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The Results of the "Positive Action for Today's Health" (PATH) Trial for Increasing Walking and Physical Activity in Underserved African-American Communities

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Authors' Statement of Conflict of Interest and Adherence to Ethical Standards Authors Wilson, Van Horn, Siceloff, Alia, St. George, Lawman, Trumpeter, Coulon, Griffin, Wandersman, Egan, Colabianchi, Forthofer, and Gadson declare that they have no conflict of interest. This study followed appropriate informed consent procedures and adhered to appropriate ethical standards and the Helsinki Declaration. This study was approved by the University of South Carolina Institutional Review Board.

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Abstract

Background—The "Positive Action for Today's Health" (PATH) trial tested an environmental intervention to increase walking in underserved communities.

Methods—Three matched communities were randomized to a police-patrolled walking plus social marketing, a police-patrolled walking-only, or a no-walking intervention. The 24-month intervention addressed safety and access for physical activity (PA) and utilized social marketing to enhance environmental supports for PA. African-Americans (*N*=434; 62 % females; aged 51±16 years) provided accelerometry and psychosocial measures at baseline and 12, 18, and 24 months. Walking attendance and trail use were obtained over 24 months.

Results—There were no significant differences across communities over 24 months for moderate-to-vigorous PA. Walking attendance in the social marketing community showed an increase from 40 to 400 walkers per month at 9 months and sustained ~200 walkers per month through 24 months. No change in attendance was observed in the walking-only community.

Conclusions—Findings support integrating social marketing strategies to increase walking in underserved African-Americans (ClinicalTrials.gov #NCT01025726).

Keywords

Physical activity; Walking interventions; African-Americans; Perceptions of safety and access

Introduction

The important influence of physical activity (PA) on chronic disease reduction has been well established [1, 2]. National studies have demonstrated that moderate intensity activity equivalent to a brisk walk provides enough benefit to improve fitness and prevent poor health outcomes, including obesity, disability, and death [1–3]. Despite the strong positive relationship between PA and health, more than half of the US population is not regularly active at recommended levels of 150 min/week [4, 5]. Inactivity is also more prevalent among African-American as compared to Caucasian adults [5], which has led to national concern for better understanding the determinants and mediating factors of inactivity among ethnic minorities [6–9]. Given the scope of these health disparities, interventions should extend beyond individual-level, behavior-change strategies to target larger population health indices.

The present study used an ecological model to develop an environmental intervention for increasing PA in underserved communities [10, 11]. This approach assumes health is shaped by environmental subsystems including intrapersonal factors (individual characteristics), interpersonal processes and primary groups (formal and informal social networks), institutional factors, community factors (physical and social-environmental supports), and public policy [12]. Despite the importance of social-environmental factors in predicting PA [13–19], only a limited number of longitudinal studies have evaluated the efficacy of interventions that specifically target community subsystems and social and environmental supports for PA (e.g., safety, access, social connectedness) in African-American adults. In the High Point for Health intervention, increases in self-reported walking were found in residents of a low-income housing community who were randomized to a walking intervention that targeted improved access (e.g., identification of walking trails), aesthetics, pedestrian safety, and social connectedness (e.g., community walking groups) [15]. Another community intervention showed a greater adherence to a 12-month walking intervention in African-American women participating in a walking plus motivational support program and among women who lived in close proximity to indoor walking facilities [16]. A PA intervention conducted in rural African-Americans demonstrated the importance of community engagement for reducing physical inactivity [17]. In that study, declines in physical inactivity over a 3-year period were predicted by the presence of a community coalition that coordinated intervention activities (e.g., walking clubs, exercise classes, and health screenings). The results of these previous studies suggest that active engagement of community residents is an essential component of interventions to promote walking and PA.

The present study expands on previous research by integrating social marketing strategies for increasing PA and walking in underserved African-American communities. Social marketing is an approach to improving personal health and quality of life that may be used to promote community connectedness and engagement for walking [20]. A review of social marketing interventions for health promotion concluded that although findings are mixed, there is evidence to support the effectiveness of this approach for improving PA behaviors [21]. However, less is known about effective strategies for increasing PA behaviors in African-American adults. One study used a mass media social marketing campaign to promote walking in a low-income, predominately African-American urban community. Whereas significant increases in attitudes for walking were found over a 5-month period of time, no changes in behavior were observed [22]. To effectively utilize social marketing for PA promotion, strategies should be adapted to reflect the perceived barriers and anticipated benefits of PA in the target population [23]. Van Duyn and colleagues [23] conducted focus groups with low-income, African-American adults to identify relevant strategies for PA promotion in this population. Participants indicated that they valued being active but need social support for PA, including support through church activities and group walks, as well as strategies to overcome access barriers to places for PA, particularly those that are free, safe, and that can support group activities.

The present study tested the integration of a police-patrolled walking program with social marketing strategies directed at improving the social and physical environment, such as increasing community engagement and perceptions of access to safe places for PA, to promote walking in low-income, African-American communities. The primary aims of the

"Positive Action for Today's Health" (PATH) trial were as follows: (1) to examine if, after 12 months, residents of a community receiving a combined police-patrolled walking and social marketing intervention would show greater increases in moderate-to-vigorous PA (MVPA) and greater use of the established walking trail than residents of a community receiving a police-patrolled walking-only intervention or residents of a community with no-walking intervention (general health education only) and (2) to determine if residents of the community with the combined police-patrolled walking and social marketing intervention would show greater maintenance of increased MVPA and walking trail use than residents of the other two communities over 18- and 24-month assessments. Intervention differences were evaluated in two independent samples: a sample of residents in each community that was recruited independently of the walking program (referred to as the community sample) and evaluations of each of the walking programs users both through attendance logs and observations of walking behavior made by trained observers (referred to as program evaluation data).

Methods

Selection of Communities

Three communities were identified and matched using census and archival data on crime rates (including murders, rapes, aggravated assaults, breaking, and entering), poverty rates, physical inactivity rates, health status (indices), and percent minorities as detailed in previous publications [24, 25]. Communities were randomized to one of three intervention programs: an intervention that combined a police-patrolled walking program with social marketing strategies, a police-patrolled walking program only, or a general health education (no walking-related) intervention (ClinicalTrials.gov #NCT01025726). Each community was assigned to one of the three treatment conditions by an independent statistician using a computer-generated randomized allocation sequence. While communities were randomly assigned, this study had only one community per condition and is thus similar to a nonequivalent control group design [26].

