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Theory-Based Behavioral Intervention Increases Self-Reported Physical Activity in South African Men: A Cluster-Randomized Controlled Trial

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Abstract

Objective—To determine whether a health-promotion intervention increases South African men's adherence to physical-activity guidelines.

Method—We utilized a cluster-randomized controlled trial design. Eligible clusters, residential neighborhoods near East London, South Africa, were matched in pairs. Within randomly selected pairs, neighborhoods were randomized to theory-based, culturally congruent health-promotion intervention encouraging physical activity or attention-matched HIV/STI risk-reduction control

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The authors declare that there are no conflicts of interest.

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intervention. Men residing in the neighborhoods and reporting coitus in the previous 3 months were eligible. Primary outcome was self-reported individual-level adherence to physical-activity guidelines averaged over 6-month and 12-month post-intervention assessments. Data were collected in 2007–2010. Data collectors, but not facilitators or participants, were blind to group assignment.

Results—Primary outcome intention-to-treat analysis included 22 of 22 clusters and 537 of 572 men in the health-promotion intervention and 22 of 22 clusters and 569 of 609 men in the attention-control intervention. Model-estimated probability of meeting physical-activity guidelines was 51.0% in the health-promotion intervention and 44.7% in attention-matched control (OR = 1.34; 95% CI, 1.09–1.63), adjusting for baseline prevalence and clustering from 44 neighborhoods.

Conclusion—A theory-based culturally congruent intervention increased South African men's self-reported physical activity, a key contributor to deaths from non-communicable diseases in South Africa.

Trial registration—ClinicalTrials.gov Identifier: NCT01490359.

Physical activity is an important protective factor for a range of chronic non-communicable diseases (NCDs), including heart disease (Sattelmair et al., 2011; Tanasescu et al., 2002), stroke (Lee et al., 2003), type 2 diabetes (Jefferis et al., 2012), colon cancer (Boyle et al., 2012), and all-cause mortality (Samitz et al., 2011; Wen et al., 2011). Indeed, an estimated 6 to 10% of all deaths from NCDs worldwide can be attributed to physical inactivity (Lee et al., 2012). Yet, worldwide, 31% of adults are physically inactive (Hallal et al., 2012). Troublingly high rates of physical inactivity are evident not only in developed countries like the United States, where 32% of adults are physically inactive (Schiller et al., 2012), but also in developing countries like South Africa undergoing a health transition involving marked increases in mortality rates from NCDs, particularly among men (Cecchini et al., 2010; Mayosi et al., 2009; Mayosi et al., 2012). In South Africa, 45% of adults are physically inactive (Guthold et al., 2008), NCDs account for 29% of deaths (World Health Organization, 2011), and physical inactivity accounts for 30% of heart disease, 27% of colon cancer, 27% of stroke, and 20% of type 2 diabetes cases (Joubert et al., 2007).

Few randomized controlled trials (RCTs) of physical-activity interventions for South African adults have been published despite the high prevalence of physical inactivity and its consequences. Moreover, although literature reviews have revealed that physical-activity interventions can be efficacious and cost effective (Avery et al., 2012; Foster et al., 2013; Garrett et al., 2011; Heath et al., 2012; Muller-Riemenschneider et al., 2008; Orrow et al., 2012), 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). Although there have been numerous calls for interventions to increase physical activity among South Africans (Cecchini et al., 2010; Joubert et al., 2007; Mayosi et al., 2009; Mayosi et al., 2012; Pillay et al., 2012; Skaal and Pengpid, 2011; Temple, 2007), to our knowledge, only two RCTs testing physical-activity interventions in South Africa have been published. One focused on young adolescents (Jemmott et al., 2011); 90% of participants in the other were women (Edries et al., 2013). Besides physical inactivity, a high prevalence of other modifiable risk factors for NCDs, including high fat intake (Bourne et al., 2002), insufficient fruit-and-vegetable consumption (World Health Organization, 2013), and obesity (World Health Organization, 2011) has been documented among South Africans.

Here we report the efficacy of an intervention to increase physical activity among men in Eastern Cape Province, South Africa. The intervention, developed based on behavior-change theories (Ajzen, 1985; Bandura, 1986) integrated with extensive formative research with the target population (Wainberg et al., 2007) to ensure that it was culturally congruent, was tested using a cluster-RCT design to reduce the potential for contamination between treatment arms. Randomly selected neighborhoods were randomized to a health-promotion intervention designed to increase physical activity and other NCD-linked behaviors or a HIV/STI risk-reduction intervention, which served as the attention-control group. We hypothesized that the health-promotion intervention would increase individual-level physical activity during the 12-month post-intervention period, the primary outcome, compared with the attention-control group, controlling for baseline physical activity.

Methods

Institutional review board (IRB) #8 at the University of Pennsylvania, the designated IRB under the federalwide assurance of the University of Pennsylvania and the University of Fort Hare, approved the study. Neighborhoods, defined as geographical clusters tied to census data, were eligible if they were residential and located in the catchment area, townships and a semi-rural area near East London 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, created 103 matched-pairs similar on population size and the percentage isiXhosa-speaking, married, male, unemployed, and living in informal dwellings, and randomly selected 22 matched-pairs.

In a cluster-RCT, computer-generated random number sequences were used to randomize one neighborhood within each pair to the health-promotion intervention and the other to a HIV/STI risk-reduction intervention, which served as the attention-matched control, 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. Neighborhoods were enrolled during a 25-month period beginning in November 2007, with all data collection completed by December 2010.

