaviors (O'Leary et al., 2014), sociodemographic variables (Heeren et al., 2014), and problem alcohol consumption (Icard et al., 2014).

Statistical Analysis

Because the primary outcome paper analyzed the outcome averaged over the 6- and 12-month follow-up, the mediation analysis also examines the outcome averaged over the 6 and 12 months. Averaging the outcomes from the two follow-ups increases statistical power to

test hypotheses, is more parsimonious, and allays concerns about multiple testing compared with the alternative of conducting separate analyses at individual follow-ups. We performed two sets of mediation analyses, single-mediator analyses on each potential mediator and serial mediation analyses on all potential mediators simultaneously. All analyses used the product-of-coefficients approach (MacKinnon et al., 2002). In the single-mediator models, α denotes the intervention's effect on the potential mediator at the immediate post-intervention assessment, and β denotes the relation of a potential mediator to the outcome adjusted for the intervention.

We estimated a serial mediation model, considering parallel and sequential mediators simultaneously (Hayes, 2013), based on the theory of planned behavior. With three stages of mediation rather than the two in single-mediator analyses, the intervention was assumed to affect in parallel attitude, the subjective norm, the descriptive norm, and self-efficacy. These four first-stage mediators were then assumed to affect the second-stage mediator, intention, and intention finally was assumed to affect the outcome, adherence to physical activity guideline in the third-stage. Following parallel mediation design, there were four first-stage, α paths that included the intervention and baseline variables as predictors and one of four first stage mediators as the outcome. In the second stage, all four first stage mediators, intervention, and baseline variables were predictors of intentions. We refer to the paths into intentions as β paths. The third-stage included intention, intervention, time (6 months or 12 months), and baseline variables. We refer to third-stage paths as γ paths. The model included 9 indirect paths.

In the single-mediator and serial mediation models, we estimated each path using generalized-estimating-equations (GEE) (Fitzmaurice et al., 2004; Liang and Zeger, 1986) with independence working correlation structures and clusters defined by neighborhood. In the single-mediator models, the $\alpha\beta$ product quantifies the mediated effect of the intervention; in the serial mediation model, the $\alpha\beta\gamma$ product quantifies the mediated effect of the intervention. In each model, mediation is determined by testing whether the product differs significantly from '0'. Because the distribution of products is non-normal, asymmetric 95% confidence intervals (ACI) for the products were calculated using the bootstrap percentile method with resampling by neighborhood (MacKinnon et al., 2004). All analyses were conducted in R version 2.15.1 (The R Project for Statistical Computing, 2012).

Results

Mediation Analyses

Table 2 presents the means and standard errors of the outcomes and the potential mediators by intervention and data-collection period. As shown in Table 3, in the single-mediator models, the $\alpha\beta$ product is significant for 4 of the 5 theoretical constructs, attitude, subjective norm, self-efficacy, and intention, indicating that they were mediators of the health-promotion intervention's effect on self-reported physical activity compared with the HIV/STI intervention. As the significant α paths indicate, the health-promotion intervention increased each of these constructs compared with the HIV/STI intervention. Significant β paths indicate that increases in these constructs predicted higher odds of self-reported

adherence to physical-activity guidelines. Although the intervention did not affect the descriptive norm regarding physical activity, the significant β path for the descriptive norm indicates that men who thought more of their closest friends were exercising had higher odds of self-reported adherence to physical-activity guidelines.

As shown in Table 4, the αβγ products are significant for attitude, the subjective norm, and self-efficacy, indicating that each of these theoretical constructs mediated the intervention's effect on self-reported physical activity through intention. As shown in Figure 1, the intervention increased attitude, the subjective norm, and self-efficacy and increases in these constructs were associated with an increased intention to engage in physical activity, which, in turn, was associated with increased self-reported adherence to physical activity guidelines. The significant β path for the descriptive norm indicates that men who thought more of their closest friends were exercising had firmer intentions for physical activity.

Discussion

The Men Together Making a Difference health-promotion intervention had a significant effect, causing improvements in self-reported adherence to physical-activity guidelines among South African men during a 12-month post-intervention period compared with an attention-matched control group. The present results clarify the mediation of that effect. In the single-mediator models, four constructs from the theory of planned behavior, the theory on which the intervention was based, attitude, subjective norm, self-efficacy, and intention, mediated the intervention-induced increases in self-reported adherence to physical-activity guidelines. Another theory-of-planned-behavior construct, the descriptive norm, not significantly increased by the intervention, was related to increased self-reported adherence to physical-activity guidelines but did not mediate the intervention's effect.