This study design utilizes longitudinal assessment of changes in walking and PA by using both the community sample and assessments of walking behavior in each of the walking programs across four time points (baseline and 12, 18, and 24 months). Because communities and individuals within communities may differ on many features other than the intervention, extensive baseline comparisons on covariates (see electronic supplementary material (ESM)) and statistical controls for differences observed in the community samples were conducted. In addition, extensive analyses were conducted examining differential attrition across the three community samples (see ESM).

Participants

Assessments addressing the primary aims in the PATH trial were conducted in two samples. Individual-level assessments (e.g., MVPA) were conducted in a community sample of adults who met inclusion criteria and consented to participate across the study period. Participants in this sample completed measures at baseline and were retained for measurement at the 12-, 18-, and 24-month assessment periods. Assessment of these participants represents the

evaluation of program effects in individuals who were representative of the community. Program-level assessments of walking were conducted on trail users in each of the intervention communities (i.e., those receiving the police-patrolled walking plus social marketing or the police-patrolled walking-only programs). Trail users were members from each target community who elected to utilize the trails in response to the walking intervention and who may or may not have included the same individuals from the communities where individual-level data was obtained. Importantly, the two samples are not linked for the analysis presented here.

Recruitment

Two recruitment strategies were used for obtaining the community sample during Fall 2008. Participants were initially recruited from a random list of households in specified census tracts in each targeted community provided by the University of South Carolina Survey Laboratory. Of the 1216 persons reached, 581 declined and 635 persons were invited to participate. Of those who were invited to participate, 231 enrolled and provided baseline information. Approximately 54 % of the final sample was actively recruited from the randomized phone lists. An additional 203 persons who enrolled and provided baseline data were recruited through volunteer advertisements, accounting for 46 % of the total sample. In all three communities, flyers were distributed, ads were placed in local newspapers, and posters and banners were posted in churches, schools, and at local businesses. Methods for recruitment were used equitably across all three communities. A total of 434 participants were recruited for the project across all three communities (see Fig. 1).

Participants in the community sample were assessed for eligibility using the following inclusion criteria (1) African-American defined as having three of four grandparents of African-American heritage, (2) age 18 years or older, (3) no plans to move in the next 2 years, (4) no medical condition that would limit participation in moderate intensity exercise including life-threatening illness (e.g., immobile, severely disabled), (5) residing in the defined census areas, (6) availability to participate in the evaluations and intervention over the study period, and (7) blood pressure (systolic <180 mmHg/diastolic <110 mmHg) and blood sugar levels (<300 non-fasting mg/dl, ≤250 fasting mg/dl).

Trail users in the program assessment sample included individuals who attended PATH intervention activities or who were observed using identified trails in each of the walking communities.

PATH Intervention

Local community centers operated as the neighborhood hub for the program activities in all three communities. Walking trails were identified in collaboration with each community's steering committee and began and ended at each center in the two trail communities. Walking leaders were trained in injury prevention and safety protocols and scheduled and led walks, Monday through Friday in early evening hours and on Saturday mornings. Program leaders and steering committee members worked with county officials to control stray dogs and to address ongoing structural and aesthetic barriers on the trials. Scheduled walks were patrolled by an off-duty police officer and monitored by program coordinators

and walking leaders. During vehicle patrols, the police cruiser remained visible to walkers and the officer maintained communication with walking leaders via a two-way radio. Data regarding fidelity to program essential elements has been previously published [25]. Trained research staff assessed program fidelity using process evaluation surveys. In both walking communities, fidelity to theoretical elements related to safety, access, and social connectedness was adequate throughout intervention implementation.

In addition to the police-patrolled program, the full intervention in the PATH trial also contributed to the development of social marketing strategies to promote walking on the identified trail by community members. Social marketing is the application of marketing strategies to the design and implementation of programs aiming to influence a behavior in a target group, such as increasing walking to improve personal health and quality of life [20, 27]. The full PATH intervention integrated principles from ecological and social marketing perspectives to develop a health promotion social marketing campaign as recommended by Alcalay and Bell [28] to improve perceptions of safety and access to places for PA as well as psychosocial and environmental barriers to walking in residents of low-income, high-crime communities [24].

The development of the social marketing strategies implemented in the full intervention community was guided by community input from focus groups [29] and a steering committee comprised of a community liaison, program coordinator, walking leaders, city leaders, community residents, a local pastor, and the city police. This grassroots approach identified and linked health-related values and social marketing strategies to motivate community members to use the identified trail and to walk regularly with others in their community to increase PA and improve health. As part of the social marketing campaign, community members and program leaders developed five specific messages, which highlighted the value of the walking program and indicated that walking on the identified trail would improve the following: (1) safety and accessibility for walking (facilitated by warm-up exercises, walking leaders, and police support), (2) physical health, (3) mental health and well-being, (4) self-confidence for engaging in regular walking (self-efficacy), and (5) community connectedness (social norms, community connectedness, collective self-efficacy).

Campaign messages were disseminated using social marketing materials that were developed to meet the needs and values of the community based on input from the community steering committee. A 12-month calendar provided the primary means of delivering messages. Monthly messages featured one of the five campaign messages per month highlighting the value of the walking trail for health promotion. Calendar photographs depicting community members walking on the trail cultivated social norms around positive health-behavior change. The calendar also served as a tool for increasing walking self-efficacy by supporting community members' engagement in goal setting, self-rewards, and progress tracking.

A second set of social marketing materials included a door hanger and field guide. The door hangers were designed to personally invite new walkers to the group. They also reinforced the campaign messages that were presented in the calendar and highlighted the incentives

(e.g., hand-held fan, grip/stress ball, shopping bag) that community members could earn for participating in at least five regularly scheduled walks per month. The field guide was developed that outlined project details, walking protocols (e.g., safety rules), and reinforced campaign messages through talking points that reflected the social marketing objectives (e.g., inspirational poems and prayers). Community members who served as leaders of peer walking groups called Pride Strides used these social marketing materials (and field guide) to invite neighbors, family, and friends to walk and to personalize the Pride Stride walks (e.g., through prayer, giving inspirational talks prior to walking etc.). Thus, these social marketing materials played an important role in enabling the Pride Stride leaders to serve as an interpersonal, grassroots channel for dissemination of the social marketing messages.

The health education comparison community engaged in health-related events to manage chronic disease conditions such as cardiovascular disease, diabetes, and cancer prevention. An event was sponsored at a community center twice a year and promoted building collaborations with county leaders. There was no walking trail present in this community given that PA was not a key focus of the health education program.