Before recruiting from a neighborhood, the researchers met with community leaders to enlist their support. Then a meeting was held to inform men about the study, and the study was advertised using posters and other materials. Eligibility criteria were based on the HIV/STI risk-reduction intervention, which was the primary intervention the trial was designed to test (Jemmott et al., 2014). Men ages 18 to 45 years living in a selected neighborhood, reporting vaginal intercourse in the previous three 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. To ensure a diverse sample, men were recruited at different hours of the day and days of the week at a variety of venues, including streets, taxi ranks, marketplaces, and shebeens (Kalichman et al., 2008). At the time of recruitment, community leaders, potential participants, and recruiters were blind to the condition to which the neighborhood had been randomized, and recruiters followed a common, standardized scripted recruitment protocol. Individuals' informed consent, with individuals blind to group assignment, was required for participation. Men who completed the baseline questionnaire and returned the subsequent week for intervention session 1 were enrolled in the trial. After enrollment, data collectors, but not facilitators or participants, were blind to group assignment. Data-collection and intervention sessions were held at a university research center and transportation to the sessions was provided.

Interventions

Developed based on social cognitive theory (Bandura, 1986) and the theory of planned behavior (Ajzen, 1985) integrated with extensive formative research (Wainberg et al., 2007), including 15 focus groups and 4 pilots of the intervention with the target population to ensure cultural congruence, each intervention consisted of six 75-minute modules, with two modules delivered during each of three sessions in three consecutive weeks. Each intervention was individual-level, highly structured and implemented in a small group of 9 to 15 men led by a specially trained male facilitator, bilingual in isiXhosa and English, using standardized manuals. The interventions were translated from English into isiXhosa, back-translated from isiXhosa to English, pilot tested in isiXhosa, and implemented in isiXhosa. Each intervention included interactive exercises, games, brainstorming, role-playing, take-home assignments, group discussions, and videos, the latter produced specifically for the interventions to address beliefs identified in formative research and filmed in township settings, including a shebeen (Kalichman et al., 2008).

The health-promotion intervention was designed to bolster beliefs, attitudes, self-efficacy, and skills to adhere to physical-activity guidelines and 5-a-Day fruit-and-vegetable consumption guidelines and to limit fat and alcohol intake. Each session began with a "Circle of Men" activity, 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 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," highlighted the devastating effect that 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," addressed how good health habits like physical activity, fruit-and-vegetable consumption, and limiting fat and alcohol intake can lead to a longer, healthier life. To build self-efficacy and skills, participants practiced strength-building, flexibility-increasing, and moderate-intensity and vigorous-intensity aerobic physical activity. They were encouraged to engage in a combination of aerobic and strength-building exercise each week: (1) at least 30 minutes of moderate-intensity physical activity on five days or at least 20 minutes of vigorous-intensity physical activity on four days and (2) strength-building activity on at least two days. Participants brainstormed concrete ways to surmount barriers to exercising, including lack of motivation, interest, time, and physical ability, that formative research identified as important.

Activities also addressed outcome expectancies regarding adhering to the 5-a-Day recommendation, defined as consuming five to nine servings of fruits and vegetables daily, and addressed barriers to following it, including the cost, taste, and availability of fresh produce, focus groups suggested. Another activity focused on the “South African Food Plate.” Sources of excess fat, including sauces and fats added in cooking and frying, were covered. Participants learned about body mass index and the association of obesity with heart disease, stroke, hypertension, and diabetes. Sessions 1 and 2 included take-home assignments to reach personally set goals regarding physical activity, diet, and limiting alcohol consumption, which participants and their facilitator reviewed in the subsequent session.

The HIV/STI risk-reduction intervention provided 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 contained activities similar to the health-promotion intervention, but focused on sexual-risk behaviors (Jemmott et al., 2014).

The facilitators were 17 men ages 25 to 53 (mean, 38.9 years) bilingual in English and isiXhosa. All had at least a high school diploma, including seven who had at least a bachelor’s degree; all had previously implemented life skills or HIV curricula. They were randomly assigned to six days of training to implement one of the two interventions; hence, randomizing facilitators’ characteristics across interventions. During the training, the trainers modeled the intervention activities and stressed the importance of implementation fidelity. Facilitators learned their assigned intervention, practiced implementing it, received feedback, and created common responses to potential issues that might arise during implementation.

Assessments

Audio computer-assisted self-interviewing (ACASI) (Langhaug et al., 2010; Metzger et al., 2000), which provided both audio and video presentation of the questions and response options on a laptop computer, was used to collect data before, immediately following, and 6, and 12 months following 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).

Self-reported physical activity was assessed with three 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 activities in the previous seven days. The a priori primary outcome was an individual-level binary variable indicating whether participants met the guideline of engaging in strength-building activity on two or more days and engaging in either 20 minutes of vigorous-intensity activity on at least four days or 30 minutes of moderate-intensity activity on at least five days (Department of Health and Human Services, 2008). Secondary outcomes included the reported number of days of moderate-aerobic, intensive-aerobic, and strength-building activity in the previous seven days.

The 7-item food frequency questionnaire the National Cancer Institute developed for 5-a-Day studies was used to assess self-reported fruit and vegetable consumption (Thompson and Byers, 1994). Three items concerned fruit consumption; four concerned vegetable consumption (Campbell et al., 1999). We calculated total intake excluding fried potatoes, an item sometimes excluded from vegetable-intake indices (Campbell et al., 2009; Krebs-Smith et al., 1995), an item we analyzed separately. A binary variable indicated whether participants met the 5-a-Day recommendation of consuming five or more servings of fruit and vegetables daily in the previous 30 days. Other outcomes included number of daily servings of fruits, vegetables, and fruits and vegetables combined. Participants also reported the number of days that they binged on alcohol (had five or more drinks on an occasion) in the previous 30 days and completed measures of sociodemographic variables, problem alcohol consumption (the CAGE) (Ewing, 1984), theoretical mediator variables, and HIV sexual-risk behaviors.

