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Dawn K. Wilson

M. Lee Van Horn

Heather Kitzman-Ulrich

Ruth P. Saunders

Russell R. Pate
University of South Carolina - Columbia, rpate@mailbox.sc.edu

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Author(s)

Dawn K. Wilson, M. Lee Van Horn, Heather Kitzman-Ulrich, Ruth P. Saunders, Russell R. Pate, Hannah G. Lawman, Brent Hutto, Sarah Griffin, Nicole Zarrett, Cheryl L. Addy, Leslie Mansard, Gary Mixon, and Porschia V. Brown

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Dawn K. Wilson,
Department of Psychology, University of South Carolina

M. Lee Van Horn,
Department of Psychology, University of South Carolina

Heather Kitzman-Ulrich,
Department of Psychology, University of South Carolina

Ruth Saunders,
Department of Health Promotion, Education and Behavior, Arnold School of Public Health, University of South Carolina

Russell Pate,
Department of Exercise Science, Arnold School of Public Health, University of South Carolina

Hannah G. Lawman,
Department of Psychology, University of South Carolina

Brent Hutto,
Prevention Research Center, Arnold School of Public Health, University of South Carolina

Sarah Griffin,
Department of Public Health Sciences, College of Health, Education, and Human Development, Clemson University

Nicole Zarrett,
Department of Psychology, University of South Carolina

Cheryl L. Addy,
Department of Epidemiology and Biostatistics, Arnold School of Public Health, University of South Carolina

Leslie Mansard,
Department of Psychology, University of South Carolina

Gary Mixon, and
Sumter County Parks and Recreation Department (ClinicalTrials.gov number NCT01028144)

Porschia V. Brown
Department of Health Promotion, Education and Behavior, Arnold School of Public Health, University of South Carolina

Abstract

Correspondence concerning this article should be addressed to Dawn K. Wilson, Department of Psychology, Barnwell College, University of South Carolina, Columbia, SC 29208. wilsondk@mailbox.sc.edu.

Objective—This study reports the results of the "Active by Choice Today" (ACT) trial for increasing moderate-to-vigorous physical activity (MVPA) in low-income and minority adolescents.

Design—The ACT program was a randomized controlled school-based trial testing the efficacy of a motivational plus behavioral skills intervention on increasing MVPA in underserved adolescents. Twenty-four middle schools were matched on school size, percentage minorities, percentage free or reduce lunch, and urban or rural setting before randomization. A total of 1,563 6th grade students (mean age, 11.3 years, 73% African American, 71% free or reduced lunch, 55% female) participated in either a 17-week (over one academic year) intervention or comparison after-school program.

Main Outcome Measure—The primary outcome measure was MVPA based on 7-day accelerometry estimates at 2-weeks postintervention and an intermediate outcome was MVPA at midintervention.

Results—At midintervention students in the intervention condition engaged in 4.87 greater minutes of MVPA per day (95% CI: 1.18 to 8.57) than control students. Students in intervention schools engaged in 9.11 min (95% CI: 5.73 to 12.48) more of MVPA per day than those in control schools during the program time periods; indicating a 27 min per week increase in MVPA. No significant effect of the ACT intervention was found outside of school times or for MVPA at 2-weeks postintervention.

Conclusions—Motivational and behavioral skills programs are effective at increasing MVPA in low-income and minority adolescents during program hours, but further research is needed to address home barriers to youth MVPA.

Keywords

National studies indicate that the increasing rate of childhood obesity is a major public health problem and that prevalence rates of obesity among youth have more than tripled in the last three decades (Levi, Vinter, Laurent, & Segal, 2008; Ogden, Carroll, Curtin, Lamb, & Flegal, 2010). Reports indicate that 34.2% of adolescents and 39.5% of African American adolescents are overweight or obese (Ogden et al., 2010). In addition, recent estimates indicate that 50–92% of youth do not meet the national guidelines for engaging in regular physical activity (PA) and PA declines by 50% between the elementary and middle school years (Nader et al., 2008; Troiano et al., 2008; U.S. Department of Health and Human Services, 2008). High levels of obesity have been found to be especially problematic among minority and low-income youth who have less access to safe PA opportunities, and who have lessfamily support for participating in PA (Molnar, Gortmaker, Bull, & Buka, 2004; Pettit, Laird, Bates, & Dodge, 1997).