Measurement Protocols

Individual-Level Measures—Trained and certified measurement staff collected individual-level data in the community sample at baseline and 12, 18, and 24 months. These measures included accelerometry-assessed PA data (7-day estimates), blood pressure, height, weight, blood sugar, waist circumference, a medications log, a psychosocial and environmental survey, and a 4-week PA recall. Measures were completed during health screenings that were held at the community center in each community. Health screenings and measurements were conducted simultaneously in all three communities to control for potential extraneous environmental and historical confounds. Participants received a monetary incentive in the form of a US$20 gift card at each assessment period, with the exception of the 24-month assessment when participants received a US$40 gift card.

Moderate-to-Vigorous PA (MVPA): PA was assessed with omnidirectional Actical (Minimeter, Bend, OR) accelerometers. At each assessment period, participants wore an Actical attached to a waistband over their right hip for seven consecutive days. Data were recorded in 1-min epochs [30] and converted into time spent engaging in MVPA (>3 METS) as indicated by an activity count ≥1075 for each 60-s epoch [31]. MVPA was coded as minutes within four time blocks per day (6 am–12 pm, 12 pm–4 pm, 4 pm–8 pm, and 8 pm–12 am), and estimates were combined for all 7 days, yielding a single measure of MVPA (i.e., average minutes spent engaging in MVPA per day) for data analysis. Non-wear was defined using 60 consecutive zero counts, and the time block was considered to be missing if 20 % of the time block was non-wear [32]. For a more detailed description of MVPA estimates, see ESM.

Trail Assessments—Assessments were conducted during regularly scheduled walks to assess the number and characteristics of walkers on the police-patrolled trails in each intervention community. To document trail use in each community, trained staff gathered walking attendance data at the start of each walk and trained observers conducted mobile

and stationary observations of each trail. Participants in the community sample were not specifically targeted for the programs implemented in each community as part of their participation in PATH. However, participants in the community sample who resided in either of the walking communities may have used the identified trails. Therefore, attendance and observational assessments of trail users were predominately conducted in members from each target community who were not part of the community sample but also included some participants who were in the community sample.

Walking Attendance: The number of walkers in attendance for each scheduled PATH walk was assessed in each intervention community. Upon their arrival to the trail, walkers signed in with a community leader to record their attendance. Attendance data gathered across the study period at scheduled PATH walks was tallied, yielding a count of trail users in each intervention community who participated in the scheduled walks each month.

Trail Observations: A modified version [33] of the Systems for Observing Play and Recreation in Communities (SOPARC) [34, 35] tool was used to assess the number and characteristics of walking trail users and their PA levels. SOPARC is a systematic observational tool that uses momentary time sampling techniques to conduct systematic scans of each trail user within each trail segment. The original SOPARC tool has been used to assess use of a bicycle path [36] for PA in parks located in low-income communities [35]. The modified tool, referred to as the SOPARC PATH [33], was adapted for trial use in underserved communities and has been shown to have high inter-rater reliability (ICC=0.98). The SOPARC PATH assessment protocol utilized mobile and stationary observations that have been previously described in detail elsewhere [33]. The mobile observations were designed to capture trail use, and stationary observations were designed to capture participation in the organized intervention walking groups.

Each walking trail was divided into segments to allow for assessment of small, observable units. The police-patrolled walking plus social marketing community was divided in 17 segments equaling 1.33 total miles. In the police-patrolled walking-only community, there were 24 segments totaling 2.35 miles. Two of the segments in the police-patrolled walking-only community were eliminated from the data analyses because of school traffic (which was only present in those two segments of the trail), resulting in a 1.76-mile walking trail. Mobile observation data were collected at baseline and 12, 18, and 24 months. Stationary observations were also collected at 12, 18, and 24 months but not at baseline given that there was no walking program in place at baseline and these assessments were designed specifically to capture walking in the organized walking groups. At each assessment period, data were collected by trained staff on seven random, non-continuous days of temperate weather for each day of the week (e.g., Sunday through Saturday). Each day of data collection included four mobile observation intervals (~1.5 h) beginning at 7:30 am, 11:30 am, 2:00 pm, and 4:30 pm and two stationary observation intervals (6:00–8:30 am and 6:00–7:30 pm). During a given interval, trained observers rated each trail user according to gender (male, female), age group (child, teen, adult, senior), ethnicity (Black, other), and activity level (sedentary, walking, vigorous). Ratings were made for all trail users, defined as any individual observed walking on the identified trail in each intervention community.

Observations were recorded only one time for trail users observed on multiple segments or on multiple occasions during a given assessment. Mobile observations were initiated at the start of each trail segment and recorded over a 1.5-min interval. Stationary observations were conducted at a station on the PATH trail that was in close proximity to the community center in each walking community. Total scores were calculated for each stationary and mobile observation by summing the number of users. Stationary scores represent the actual number of trail users observed, whereas mobile scores were adjusted to account for differences in trail length (i.e., total trail users divided by trail length).

Data Analytic Plan

A longitudinal mixed model analysis of covariance (ANCOVA) was implemented within the community sample to examine differences between communities in accelerometer-assessed MVPA in the PATH trial, with random effects included for individuals over time. Data from all waves were included in one analysis that included assessment of differences between groups at baseline, 12 months, and trajectories from 12 to 18 months (see ESM for details). Because treatment status and community overlap in this study (i.e., one community per treatment condition), random effects for community were not included in these analyses. Preliminary analyses were conducted to evaluate baseline equivalence of the community sample across communities (see ESM). Variables that were found to differ by community were included as model covariates along with sex, age, income, education, BMI, and season, a variable indicating whether baseline data were collected during the spring or fall (see ESM for analysis of baseline equivalence).

In the final model, MVPA was square root transformed (denoted $MVPA^{1/2}$) to normalize a skewed distribution and all continuous covariates were centered around their mean. Holding covariates constant, this model was tested for differences between communities in square root minutes of MVPA in the police-patrolled walking-only (TX.walk) and the police-patrolled walking plus social marketing (TX.full) communities compared to those in the general health education community. Differences from baseline to 12 months were assessed by a time varying dummy-coded variable (12 months), and the stability of MVPA beyond 12 months was assessed by a time varying indicator variable (12–24 months) coded 0 at 12 months, 0.5 at 18 months, and 1 at 24 months. Interaction terms were tested for intervention effects, with the average MVPA slope in the referent community compared to that in each walking community from baseline to 12 months (Walk*12 Months and Full*12 Months) and beyond 12 months (Walk*12–24 Months and Full*12–24 Months). See also the ESM for details on the statistical model.