As compensation, participants received R100 ($13) grocery-store vouchers immediately post-intervention and 6 and 12 months post-intervention, a cap with study logo immediately post-intervention, a t-shirt with study logo 6 months post-intervention, and a jersey 12 months post-intervention.

Statistical Analysis

Sample size and power for this trial, based on the HIV/STI risk-reduction intervention, are described elsewhere (Jemmott et al., 2014). The a priori unit of inference was the individual. Chi-square and t tests were used to analyze attrition. The efficacy of the health-promotion intervention compared with the HIV/STI risk-reduction intervention over the 6- and 12-month follow-ups was tested using a logistic or linear generalized-estimating-equation (GEE) model, depending on the type of outcome variable (binary or continuous), properly adjusting for longitudinal repeated measurements on men clustered within neighborhoods (Fitzmaurice et al., 2004; Liang and Zeger, 1986) and controlling for baseline measure of the criterion. The models were fit and contrast statements specified to obtain estimated odds ratios for binary outcomes and mean differences for continuous outcomes, and their corresponding 95% confidence intervals. Robust standard errors were used and an independent working correlation matrix was specified.

The models included time-independent covariates, baseline measure of the criterion, intervention condition, and time (two categories representing 6- and 12-month follow-up). Estimated average intervention effects over the two follow-ups, constructed from appropriate ‘estimate’ statements from fitted GEE models, are reported. Models assessing whether the efficacy of the intervention differed between the two follow-ups included the baseline measure of the criterion, intervention condition, time, and the Intervention-

Condition x Time interaction. The analyses were performed using an intent-to-treat mode with participants analyzed based on their intervention assignment, regardless of the number of intervention or data-collection sessions attended. Analyses were completed using SAS V9.

Results

Table 1 presents characteristics of the neighborhoods and participants by condition. There were 572 men in the 22 neighborhoods randomized to the health-promotion intervention and 609 in the 22 neighborhoods randomized to the HIV/STI risk-reduction control intervention. Participants' ages ranged from 18 to 45 years (mean=26.7; SD=6.6). Only 5.8% were married, 67.1% were unemployed, 43.9% were high-school graduates, and 59.9% had a drinking problem based on the CAGE. Most (61.8%) lived in their family's residence, 18.8% lived in their own residence, and 14.3% in a shack in someone else's yard.

All 44 neighborhoods remained in the trial to its completion. Attendance at intervention sessions was high: all participants attended intervention session 1, 1,171 (99.2%) attended session 2, and 1,165 (98.6%) attended session 3. Of the 1,181 participants, 1,140 (96.5%) attended at least one of the two follow-ups: 1,093 (92.5%) attended the 6-month follow-up; 1,106 (93.6%) attended the 12-month follow-up. The percentage attending a follow-up did not differ in the health-promotion (555 of 572 or 97.0%) compared with control intervention (585 of 609 or 96.1%). Attending a follow-up was unrelated to age group, high-school education, employment status, marital status, and pre-intervention self-reported aerobic physical activity, fruit-and-vegetable consumption, and alcohol problems. However, participants not meeting the strength-building exercise guideline at baseline were less likely to return for follow-up than those who met the guideline ($p = 0.001$).

Effects of the Health-Promotion Intervention

Table 2 presents descriptive statistics for health behaviors by condition and assessment period. Table 3 presents estimated intervention effects unadjusted and adjusted for baseline response. The health-promotion intervention significantly increased adherence to physical-activity guidelines. The model-estimated probability of meeting physical-activity guidelines in the past seven days averaged over the 6- and 12-month follow-ups was 51.0% in the health-promotion intervention compared with 44.7% in the control group. Health-promotion-intervention participants compared with controls had significantly greater odds of meeting the vigorous and moderate aerobic exercise guidelines, but not strength-building guidelines. The model-estimated probability of meeting vigorous- and moderate-aerobic and strength-building exercise guidelines in the health-promotion intervention compared with the control group was 50.7% versus 44.3%, 34.6% versus 29.7%, and 77.1% versus 73.9%, respectively.

The health-promotion intervention did not increase the odds of meeting 5-a-Day fruit-and-vegetable recommendations in the past 30 days over the 6- and 12-month follow-ups. The model-estimated probability of meeting 5-a-Day guidelines was 42.3% in the health-promotion intervention compared with 44.8% in the control group. Although the health-promotion and control group did differ on servings of fruit (adjusted means = 3.52 and 4.00, respectively), contrary to prediction, health-promotion-intervention participants (adjusted mean = 4.54) reported fewer servings of vegetables than did control participants (adjusted mean = 5.38). The health-promotion intervention significantly reduced self-reported fried-potato intake over the follow-up period, compared with control group, adjusted means = 2.04 versus 2.55, respectively. The health-promotion intervention (57.3%) and control group (57.6%) did not significantly differ in binge drinking.

The Intervention-Condition x Time interaction was not significant on any outcome, indicating that the intervention's effects were not significantly different 6 months compared with 12 months post-intervention.

Discussion

This study found that the health-promotion intervention significantly increased self-reported adherence to physical-activity guidelines averaged over the 12-month post-intervention period, the primary outcome, compared with the attention-matched control intervention. Moreover, the intervention's efficacy in increasing self-reported physical activity did not significantly diminish between the 6-month and 12-month follow-up. The intervention-induced increase in adherence to physical-activity guidelines was mainly due to the effect of the intervention in increasing aerobic physical activity. Compared with attention-control participants, health-promotion-intervention participants significantly increased their vigorous-intensity and moderate-intensity physical activity, but not their strength-building exercise. The increases in self-reported physical activity are important because physical inactivity is a well-established risk factor for NCDs (Boyle et al., 2012; Jefferis et al., 2012; Lee et al., 2003; Sattelmair et al., 2011; Tanasescu et al., 2002) that contributes to the high burden of disease in South Africa (Joubert et al., 2007), a high burden that has not been met by rigorous intervention research to increase physical activity.