The serial mediation model provided support for the theory of planned behavior as a structural model of mediation. According to the theory (Ajzen, 1991), attitude toward the behavior, subjective norm regarding the behavior, and perceived behavior control or self-efficacy to perform the behavior (Bandura, 1997; Fishbein and Ajzen, 2010) determine intention, and intention determines behavior. The theory further states that the effects of all other variables are mediated through intentions: that is, no other variables have direct effects on behavior (Ajzen, 1991). Consistent with the theory, our results suggest that the intervention increased attitude, the subjective norm, and self-efficacy, which increased intention, which in turn increased physical activity. Tests of alternative models (not shown) did not reveal any mediating effects of attitude, the subjective norm, the descriptive norm, or self-efficacy on physical activity without going through intention.

Our findings are consonant with previous research that has examined cognitive mediators of physical-activity interventions and extends such research to South African men. For instance, trials have found that intention mediated the effects of physical-activity interventions among breast-cancer survivors (Vallance et al., 2008) and among women with type 2 diabetes (Plotnikoff et al., 2014). In addition, our finding that self-efficacy was a mediator is consonant with the results of mediation analyses of physical-activity intervention trials on a diversity of populations, including overweight adults living with hypertension

(Burke et al., 2008), women with type 2 diabetes (Plotnikoff et al., 2014), and older sedentary adults (Darker et al., 2010; McAuley et al., 2003). In contrast to our findings, two trials found that attitude and subjective norms did not mediate the efficacy of physical-activity interventions (Darker et al., 2010; Plotnikoff et al., 2014).

The present study has several strengths. Behavior-change theory integrated with formative research with South African men guided the intervention's development and the identification of potential mediators, ensuring both theoretical grounding and cultural appropriateness. We used the product-of-coefficients approach to mediation (MacKinnon et al., 2002), which is more powerful than the widely used steps approach (Baron and Kenny, 1986). To our knowledge, this is the first trial to report a serial mediation analysis of the theory of planned behavior as a structural model of an intervention's efficacy. We achieved excellent retention and intervention-attendance rates. We randomly selected matched pairs of neighborhoods and within pairs randomized neighborhoods to interventions, increasing external validity and internal validity.

Limitations of the study also should be considered. Although the use of ACASI is associated with more accurate responding (Hewett et al., 2004; Metzger et al., 2000; Turner et al., 1998; Waruru et al., 2005), we did rely on self-reports to evaluate the intervention's efficacy. The use of objective data such as accelerometer data or field tests of physical fitness might have strengthened confidence in the findings. Another limitation is that the results may not generalize to all South African men. A limitation of the mediation analyses is that they are correlational; evidence from factorial experiments manipulating intervention components and putative mediators would be more cogent, though admittedly difficult to implement in practice (MacKinnon, 2008).

Conclusions

In conclusion, theory-based, culturally appropriate interventions can be implemented with South African men and such interventions can increase their self-reported adherence to physical-activity guidelines. South African men were willing to attend multiple intervention sessions and to return for follow-up data-collections sessions over a 1-year period. The theory of planned behavior, a theory developed in the West, when integrated with formative research with the target population, provides a useful framework for physical-activity-intervention development in South Africa. In contrast to a recent editorial (Sniehotta et al., 2014) containing flawed arguments and a skewed literature review (Ajzen, 2014), the present study highlights the theory's utility. The theory-of-planned-behavior constructs, attitude, subjective norm, self-efficacy, and intention, were significant mediators of the intervention's effect: Each was changed by the intervention; each was related to increased self-reported adherence to physical-activity guidelines. Moreover, although the descriptive norm, the man's belief that his closest friends were exercising, was not changed by the intervention, it was related to physical activity in the single-mediator model and to intention in the serial mediation model, which suggests that targeting the descriptive norm, perhaps by including men and their closest friends in the intervention, would be a way to enhance the efficacy of physical-activity interventions for South African men. More generally, interventions designed using Western behavior-change theories adapted to the local setting

can be fruitfully applied in South Africa. Implementing such interventions may help stem the increasing burden of NCDs (Cecchini et al., 2010; Mayosi et al., 2009; Mayosi et al., 2012) in South Africa and perhaps in other developing countries.

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Highlights

- A large percentage of South African men are physically inactive.
- Our intervention based on the theory of planned behavior aimed to remedy that.
- It increased self-reported adherence to physical-activity guidelines.
- Attitude, subjective norm, self-efficacy, and intention were significant mediators.
- Serial mediation analysis supports the theory of planned behavior structural model.