Across communities in the PATH trial, accelerometer data were missing for 10.4 % of the participants at baseline and for 30.9–36.4 % at each of the post-assessment time points (see ESM for details). Multiple imputation [37] was used to address missing data, consistent with previous national trials [38]. Multiple imputation has been shown to provide unbiased parameter estimates and standard errors, has been recommended for addressing missing accelerometer data [39], and is appropriate for longitudinal data [40]. Addressing the assumption that data are missing at random in the PATH trial, analyses were conducted to identify predictors of attrition. Covariates that significantly predicted the odds that

participants were missing accelerometry data at one or more assessment periods were included in the imputation model (age, gender, perceptions of crime, motivation for PA, peer social support for PA) along with other variables of theoretical and substantive importance, thereby minimizing the likelihood of biased estimates and increasing the plausibility of the missing at random assumption [37, 41]. The MICE package [42] implemented within R [43] was used to generate 20 imputations. Given the challenges of collecting 7-day accelerometry estimates in low-resource communities, missing data were imputed for participants meeting a compliance criterion of one or more 4-h time blocks [44]. Methods of obtaining final estimates are adjusted for the amount of between-imputation variability. Therefore, individuals with little data contribute only minimally to the final parameter estimates and do not artificially increase power. MVPA was square root transformed to normalize the distribution and imputed within time block at the level of the individual, with baseline information included for each participant. Imputed values were back transformed within each time block and combined for all 7 days to obtain a single measure of average daily MVPA. If participants were missing MVPA data for an entire assessment period, then, a summary score representing average minutes of MVPA for the entire period was imputed. All reported standard errors were adjusted for missing information (see the ESM for details).

Results

Community Sample

Characteristics—Demographic and baseline characteristics of the community sample are shown in Table 1 and have been previously described [24]. This sample (*N*=434, 62 % female) was comprised of African-American adults, with an average age of 51 years (SD=16 years) and an average BMI of 30.26 (SE=0.39). The majority of the sample was not married (76 %), earned less than US$24,000 annually (62 %), had no children living at home (63 %), and had a high school diploma or less (67 %).

A total of 417 participants in the community sample had valid PA data (assessed via accelerometry) for at least one of four assessments. Participants without any PA data across all assessment periods (*n*=17) were excluded from the present analyses that examined the effect of treatment on MVPA (see Fig. 1). Compared to participants included in the analysis sample, excluded participants were more likely to be male, $\chi^2(1, N=434)=9.32$, $p=002$, and to have a lower BMI, $t(19.86)=4.79$, $p<001$.

Community Intervention Effects on MVPA—Table 2 presents results of a mixed model ANCOVA implemented within the community sample to examine intervention differences between communities in $MVPA^{1/2}$. This model demonstrated significant associations between covariates and $MVPA^{1/2}$ at baseline. Men, older participants, those with higher BMI, and those with lower levels of motivation for PA engaged in less daily $MVPA^{1/2}$ as compared to women, those at or below the sample averages for age and BMI, and those at or above the sample average for motivation for PA. Predicted estimates of $MVPA^{1/2}$ by community and time are shown in Fig. 2. There were no significant differences between communities in $MVPA^{1/2}$ at baseline, 12 months, or from 12 to 24 months and no significant within-community changes in MVPA across time.[1]

Trail Users Sample

Characteristics—Demographics for the trail user sample were obtained from mobile observations. Baseline results indicated that trail users (unadjusted *n*=275) in the police-patrolled walking plus social marketing community were predominately male (79 %), adult (72 %), and African-American (97 %). Demographic characteristics were similar for trail users (unadjusted *n*=297) in the police-patrolled walking-only community, with 78 % male, 61 % adults, and 99 % African-American. However, there were slightly more teens in the police-patrolled walking-only community (23 %) as compared to the police-patrolled walking plus social marketing community (8 %). The trail communities showed similar ratings at baseline for traffic safety (means =2.75 vs. 2.65) and for vandalism (means =3.43 vs. 3.37) across the police-patrolled walking plus social marketing and police-patrolled walking-only communities, respectively, as measured by trained staffed [33].

Monthly Walking Attendance Data—Figure 3 shows the walking attendance data assessed in the trail sample from baseline through 24 months of the intervention. The number of walkers in the police-patrolled walking plus social marketing community increased from 40 walkers per month to 400 walkers by 9 months. At the 18- and 24-month assessments, walking was sustained in the police-patrolled walking plus social marketing community with ~200 walkers per month on average. No such increases in walking attendance were observed in the police-patrolled walking-only community.

Mobile Observations—Descriptive results indicated that the total trail users observed (adjusted for trail length) per mobile assessment in the police-patrolled walking plus social marketing community increased from baseline (adjusted *n*=207) to 12 months (adjusted *n*= 245). The number of trail users observed decreased at 18 months (adjusted *n*=183) and increased again slightly at 24 months (adjusted *n*=205). A similar pattern was shown in the police-patrolled walking-only community indicating that the total number of trail users observed (adjusted for trail length) per mobile assessment increased from baseline (adjusted *n*=169) to 12 months (adjusted *n*=194), decreased at 18 months (adjusted *n*=158) and increased again at 24 months (adjusted *n*=211).

Stationary Observations—Results of the stationary SOPARC observations are presented in Table 3 and Fig. 4. Descriptive analysis of trends shows the total number of trail users observed per stationary assessment for the police-patrolled walking plus social marketing community increased from 12 (*n*=168) to 18months (*n*=189) and decreased at 24 months (*n*=127). Patterns were similar in the police-patrolled walking-only community, with an increase from 12 (*n*=83) to 18 months (*n*=137) and a decrease at 24 months (*n*=104). Overall, the number of trail users observed using stationary observations was consistently higher in the police-patrolled walking plus social marketing community relative to the police-patrolled walking-only community (Fig. 4).[2]

[1]Separate mixed model ANCOVA with random effects for individuals was conducted to examine differences between communities in psychosocial variables over time. Two significant community-by-time interactions were found. First, there was a significant change in social cohesion within the full treatment condition such that following a slight increase at the 12-month assessment, levels of social cohesion declined over the 18- and 24-month assessments (CI−0.50,−0.02). Second, there was a significant change in perceptions of neighborhood crime within the full treatment condition such that participants reported lower perceptions of crime at the 12-month assessment than at the initial assessment (CI −0.65, −0.15).