A recent RCT found that a worksite-wellness intervention did not increase self-reported physical activity, but the sample was small, 90% of participants were women, and the follow-up was brief, only six weeks post-intervention (Edries et al., 2013). Although a RCT found that an intervention increased self-reported physical activity in young South African adolescents (Jemmott et al., 2011), the current study is, to our knowledge, the first to demonstrate that a theory-based behavioral intervention can significantly increase self-reported physical activity among men in sub-Saharan Africa. Future research should seek to enhance the effects of the intervention on strength-building because, quite apart from aerobic activity, strength-building is an important aspect of physical activity for health (Department of Health and Human Services, 2008; Tanasescu et al., 2002).

Besides physical activity, the intervention was designed to influence fruit-and-vegetable, fried-potato, and alcohol intake. Although it decreased self-reported servings of fried potatoes compared with the attention-control intervention, it did not increase adherence to the 5-a-Day fruit-and-vegetable recommendation or reduce alcohol consumption. Moreover, contrary to expectation, men in health-promotion intervention reported eating *fewer* vegetables than those in the control condition. Why adherence to the 5-a-Day recommendation was not increased by the intervention is unclear. Several intervention activities focused on increasing vegetable consumption: a cooking activity in which vegetables were grilled rather than fried, an activity the men enjoyed very much, and another activity focused on barriers to eating vegetables and ways to surmount them.

It is possible that the difference in efficacy of the intervention on self-reported physical activity compared to self-reported fruit-and-vegetable consumption may reflect the greater control that men have over their physical activity than over their diet, which may be more in the control of others who prepare their meals. A previous intervention increased adherence to the 5-a-Day recommendation among young South African adolescents (Jemmott et al., 2011); however, that intervention included take-home assignments the adolescents did with their parents, which may have influenced the parents to help the adolescents adhere to the 5-a-Day recommendation. An intervention in the US found that a health-promotion intervention targeting couples increased adherence to the 5-a-Day recommendation (El-Bassel et al., 2011). Perhaps an intervention targeting South African couples might be more efficacious than a focus on South African men only.

One possible explanation for the lack of an effect of the health-promotion intervention on alcohol use is that both interventions addressed it, albeit from different angles. The HIV/STI control intervention cautioned that alcohol use could be a trigger for unsafe sexual behavior; the health-promotion intervention stressed the adverse health consequences of excessive alcohol consumption. Another possibility is that, inasmuch as 60% of the men screened positive for alcohol dependency, a stronger intervention may be required to reduce their binge drinking.

The limitations of the study should be considered. Behavior was measured with self-reports, which may be subject to social desirability bias. Although the use of ACASI may have mitigated potential problems with the use of self-reports (Langhaug et al., 2010), objective measures of physical activity, fruit-and-vegetable consumption, and physiological variables (blood pressure, body mass index, and waist circumference) would have improved the study. In addition, the findings may not generalize to all South African men because participants were not randomly selected. There were also important strengths. Behavior-change theory was integrated with extensive formative research to develop an intervention that was both theoretically grounded and culturally congruent. A RCT design and a dose- and modality-equivalent control intervention, controlling for group interaction and special attention, was employed. Participants were blind to intervention condition prior to enrollment, thus avoiding differential self-selection bias (Pronyk et al., 2006). The retention rate was relatively high and did not differ by intervention arm. The findings are generalizable to other neighborhoods in the area because neighborhoods were randomly selected.

The attention-control condition in this trial was an HIV/STI risk-reduction intervention, which also proved to be effective (Jemmott et al., 2014). Indeed, the funding for both arms of this study was available for the purpose of testing the HIV intervention. This is reasonable because South Africa has the largest number of HIV-infected people of any country (UNAIDS, 2012); however, with the growing success of antiretroviral treatment of HIV (Adam and Johnson, 2009), more South Africans will probably die from NCDs such as those linked to the behaviors addressed in the health-promotion intervention than from HIVrelated causes. As effective treatment continues to reach all HIV-infected South Africans, HIV is itself becoming a chronic disease rather than a death sentence at a young age. This development, juxtaposed with the health transition occasioning rising mortality rates from NCDs in South Africa and other parts of sub-Saharan Africa (Cecchini et al., 2010; Ikem and Sumpio, 2011; Mayosi et al., 2012), suggests that strategies to mitigate the effects of all chronic illnesses deserve public-health attention.

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References

Adam MA, Johnson LF. Estimation of adult antiretroviral treatment coverage in South Africa. S Afr Med J. 2009; 99:661–7. [PubMed: 20073293]

Ajzen, I. From intentions to actions: a theory of planned behavior. In: Kuhl, J.; Beckmann, J., editors. Action-control: From cognition to behavior. Springer; Heidelberg: 1985. p. 11-39.

Avery L, Flynn D, van Wersch A, Sniehotta FF, Trenell MI. Changing physical activity behavior in type 2 diabetes: a systematic review and meta-analysis of behavioral interventions. Diabetes Care. 2012; 35:2681–9. [PubMed: 23173137]

Bandura, A. Social foundations of thought and action: a social cognitive theory. Prentice-Hall; Englewood Cliffs: 1986.