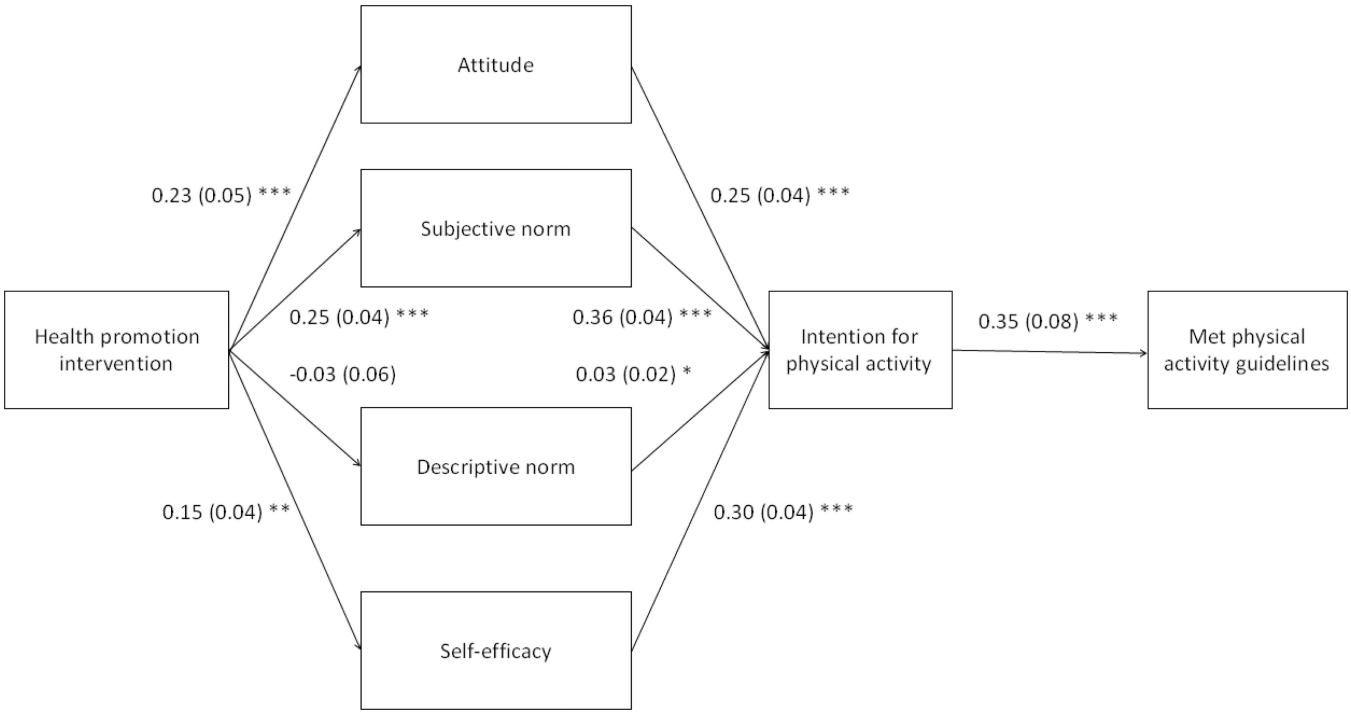

Figure 1.

Estimated paths (SE) from a theory-of-planned-behavior serial mediation model of the effect of the health-promotion intervention on theoretical constructs and adherence to physical-activity guidelines, averaged over 6- and 12-month post-intervention assessments, Eastern Cape Province, South Africa, 2007–2010. *p < .05; **p < .001; ***p < .0001.

Table 1

Measures of theoretical constructs regarding physical activity.

Alpha	Items
.90	Attitude toward physical activity
	How foolish or wise would it be to exercise for 30 minutes at least 6 times a week in the next 6 months?
	How unpleasant or pleasant would it be to exercise for 30 minutes at least 6 times a week in the next 6 months?
	How harmful or beneficial would it be to exercise for 30 minutes at least 6 times a week in the next 6 months?
	Physical activity subjective norm
.94	Most people who are important to me would think it is okay for me to exercise for 30 minutes at least 6 times a week in the next 6 months
	Most people who are important to me would think I should exercise for 30 minutes at least 6 times a week in the next 6 months.
	Most people who are important to me would want me to exercise for 30 minutes at least 6 times a week in the next 6 months.
	Physical activity descriptive norm
	How many of your 5 closest friends exercise for 30 minutes at least 6 times a week?
.71	Physical activity self-efficacy
	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.
	I am sure that I can exercise for 30 minutes at least 6 times a week in the next 6 months.
.93	Physical activity intention
	I plan to exercise for 30 minutes at least 6 times a week in the next 6 months.
	My goal is 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.

Note. Items were rated on 5-point scales with labeled endpoints with the exception of the descriptive norm, which was measured on 4-point scales with labeled endpoints.