Discussion

This study is one of the first to test the effects of an environmental walking intervention on PA in underserved communities. Program assessments of trail users in the PATH trial provide support indicating that social marketing was an effective strategy for increasing walking in underserved, predominantly African-American communities. Specifically, attendance data recorded during scheduled PATH walks demonstrated increases in walking such that trail use in the community receiving the police-patrolled walking plus social marketing program increased from 40 to 400 walkers per month 9 months after the initial assessment. Further, increased walking was sustained in this community, with ~200 trail users recorded each month during the 18- to 24-month assessments. No such increases in walking attendance were seen in the police-patrolled walking-only community. Stationary observations of trail users also showed a greater number of walkers in the police-patrolled walking plus social marketing community as compared to the police-patrolled walking-only community at 12 and 18 months; however, these differences were not statistically different. Analysis of accelerometry estimates of MVPA in the community sample revealed no significant differences across communities.

This is one of the first studies to demonstrate promising results for a social marketing walking program on walking outcomes in underserved African-American communities. Using an ecological approach that conceptualizes individuals as part of a broader social context [45, 46], this study expanded on previous research by applying a grassroots approach to social marketing to address cultural values around access, improved safety, and social connectedness to promote walking in low-income, African-American communities.

Further, the PATH trial included comparison communities that received either a gradient of the walking plus social marketing intervention or health education only. Assessments were conducted at multiple levels in the PATH trial, allowing for the evaluation of program effects on PA in individual community residents and on trail use within each walking community. Changes in accelerometry-assessed MVPA were evaluated in the community sample to demonstrate the broader impact of program effects on PA in individuals representing average residents within each community. No differences in MVPA across communities were observed. However, an examination of the more immediate impact of the walking program using attendance and stationary observations of walking did reveal patterns that indicated substantial increases in program attendance and walking behavior in the police-patrolled walking plus social marketing community.

This program effect was sustained past the peak of the social marketing program that was driven in part by community efforts. Hawe et al. [47] have argued that uncovering how interventions interact with contextual factors (e.g., social neighborhood features) may shed light on program sustainability in particular. The fact that the social marketing intervention

[2]Results from a one-way repeated measures ANOVA showed an effect for mobile observations in the police-patrolled walking program-only community ($F(3, 78)=4.54$, $p<0.01$). Results from a one-way repeated measures ANOVA also showed a trend for a within-subject effect for stationary observations in the walking plus social marketing community ($F(2, 26)=3.00$, $p=0.06$). The pattern of the results was consistent with the descriptive results already reported. However, it is important to note that the study was underpowered; thus, these analyses should be interpreted with caution.

ended at 12 months but was sustained for an additional year by the community suggested that social marketing strategies may be able to extend beyond the original implementation period of a program when they are adopted by the community and translated into a program consistent with community social values. In addition, the community observations seemed to suggest that there were increases in the amount of PA carried out in highly visible locations, which could in turn shape social norms for PA in these communities and further sustain program effects.

Recently, investigators have argued that distribution and transformation of resources may be instrumental in developing effective, long-term behavior-change impacts within community-based interventions [47]. This type of community-based intervention approach provides opportunities for both skill-building (increasing collective efficacy for PA) and community connectedness (social opportunities to connect with neighbors etc.) that can indirectly transform social norms by positively impacting social networks within communities [47]. While this paper does not provide information on social mediators of the intervention effects, our team has evaluated the role of social factors and neighborhood-level factors on PA in the PATH trial. One published paper [48] examined the effects of spatial proximity, police-reported crime, and social-environmental factors on walking status in African-American adults in the PATH police-patrolled walking plus social marketing community. Specifically, relationships between household proximity to the walking trail and social factors (social life, safety) were evaluated in relation to walking status (walker, non-walker). Results showed a consistent pattern indicating that neighborhood social life and income were consistently significant predictors of walking status. Specifically, income and social life were negatively associated with greater likelihood of joining the walking group program through 12 months of the intervention. In another publication, we reported formative process evaluation methods and implementation of dose, fidelity, and reach of the PATH trial [25]. Pride Strides were a key social marketing component that allowed for social interaction among walkers who were identified as part of a regular walking group within the community. Taken together, supplemental analyses of the PATH trial suggest that social life and identifying with a walking group were key determinants of increased walking rates in the walking plus social marketing community of the PATH trial.

There are several limitations to the present study that should be noted. Most importantly are internal threats to the validity of the trial given that each trial arm included only one community. Because treatment status and community overlap in this study, random effects for community were not included in these analyses; thus, strong statements about the causes of any differences seen between communities cannot be made. In order to better equate communities, matching on critical variables prior to randomization was used and the analyses controlled for baseline differences across communities. To address potential selection differences introduced by the absence of random assignment at the individual level, preliminary analyses evaluated baseline equivalence across communities. There is a variety of design features that have been shown to improve the interpretability of results using these limited study designs [49]. Many of these design features are characteristics of the PATH trial, including having more than one comparison group, completing assessments at multiple time points, and providing varying amounts of the treatment dose across conditions (e.g., communities). Nevertheless, this study design limits the generalizations that

can be made from this study and more research including a group-randomized trial is needed to demonstrate that these results can be replicated across similar communities.

In conclusion, this project is the first to examine the efficacy of developing and implementing an environmental intervention that includes a social marketing grassroots campaign for changing perceptions of safety and access to PA and increasing community connectedness in neighborhoods that experience significant socioeconomic- and safety-related barriers to PA and health. Overall, this innovative intervention approach provides support for future investigators to integrate valuable social marketing strategies for increasing walking in high-need communities. The community-based participatory approach utilized in the study also gives credibility for the translational aspects of the intervention approach. Future research using multiple level outcomes and including group-randomized trials is needed to demonstrate that these results can be replicated across similar communities.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