Bourne LT, Lambert EV, Steyn K. Where does the black population of South Africa stand on the nutrition transition? Public Health Nutr. 2002; 5:157–62. [PubMed: 12027279]

Boyle T, Keegel T, Bull F, Heyworth J, Fritschi L. Physical activity and risks of proximal and distal colon cancers: a systematic review and meta-analysis. J Natl Cancer Inst. 2012; 104:1548–61. [PubMed: 22914790]

Campbell MK, Carr C, Devellis B, Switzer B, Biddle A, Amamoo MA, Walsh J, Zhou B, Sandler R. A randomized trial of tailoring and motivational interviewing to promote fruit and vegetable consumption for cancer prevention and control. Ann Behav Med. 2009; 38:71–85. [PubMed: 20012809]

Campbell MK, Demark-Wahnefried W, Symons M, Kalsbeek WD, Dodds J, Cowan A, Jackson B, Motsinger B, Hoben K, et al. Fruit and vegetable consumption and prevention of cancer: the Black Churches United for Better Health project. Am J Public Health. 1999; 89:1390–6. [PubMed: 10474558]

Cecchini M, Sassi F, Lauer JA, Lee YY, Guajardo-Barron V, Chisholm D. Tackling of unhealthy diets, physical inactivity, and obesity: health effects and cost-effectiveness. Lancet. 2010; 376:1775–84. [PubMed: 21074255]

Centers for Disease Control and Prevention. Public-use data documentation. Division of Adolescent and School Health, National Center for Chronic Disease Prevention and Health Promotion, Centers for Disease Control and Prevention; Atlanta, GA: 2001. 2001 national school-based youth risk behavior survey.

Cook, T.; Campbell, D. Quasi-experimentation: design and analysis for field settings. Houghton Mifflin; Chicago: 1979.

Department of Health and Human Services. 2008 physical activity guidelines for Americans. Department of Health and Human Services; Washington, DC: 2008.

Edries N, Jelsma J, Maart S. The impact of an employee wellness programme in clothing/textile manufacturing companies: a randomised controlled trial. BMC Public Health. 2013; 13:25. [PubMed: 23311458]

El-Bassel N, Jemmott JB 3rd, Landis JR, Pequegnat W, Wingood GM, Wyatt GE, Bellamy SL. Intervention to Influence Behaviors Linked to Risk of Chronic Diseases: A Multisite Randomized Controlled Trial With African-American HIV-Serodiscordant Heterosexual Couples. Arch Intern Med. 2011; 171:728–36. [PubMed: 21518939]

Ewing J. Detecting alcoholism: The CAGE questionnaire. JAMA. 1984; 252:1905–07. [PubMed: 6471323]

Fitzmaurice, GM.; Laird, NM.; Ware, JH. Applied longitudinal analysis. John Wiley & Sons; New York: 2004.

Foster C, Hillsdon M, Thorogood M, Kaur A, Wedatlake T. Interventions for promoting physical activity. Cochrane Database Syst Rev. 2013:1–92.

Garrett S, Elley CR, Rose SB, O'Dea D, Lawton BA, Dowell AC. Are physical activity interventions in primary care and the community cost-effiective? A systematic review of the evidence. The British journal of general practice: the journal of the Royal College of General Practitioners. 2011; 61:e125–33. [PubMed: 21375895]

George ES, Kolt GS, Duncan MJ, Caperchione CM, Mummery WK, Vandelanotte C, Taylor P, Noakes M. A review of the effectiveness of physical activity interventions for adult males. Sports Med. 2012; 42:281–300. [PubMed: 22350570]

Guthold R, Ono T, Strong KL, Chatterji S, Morabia A. Worldwide variability in physical inactivity a 51-country survey. Am J Prev Med. 2008; 34:486–94. [PubMed: 18471584]

Hallal PC, Andersen LB, Bull FC, Guthold R, Haskell W, Ekelund U. Global physical activity levels: surveillance progress, pitfalls, and prospects. Lancet. 2012; 380:247–57. [PubMed: 22818937]

Heath GW, Parra DC, Sarmiento OL, Andersen LB, Owen N, Goenka S, Montes F, Brownson RC. Evidence-based intervention in physical activity: lessons from around the world. Lancet. 2012; 380:272–81. [PubMed: 22818939]

Ikem I, Sumpio BE. Cardiovascular disease: the new epidemic in sub-Saharan Africa. Vasc. 2011; 19:301–7.

Jefferis BJ, Whincup PH, Lennon L, Wannamethee SG. Longitudinal associations between changes in physical activity and onset of type 2 diabetes in older British men: the influence of adiposity. Diabetes Care. 2012; 35:1876–83. [PubMed: 22751959]

Jemmott JB 3rd, Jemmott LS, O'Leary A, Ngwane Z, Icard L, Bellamy S, Jones S, Landis JR, Heeren GA, et al. Cognitive-behavioural health-promotion intervention increases fruit and vegetable consumption and physical activity among South African adolescents: a cluster-randomised controlled trial. Psychol Health. 2011; 26:167–85. [PubMed: 21318928]

Jemmott JB 3rd, Jemmott LS, O'Leary A, Ngwane Z, Icard LD, Heeren GA, Mtose X, Carty C. Cluster-randomized controlled trial of an HIV/STI risk-reduction intervention for South African men. American Journal of Public Health. 2014; 104:467–73. [PubMed: 24432923]

Joubert J, Norman R, Lambert EV, Groenewald P, Schneider M, Bull F, Bradshaw D. Estimating the burden of disease attributable to physical inactivity in South Africa in 2000. S Afr Med J. 2007; 97:725–31. [PubMed: 17952230]

Kalichman SC, Simbayi LC, Vermaak R, Jooste S, Cain D. HIV/AIDS risks among men and women who drink at informal alcohol serving establishments (Shebeens) in Cape Town, South Africa. Prev Sci. 2008; 9:55–62. [PubMed: 18264762]

Krebs-Smith SM, Cook A, Subar AF, Cleveland L, Friday J. US adults' fruit and vegetable intakes, 1989 to 1991: a revised baseline for the Healthy People 2000 objective. Am J Public Health. 1995; 85:1623–9. [PubMed: 7503335]

Langhaug LF, Sherr L, Cowan FM. How to improve the validity of sexual behaviour reporting: systematic review of questionnaire delivery modes in developing countries. Tropical Med & Int Health. 2010; 15:362–81.