Few studies have examined the effects of school-based interventions on increasing PA in underserved adolescent populations such as low income, ethnic minorities (Bayne-Smith, Fardy, Magel, Schmitz, & Agin, 2004; Coleman, Tiller, Sanchez, et al., 2005; McKenzie et al., 2004; Robinson et al., 2003; Story et al., 2003). In general school-based interventions have had little or only modest effects on increasing PA and have resulted in little to no change in PA outside of school settings (Baranowski, Anderson, & Carmark, 1998; Gortmaker et al., 1999; Kelder, Perry, & Klepp, 1989; Killen et al., 1988; Saunders et al., 2006; van Sluijs, McMinn, & Griffin, 2007). Where comprehensive school-based interventions have typically included common behavior modification components including self-monitoring of PA, goal setting, and behavioral skills training, little attention has been given to involving youth in developing program ideas and PA choices that may enhance

more intrinsic motivation, and thus, increase the likelihood of continued engagement in PA. Previous studies have provided evidence for the importance of choice and self-initiated behavior change on increasing intrinsic motivation for engaging in PA (Ferrer-Caja & Weiss, 2000; Thompson & Wankel, 1980; Wilson et al., 2005), but large scale randomized trials have not tested motivational and behavioral skills interventions specifically in low-income, ethnic minority adolescents (Wilson, 2009; Wilson et al., 2002; Wilson et al., 2005).

The ACT intervention integrated principles from Self-Determination Theory (Deci, Koestner, & Ryan, 1999; Ryan & Deci, 2000) and Social Cognitive Theory (Bandura, 1989, 2004). Self-Determination Theory (SDT) proposes that behavior changes that are motivated by intrinsic factors such as novel, enjoyable, self-driven, and satisfying experiences will be sustained over time. In the ACT intervention elements from SDT targeted the social environmental during the after-school program for enhancing autonomy (choice), fun, belongingness (engagement), and competence (challenges emphasizing non- competitive play) for PA (Wilson et al., 2006; Wilson et al., 2009). SCT theory assumes that individual-cognitive factors, environmental events, and behavior are interacting and reciprocal determinants of each other. Thus, both cognitive and social factors were integrated into the development of a behavioral skills component of the ACT intervention for increasing PA. The ACT intervention specifically targeted development of behavioral skills (communication, reciprocity of social support, group goal setting, and behavioral competence) for increasing PA outside of program days. In addition, the ACT after-school program social environment (autonomy, choice, participation, belongingness, fun, enjoyment, support) was designed to have a positive impact on cognitive mediators (self-confidence, perceived competence) and motivational orientation (intrinsic motivation, commitment, positive self-concept) to promote longterm PA behavior (Wilson et al., 2009, 2006, 2008). The primary aim of this study was to determine the efficacy of the motivational and behavioral skills ACT intervention (vs. a control program– general health education) on increasing PA at 2-weeks postintervention (primary outcome) and at midintervention (intermediate outcome) in underserved adolescents.

Method

Study Design

The ACT trial is a group-randomized cohort design (12 intervention, 12 comparison schools; Wilson et al., 2008). Schools were paired on school size, percentage of minorities, proportion of free and reduced lunch, and urban or rural setting before recruitment and randomization. Baseline measures were obtained by blinded measurement staff and schools were randomized to condition using computer generated random numbers after the completion of baseline measures. A total of 24 middle schools in South Carolina were recruited to participate.

Recruitment

The recruitment flowchart is presented in Figure 1. All 6th grade students in 24 public middle schools were eligible to participate if they had parental consent and agreed to study participation and random assignment (Wilson et al., 2008). A total of 71% of our final sample qualified for free or reduced lunch. Adolescents were excluded if they (1) had a medical condition that interfered with PA, (2) were developmentally delayed such that the intervention materials were not cognitively appropriate or, (3) were currently in treatment for a psychiatric disorder. Presentations to parents and students were given at the school orientations encouraging participation in the after-school program (Wilson et al., 2008). During the presentations staff presented highlights of the program including no cost for

student participation, help with homework, having fun, and making friends at their new school. Pep rallies and homeroom visits were two methods of recruitment that were implemented during a second phase of recruitment to increase enrollment in the after-school program (Wilson et al., 2008).