Acknowledgments

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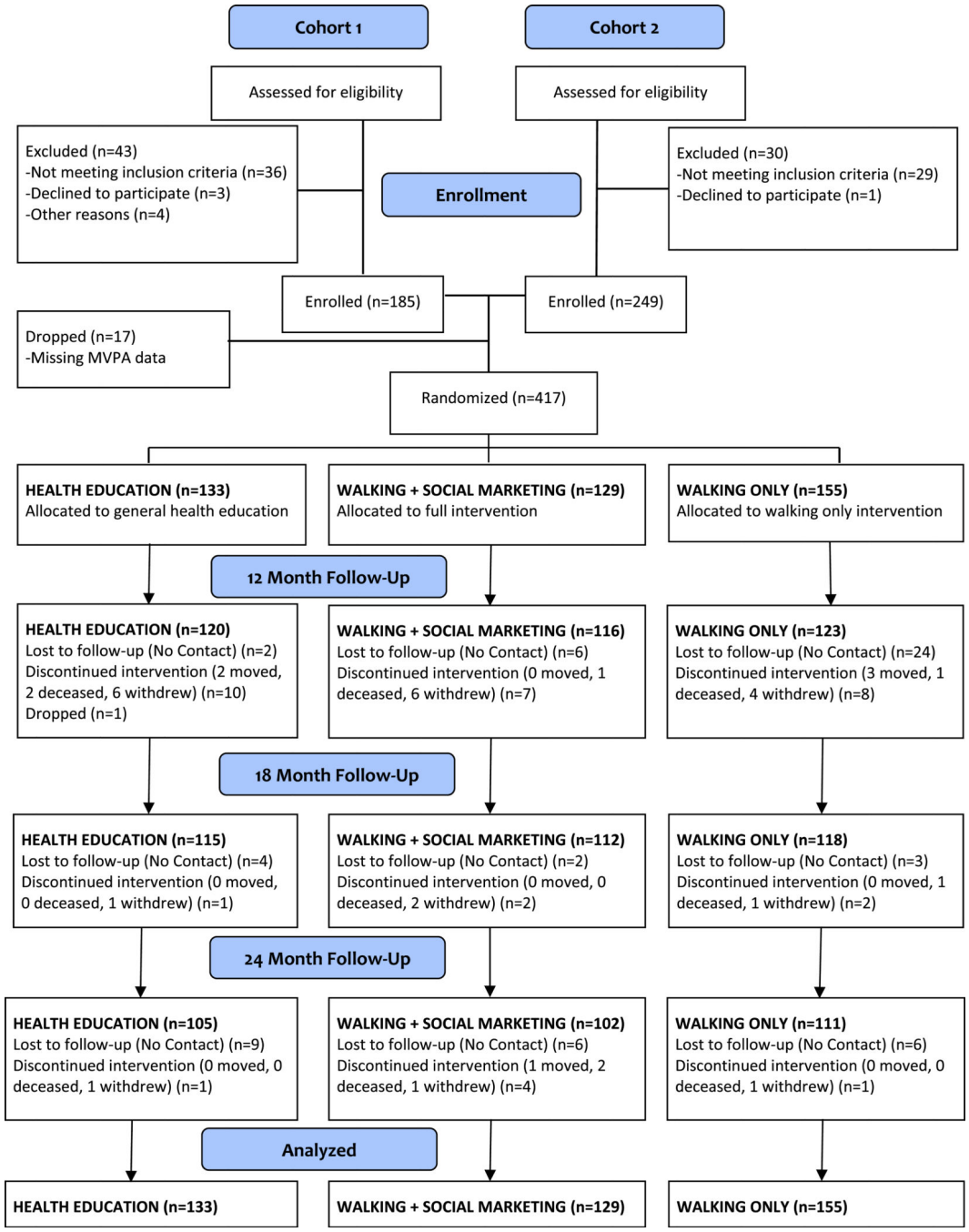

Fig. 1.
Consort guideline

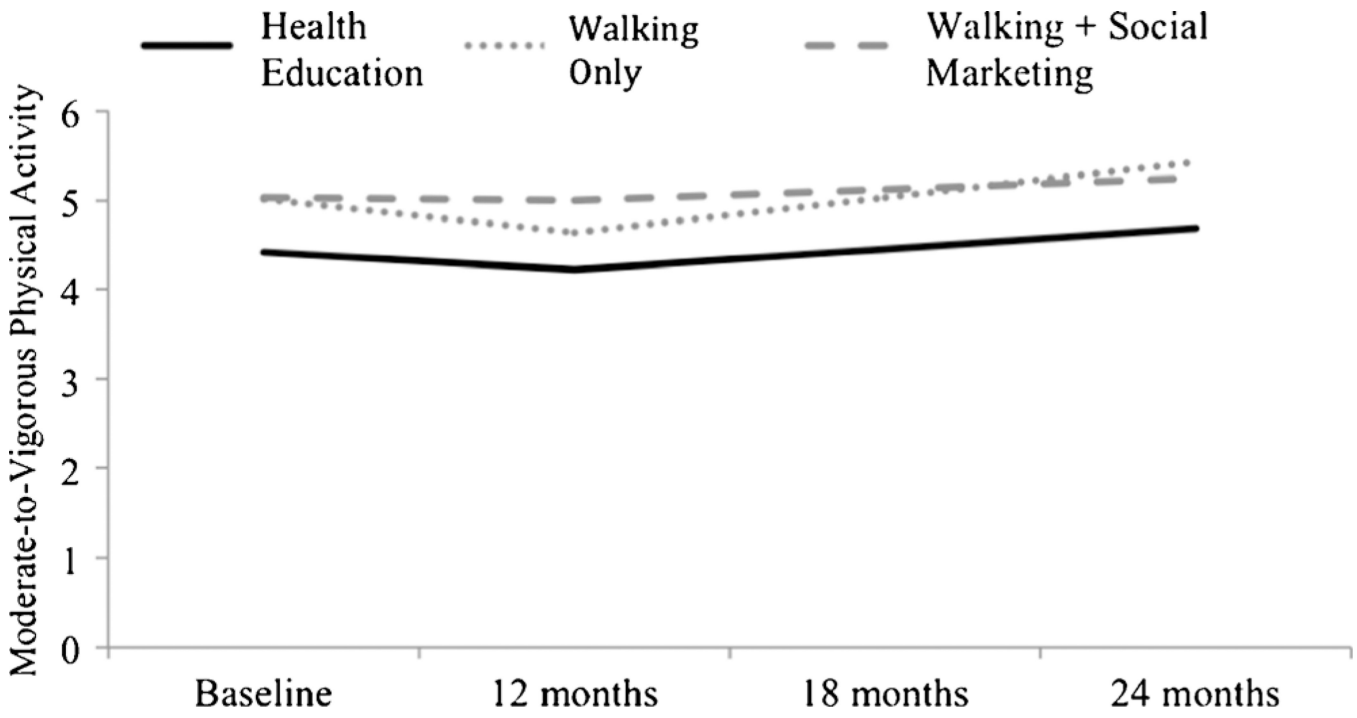

Fig. 2.