Lee CD, Folsom AR, Blair SN. Physical activity and stroke risk: a meta-analysis. Stroke. 2003; 34:2475–81. [PubMed: 14500932]

Lee IM, Shiroma EJ, Lobelo F, Puska P, Blair SN, Katzmarzyk PT. Effect of physical inactivity on major non-communicable diseases worldwide: an analysis of burden of disease and life expectancy. Lancet. 2012; 380:219–29. [PubMed: 22818936]

Liang KY, Zeger SL. Longitudinal data analysis using generalized linear models. Biometrika. 1986; 73:13–22.

Mayosi BM, Flisher AJ, Lalloo UG, Sitas F, Tollman SM, Bradshaw D. The burden of non-communicable diseases in South Africa. Lancet. 2009; 374:934–47. [PubMed: 19709736]

Mayosi BM, Lawn JE, van Niekerk A, Bradshaw D, Abdool Karim SS, Coovadia HM. Health in South Africa: changes and challenges since 2009. Lancet. 2012; 380:2029–43. [PubMed: 23201214]

Metzger DS, Koblin B, Turner C, Navaline H, Valenti F, Holte S, Gross M, Sheon A, Miller H, et al. Randomized controlled trial of audio computer-assisted self-interviewing: utility and acceptability in longitudinal studies. HIVNET Vaccine Preparedness Study Protocol Team. Am J Epidemiol. 2000; 152:99–106. [PubMed: 10909945]

Muller-Riemenschneider F, Reinhold T, Nocon M, Willich SN. Long-term effectiveness of interventions promoting physical activity: a systematic review. Prev Med. 2008; 47:354–68. [PubMed: 18675845]

Orrow G, Kinmonth AL, Sanderson S, Sutton S. Effectiveness of physical activity promotion based in primary care: systematic review and meta-analysis of randomised controlled trials. Br Med J. 2012; 344:e1389. [PubMed: 22451477]

Pillay JD, Kolbe-Alexander TL, Proper KI, van Mechelen W, Lambert EV. Steps that count! The development of a pedometer-based health promotion intervention in an employed, health insured South African population. BMC Public Health. 2012; 12:880. [PubMed: 23075000]

Pronyk PM, Hargreaves JR, Kim JC, Morison LA, Phetla G, Watts C, Busza J, Porter JD. Effect of a structural intervention for the prevention of intimate-partner violence and HIV in rural South Africa: a cluster randomised trial. Lancet. 2006; 368:1973–83. [PubMed: 17141704]

Samitz G, Egger M, Zwahlen M. Domains of physical activity and all-cause mortality: systematic review and dose-response meta-analysis of cohort studies. Int J Epidemiol. 2011; 40:1382–400. [PubMed: 22039197]

Sattelmair J, Pertman J, Ding EL, Kohl HW 3rd, Haskell W, Lee IM. Dose response between physical activity and risk of coronary heart disease: a meta-analysis. Circulation. 2011; 124:789–95. [PubMed: 21810663]

Schiller JS, Lucas JW, Peregoy JA. Summary health statistics for U. S. adults: National Health Interview Survey, 2011. Vital Health Statistics. 2012; 10

Skaal L, Pengpid S. Physical activity, fitness level and health problems of healthcare workers in South Africa: the transtheoretical model as an explanatory framework. Afr J Phys Health Educ Recreat Dance. 2011; 17:612–23.

Tanasescu M, Leitzmann MF, Rimm EB, Willett WC, Stampfer MJ, Hu FB. Exercise type and intensity in relation to coronary heart disease in men. JAMA. 2002; 288:1994–2000. [PubMed: 12387651]

Temple NJ. Strategies for health promotion: facing the challenge in South Africa. Ethn Dis. 2007; 17:749–54. [PubMed: 18072390]

Thompson FE, Byers T. Dietary assessment resource manual. J Nutr. 1994; 124:2245S–317S. [PubMed: 7965210]

UNAIDS. Global report: UNAIDS report on the global AIDS epidemic, 2012. Joint United Nations Programme on HIV/AIDS (UNAIDS); Geneva: 2012.

Wainberg ML, Gonzalez MA, McKinnon K, Elkington KS, Pinto D, Mann CG, Mattos PE. Targeted ethnography as a critical step to inform cultural adaptations of HIV prevention interventions for adults with severe mental illness. Soc Sci Med. 2007; 65:296–308. [PubMed: 17475382]

Waters LA, Galichet B, Owen N, Eakin E. Who participates in physical activity intervention trials? J Phys Act Health. 2011; 8:85–103. [PubMed: 21297189]

Wen CP, Wai JP, Tsai MK, Yang YC, Cheng TY, Lee MC, Chan HT, Tsao CK, Tsai SP, et al. Minimum amount of physical activity for reduced mortality and extended life expectancy: a prospective cohort study. Lancet. 2011; 378:1244–53. [PubMed: 21846575]

World Health Organization. Noncommunicable diseases country profiles 2011: WHO global report. World Health Organization; Geneva: 2011.

World Health Organization. World health survey results. World Health Organization; Geneva: 2013.

Wu Y, Zhang D, Kang S. Physical activity and risk of breast cancer: a meta-analysis of prospective studies. Breast cancer research and treatment. 2013; 137:869–82. [PubMed: 23274845]

Highlights

- A large percentage of South African men are physically inactive.
- This 3-week intervention aimed to increase South African men's physical activity.
- Small-group activities, games, brainstorming, videos, and discussions were included.
- Male facilitators given 6 days of training implemented the intervention
- Intervention men reported increased adherence to physical-activity guidelines.