Table 2

Self-Reported Physical Activity and Potential Mediators by Intervention Condition and Assessment Period, Eastern Cape Province, South Africa, 2007–2010.

	Baseline		Post		6 months	
Outcome, N (%) Mediators, Mean +/−SE	**Health Promotion (N=572)**	**HIV/STI (N=609)**	**Health Promotion (N=562)**	**HIV/STI (N=596)**	**Health Promotion (N=535)**	**HIV/STI (N=558)**
Met Physical Activity Guidelines	238 (41.6)	264 (43.4)	-	-	270 (50.5)	265 (47.5)
Physical Activity Attitude	3.74 ± 0.04	3.79 ± 0.04	4.14 ± 0.04	3.96 ± 0.04	4.09 ± 0.04	4.08 ± 0.04
Physical Activity Subjective Norm	3.63 ± 0.04	3.65 ± 0.04	4.04 ± 0.04	3.83 ± 0.04	3.99 ± 0.04	3.97 ± 0.04
Physical Activity Descriptive Norm	2.08 ± 0.04	2.19 ± 0.04	2.29 ± 0.04	2.37 ± 0.04	2.42 ± 0.04	2.48 ± 0.04
Physical Activity Self-Efficacy	3.67 ± 0.04	3.77 ± 0.04	4.04 ± 0.04	3.93 ± 0.04	3.96 ± 0.04	3.96 ± 0.04
Physical Activity Intention	3.68 ± 0.04	3.74 ± 0.04	4.07 ± 0.04	3.88 ± 0.04	4.02 ± 0.04	3.97 ± 0.04

Table 3

GEE Single-Mediator Analyses of Intervention Effects (Health Promotion versus Attention Control) on Self-Reported Adherence to Physical Activity Guidelines Averaged Over 6 and 12 months Post-Intervention Assessments, Eastern Cape Province, South Africa, 2007–2010.

	α-path			β-path				αβ		
	α	SE	95% CI	β	SE	OR	95% CI	αβ	SE	95% ACI
Attitude	0.214	0.047	0.121, 0.306	0.353	0.060	1.424	1.265, 1.602	0.076	0.021	0.039, 0.120
Subjective Norm	0.226	0.046	0.136, 0.316	0.270	0.063	1.309	1.158, 1.481	0.061	0.018	0.03, 0.100
Descriptive Norm	−0.031	0.059	−0.146, 0.083	0.328	0.051	1.388	1.256, 1.535	−0.010	0.020	−0.05, 0.028
Self-Efficacy	0.148	0.039	0.071, 0.225	0.283	0.072	1.327	1.153, 1.528	0.042	0.016	0.015, 0.076
Intention	0.222	0.041	0.142, 0.303	0.297	0.071	1.346	1.170, 1.548	0.066	0.021	0.031, 0.114

Note. The α-path is the effect of the health promotion intervention (mean difference compared with the attention-control) on the potential mediator adjusted for the baseline of physical activity and the potential mediator. The β-path is relation of the potential mediator to physical activity adjusted for the intervention and the baseline of physical activity and the potential mediator. The αβ product is the indirect or mediated effect. ACI is the asymmetric confidence interval for the αβ product by bootstrap percentile method using 2,000 bootstrap iterations.

Table 4

GEE Serial Mediation Analysis of Intervention Effects (Health Promotion versus Attention Control) on Self-Reported Adherence to Physical Activity Guidelines Averaged Over 6 and 12 months Post-Intervention Assessments, Eastern Cape Province, South Africa, 2007–2010.

	α-path			β-path			γ-path			αβγ	
	α	SE	P value	β	SE	P value	γ	SE	P value	αβγ	95% ACI
Attitude	0.23	0.05	<.0001	0.25	0.04	<.0001				0.019	0.008, 0.035
Subjective Norm	0.25	0.04	<.0001	0.36	0.04	<.0001				0.031	0.017, 0.047
Descriptive Norm	−0.03	0.06	.6474	0.03	0.02	.0391				0.000	−0.002, 0.001
Self-Efficacy	0.15	0.04	.0004	0.30	0.04	<.0001				0.015	0.005, 0.029
Intention							0.35	0.08	<.0001		

Note. The α-paths are the effects of the health promotion intervention (mean difference compared with the attention-control) on the potential mediators except intention adjusted for the baseline of physical activity and the potential mediators. The β-paths are the relations of the potential mediators to intention adjusted for the intervention and the baseline of physical activity and the potential mediator. The γ path is the relation of intention to physical activity adjusted for the intervention and the baseline of physical activity and intention. The αβγ product is the indirect or mediated effect. ACI is the asymmetric confidence interval for the αβγ product by bootstrap percentile method using 2,000 bootstrap iterations.