Predicted community-level estimates of square root transformed moderate-to-vigorous physical activity by treatment group and time

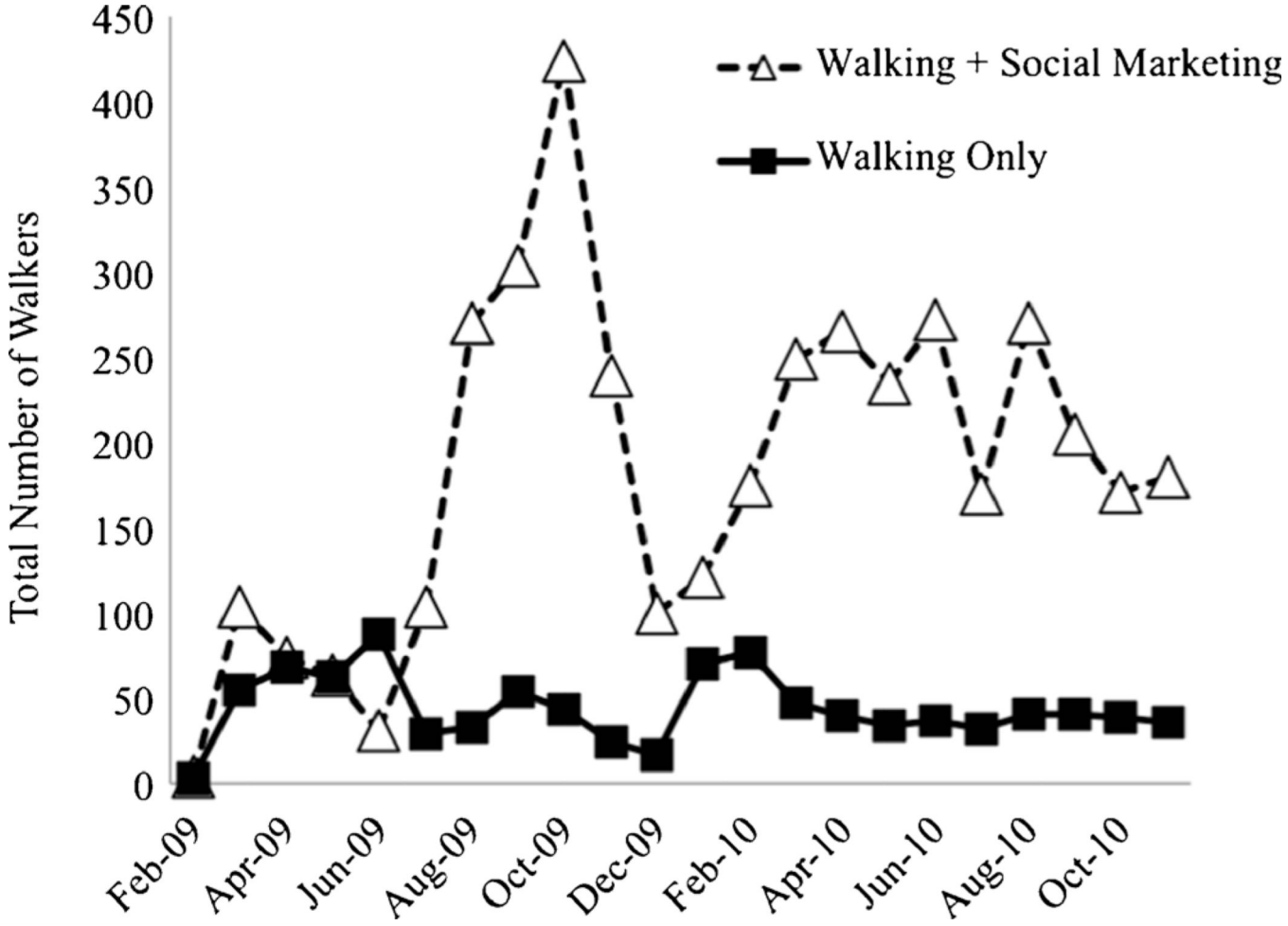

Fig. 3.
Walking attendance by month, baseline to 24 months

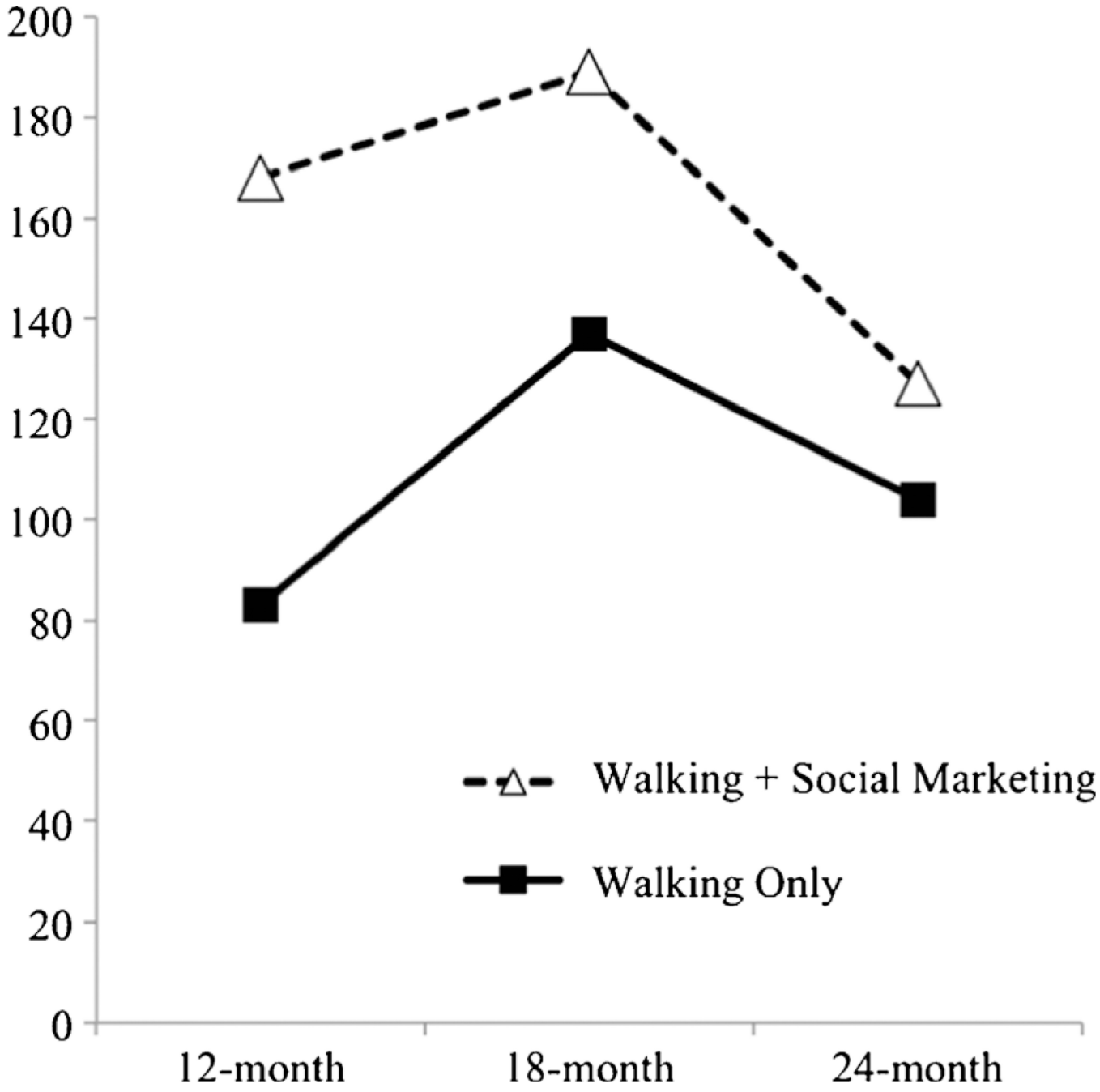

Fig. 4.
Total trail users per month assessed by stationary observation, 12 to 24 months