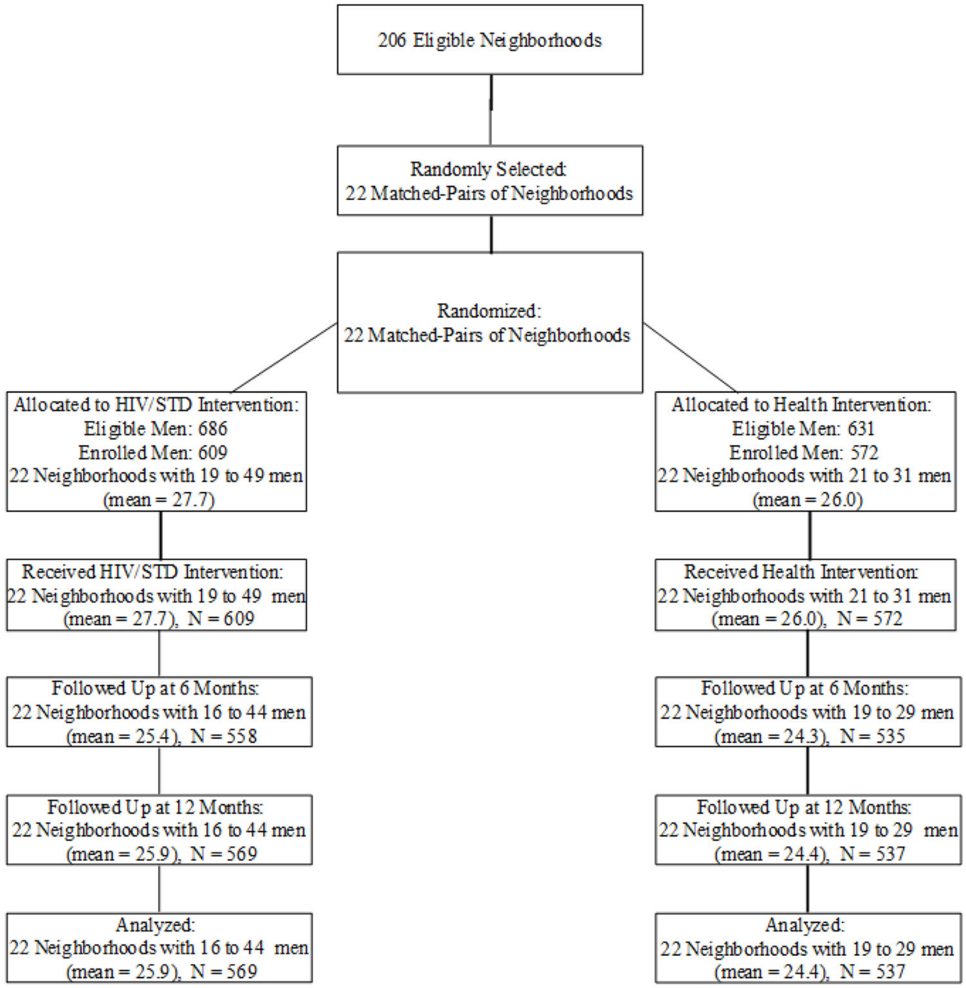

Figure 1.

Progress of participating neighborhoods and men through the trial, Eastern Cape Province, South Africa 2007–2010. Eligible men not enrolled failed to return for intervention session 1 for unknown reasons. The enrollment rate did not differ between treatment (88.8%) and control (90.6%) arms, P = .2642). Men who did not complete the 6-month follow-up were deceased (n = 8) or in prison (n = 4), had permanently moved from the area (n = 21), or were absent from the scheduled follow-up sessions or make-up sessions for unknown reasons (n = 55). Men not followed up at 12 months were deceased (n = 14) or in prison (n = 2), had permanently moved from the area (n = 34), or were absent for unknown reasons (n = 25).

Table 1

Sociodemographic Characteristics of Neighborhoods and Participating Men by Intervention Condition at Baseline, Eastern Cape Province, South Africa 2007–2010.

Characteristic	Health Intervention	HIV/STI Intervention	Total
Neighborhoods			
No.	22	22	44
Mean % (SD) isiXhosa home language	99.0 (3.2)	99.0 (2.9)	99.0 (3.0)
Mean % (SD) Married	19.2 (3.2)	19.1 (3.1)	19.1 (3.1)
Mean % (SD) Male	48.1 (2.1)	48.1 (2.1)	48.1 (2.2)
Mean % (SD) Unemployed	60.6 (9.5)	60.6 (9.3)	60.6 (9.3)
No. (%) Urban-Informal	6 (27.3%)	6 (27.3%)	12 (27.3%)
No. (%) Population size group			
727 to 1113	10 (45.4%)	9 (40.9%)	19 (43.2%)
1114 to 1299	3 (13.6%)	4 (18.2%)	7 (15.9%)
1300 to 1881	9 (40.9%)	9 (40.9%)	18 (40.9%)
Men			
No.	572	609	1181
No. (%) isiXhosa home language	571/572 (99.8%)	607/609 (99.7%)	1178/1181 (99.8%)
No. (%) Age (years) group			
18 to 24 years	273/572 (47.7%)	282/609 (46.3)%	555/1181 (47.0%)
25 to 29 years	126/572 (22.0%)	158/609 (25.9%)	284/1181 (24.0%)
30 to 45 years	173/572 (30.2%)	169/609 (27.8%)	342/1181 (29.0%)
No. (%) Married	41/572 (7.2%)	27/609 (4.4%)	68/1181 (5.8%)
No. (%) Unemployed	368/572 (64.3%)	425/609 (69.8%)	793/1181 (67.1%)
No. (%) Completed high school	239/572 (41.8%)	279/609 (45.8%)	518/1181 (43.9%)
No. (%) Alcohol dependent [a]	330/572 (57.7%)	377/609 (61.9%)	707/1181 (59.9%)
No. (%) Housing circumstances			
Own house or flat	107/572 (18.7%)	115/609 (18.8)%	222/1181 (18.8%)
Family's house	361/572 (63.1%)	369/609 (60.6%)	730/1181 (61.8%)
Partner's house	13/572 (2.3%)	19/609 (3.1)%	32/1181 (2.7%)
Rented room	12/572 (2.1%)	15/609 (2.5%)	27/1181 (2.3%)

Characteristic	Health Intervention	HIV/STI Intervention	Total
Shack in someone else's yard	79/572 (13.8%)	91/609 (14.9%)	170/1181 (14.3%)

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

Table 2

Self-Reported Health Behaviors by Intervention Condition and Assessment Period, Eastern Cape Province, South Africa 2007–2010.

Variable	Baseline	6-Month	12-Month
No. (%) meeting physical activity guideline in the past 7 days			
Health Intervention	238 (41.61)	270 (50.47)	277 (51.58)
HIV/STI Intervention	264 (43.35)	265 (47.49)	240 (42.18)
No. (%) meeting vigorous-intensity aerobic exercise guideline in the past 7 days			
Health Intervention	242 (42.31)	274 (51.21)	270 (50.28)
HIV/STI Intervention	267 (43.84)	260 (46.59)	240 (42.18)
No. (%) meeting moderate-intensity aerobic exercise guideline in the past 7 days			
Health Intervention	142 (24.83)	178 (33.27)	193 (35.94)
HIV/STI Intervention	162 (26.60)	175 (31.36)	161 (28.30)
No.(%) meeting strength-building exercise guideline in the past 7 days			
Health Intervention	365 (63.81)	408 (76.26)	418 (77.84)
HIV/STI Intervention	411 (67.49)	416 (74.55)	418 (73.46)
No. (%) meeting 5-a-Day guideline on fruit and vegetable servings in the past 30 days			
Health Intervention	184 (32.74)	224 (42.50)	216 (41.46)
HIV/STI Intervention	224 (37.97)	251 (45.89)	235 (43.12)
Mean (SE) Self-reported servings of fruit per day in the past 30 days			
Health Intervention	3.44 (0.21)	3.61 (0.23)	3.41 (0.23)
HIV/STI Intervention	3.78 (0.21)	4.14 (0.26)	3.78 (0.26)
Mean (SE) Self-reported servings of vegetables per day in the past 30 days			
Health Intervention	2.60 (0.22)	4.38 (0.31)	4.49 (0.34)
HIV/STI Intervention	2.62 (0.19)	5.21 (0.38)	5.48 (0.42)
Mean (SE) Self-reported servings of fried food per day in the past 30 days			
Health Intervention	2.25 (0.20)	2.03 (0.19)	2.02 (0.20)
HIV/STI Intervention	2.06 (0.17)	2.33 (0.19)	2.74 (0.22)
No. (%) Reported binge drinking in the past 30 days			
Health Intervention	321 (68.88)	310 (76.92)	307 (76.56)
HIV/STI Intervention	355 (72.01)	321 (74.83)	324 (77.14)

Table 3

GEE Empirical Significance Tests for the Intervention Effect on Self-Reported Health Behaviors Averaged Over the 6- and 12-month Follow-up Assessments Unadjusted for Baseline Prevalence and Adjusted for Baseline Prevalence, Eastern Cape Province, South Africa 2007–2010.

		Unadjusted for Baseline		Adjusted for Baseline	
Outcome	**ICC**	**Estimate (95% CI)**	**P value**	**Estimate (95% CI)**	**P value**
Met physical-activity guideline in past 7 days	0.019	1.28 (1.05, 1.57) [b]	0.013	1.34 (1.09, 1.63) [b]	0.004
Met vigorous-intensity aerobic exercise guideline in the past 7 days	0.024	1.30 (1.06, 1.57) [b]	0.011	1.35 (1.11, 1.65) [b]	0.004
Met moderate-intensity aerobic exercise guideline in the past 7 days	0.007	1.25 (1.02, 1.52) [b]	0.030	1.28 (1.05, 1.57) [b]	0.015
Met strength-building exercise guideline in the past 7 days	0.012	1.19 (0.94, 1.48) [b]	0.155	1.25 (0.99, 1.58) [b]	0.058
Met 5-a-Day guideline on fruit and vegetable servings in the past 30 days	0.004	0.90 (0.74, 1.11) [b]	0.314	0.95 (0.77, 1.17) [b]	0.633
Self-reported servings of fruit per day in the past 30 days	0.004	−0.45 (−1.02, 0.12) [a]	0.125	−0.37 (−0.92, 0.18) [a]	0.188
Self-reported servings of vegetables per day in the past 30 days	0.014	−0.92 (−1.75, −0.08) [a]	0.032	−0.82 (−1.64, −0.01) [a]	0.048
Self-reported servings of fried food per day in the past 30 days	0.002	−0.51 (−0.96, −0.06) [a]	0.026	−0.56 (−1.01, −0.11) [a]	0.015
Self-reported binge drinking in past 30 days	0.028	1.04 (0.80, 1.35) [b]	0.748	1.09 (0.83, 1.45) [b]	0.529

[a] Estimate = mean difference (Health intervention – HIV risk reduction intervention) for continuous outcomes (servings of fruit, vegetables, and fried food per day in the past 30 days).

[b] Estimate = OR (Health intervention versus HIV risk reduction intervention) for binary outcomes (met physical-activity guideline, strength-building exercise guideline, vigorous-intensity aerobic exercise guideline, and moderate-intensity aerobic exercise guideline in the past 7 days, and self-reported binge drinking in the past 30 days). ICC = intraclass correlation coefficient.