Table 1

Baseline characteristics of the PATH sample by community and in total

	Full (*n*=133)	Walking only (*n*=164)	General health (*n*=137)	Total (*N*=434)
Gender				
Male	44	61	61	166
Female	89	103	76	268
Age (yrs)				
Mean (SD)	54.15 (15.59)	47.99 (15.53)	51.93 (15.39)	51.12 (15.68)
18–24	8	15	11	34
25–44	26	54	33	113
45–64	66	72	66	204
65–85	33	23	27	83
Marital status				
Married	36	32	32	100
Separated	18	20	21	59
Divorced	16	18	15	49
Widowed	30	27	24	81
Never married	23	54	34	111
Unmarried couple	9	13	9	31
Children in household				
No	91	97	87	275
Yes	41	63	42	146
Employment				
Working	38	71	60	169
Laid off/unemployed	29	32	24	85
Retired	39	26	29	94
Disabled	7	19	9	35
Homemaker	5	4	3	12
Student	5	6	2	13
Education				
<HS degree	36	43	39	118
HS degree/GED	49	76	49	174
Some college/technical training	32	31	27	90
College degree	5	4	10	19
Graduate/professional degree	8	8	7	23
Income				
<US$10,000	42	42	41	125
US$10,000–24,000	43	61	41	145
US$25,000–39,000	24	24	29	77
US$40,000–54,000	11	16	7	34
>US$54,000	9	11	9	29
BMI				

	Full (*n*=133)	**Walking only (*n*=164)**	**General health (*n*=137)**	**Total (*N*=434)**
Mean (SE)	30.40 (0.70)	29.74 (0.66)	31.21 (0.73)	30.26 (0.39)
<25	30	48	32	110
25–<30	36	41	32	109
>30	67	73	72	212
MVPA				
Mean (SE)	35.96 (4.17)	40.24 (4.32)	27.86 (2.43)	34.78 (2.24)

Values for categorical data are based on pre-imputed data. Means (SE) for BMI and MVPA are predicted values based on imputed data. MVPA values are model based estimates using imputed data where MVPA was square root transformed and then back transformed for reporting. *BMI* Body Mass Index; *MVPA* Moderate-to-Vigorous Physical Activity; *HS* High School; *GED* Graduate Equivalent Degree.

Table 2

Effects of treatment on moderate-to-vigorous physical activity in community sample at 12 months and from 12 to 24 months (*N*=417)

	Estimate	(SE)	df	Lower CI	Upper CI	MI
Intercept	4.41 [a]	0.29	3458.17	3.84	4.98	0.07
Female	1.42 [a]	0.27	457.29	0.90	1.94	0.21
Age	−1.32 [a]	0.12	357.32	−1.56	−1.08	0.23
BMI	−0.38 [a]	0.13	160.63	−0.64	−0.13	0.35
Diastolic BP	0.04	0.11	1176.11	−0.17	0.26	0.13
Income	−0.02	0.13	207.29	−0.28	0.24	0.31
Education	−0.11	0.12	687.11	−0.34	0.12	0.17
Family SS	0.10	0.13	1392.40	−0.15	0.36	0.12
Friend SS	0.05	0.13	446.68	−0.21	0.31	0.21
Motivation for PA	0.36 [b]	0.13	306.32	0.11	0.62	0.25
Access to places	0.10	0.13	210.05	−0.15	0.35	0.31
Crime	0.04	0.11	1857.13	−0.18	0.26	0.10
Season	0.03	0.24	414.23	−0.44	0.49	0.22
Walking only	0.60	0.39	537.20	−0.17	1.37	0.19
Full intervention	0.62	0.39	1088.17	−0.14	1.39	0.13
Time	−0.19	0.47	58.64	−1.13	0.76	0.58
Time change	0.47	0.41	84.43	−0.35	1.29	0.49
Walk×time	−0.18	0.63	62.95	−1.45	1.08	0.56
Full×time	0.16	0.49	546.70	−0.80	1.13	0.19
Walk×time change	0.32	0.55	96.27	−0.76	1.41	0.46
Full×time change	−0.22	0.48	473.18	−1.16	0.71	0.20

Average daily minutes of MVPA is on the square root scale. Continuous covariates are centered. Walking and full intervention are dummy-coded variables, with 1 indicating the presence of each program, respectively. Time is a dummy-coded variable, with baseline coded 0 and all subsequent assessment periods coded 1. Time change is a variable representing change from12 to 24 months. (SE) is the standard error of the parameter estimate and df is the estimated df, both adjusted for the use of multiple imputation. CI is the 95 % confidence interval. MI is the fraction of missing information, a measure of differences in each parameter estimate between imputed datasets

BMI body mass index, *BP* blood pressure, *PA* physical activity, *SS* social support

[a] Denotes $p<001$

[b] Denotes $p<01$

Table 3

Number of trail users for mobile and stationary trail assessments

	Walking+social marketing				Walking only			
	Baseline	**12-month**	**18-month**	**24-month**	**Baseline**	**12-month**	**18-month**	**24-month**
Total walkers per mobile time point[a]	206.77	245.11	183.46	205.26	168.75	194.32	157.95	211.36
Average walkers per mobile interval, mean (SD)	7.38 (4.91)	6.86 (4.69)	6.55 (3.07)	7.33 (5.17)	6.02 (4.18)	7.20 (2.88)	5.64 (2.33)	7.54 (4.13)
Total walkers per stationary time point	N/A	168	189	127	N/A	83	137	104
Average walkers per stationary interval, mean (SD)	N/A	12.0 (7.52)	13.50 (7.42)	9.07 (3.39)	N/A	5.93 (3.20)	9.79 (7.83)	7.43 (4.01)

SD standard deviation

[a]Total walkers is an adjusted rate to account for trail length with total walkers observed divided by 1.33 for trail length in walking+social marketing and 1.76 in the walking-only community