ACT Intervention

All of the theoretically based elements of the ACT intervention are summarized into the ACT essential elements, which have been previously described (Wilson et al., 2009, 2008). Specifically in the present study elements from SCT and SDT were combined to develop an intervention that promoted behavioral skills (communication, reciprocity of social support, group goal setting, and behavioral competence) for PA outside the program and a social environmental approach during the after-school program for enhancing autonomy (choice), fun, belongingness (engagement), and competence (challenges emphasizing noncompetitive play) for PA. Noncompetitive play involved, for example, five-pass basketball in which all players on the team had to handle the ball before shooting. This notion here was to create a positive climate were belonging rather that winning was emphasized. Behavioral goal setting was always performed as a group and involved making a public commitment (i.e., exercise for a set amount of minutes per day in the home environment) to create belongingness and positive social support among peers in the program.

The ACT intervention was a 17-week program implemented on Mondays, Tuesdays, and Thursdays for 2 hr after school. On Wednesdays students practiced what they had learned in the after-school program in their home environment. A trained team leader, with expertise in implementing physical activities in youth, provided the structure for the ACT intervention program implementation (see also Wilson et al., 2009, for details on training). The program had three main components: homework/snack (30 min), MVPA activities (60 min) that students selected each week, and a behavioral skills and motivational component (30 min) during which intervention staff worked with participants on developing strategies for increasing their MVPA in their home environment. The General Health Education Program (comparison program) focused on nutrition, stress management, drug prevention, and drop-out prevention (with no PA component). The comparison program consisted of a homework/snack (30 min) and three hands-on activities related to general health (30 min each). The comparison program was held on the same days and times as the ACT intervention program (Wilson et al., 2008).

Measures

The ACT intervention was 17 weeks in duration over the course of one academic school year. Measures were collected at baseline (October), midintervention (9-weeks; December) (intermediate outcome), and at 2-weeks postintervention (19-weeks; April). Process evaluation data were obtained throughout the duration of the program (Wilson et al., 2009).

Process evaluation measures—The ACT trial incorporated a comprehensive process evaluation methodology for assessing program implementation (Wilson et al., 2009, 2008). The ACT process data for this report were assessed for summative purposes and were collected by a trained, independent process evaluator using systematic observation of after-school program activities to assess the fidelity of intervention implementation, dose delivered, and reach of the intervention (Wilson et al., 2009, 2008). The process evaluation questions can be summarized as: (1) *Dose delivered* (completeness for all components), To what extent were all planned components of the program provided to program participants? (2) *Fidelity* (for PA and behavioral skills components), To what extent was the social environment autonomy supportive, (3) *Reach*, What percentage of the possible target group attended each day of the program? Observational data capturing fidelity were scored on a 4

point scale with 1 representing lowest fidelity and 4 representing highest level of fidelity. Mean scores were used to summarize the results. Fidelity measures for the PA and behavioral skills component of the program included measures for clarity of rules and expectations, choice, optimal challenge, and relatedness and belonging. The dose assessment used yes or no response options.

The process evaluator observed the 2-hr program for each day of the program for 2 weeks (3 program days for 2 weeks) at three points in time, early (weeks 1 and 2), midpoint (weeks 8 and 9), and near the end (weeks 15 and 16) of the 17-week program. Fidelity data were not obtained in comparison schools because of limited resources. Daily attendance was recorded by the team leader at each school (across intervention and control schools) during program days. Before implementation, the team determined that the minimal acceptable level of fidelity was 3 on a 1–4 scale. In addition, the dose criteria was based on the percentage of core activities that program staff completed during the sessions that were observed and that before implementation, the team determined that the minimum acceptable level was 75% completion.

Demographic measures—Participants' age, sex, and race were self-reported at baseline. Height and weight were assessed objectively at baseline and at 2-weeks postintervention. Information about whether students were on the free or reduced lunch was obtained from school records.

Motivational measures—The Intrinsic Motivation Inventory (IMI), a multidimensional measurement to assess participants' subjective motivational experience related to PA was measured at midintervention during the after-school program. This measure has been previously validated (Deci, Eghrari, Patrick, & Leone, 1994). The instrument assesses participants' enjoyment, perceived competence, effort, value/usefulness, felt pressure and tension, and perceived choice while performing a given activity, thus yielding six subscale scores. The two subscales used in the present study included the: (1) interest/enjoyment subscale and (2) perceived choice subscale. These subscales were theorized to be positive predictors of both self-report and behavioral measures of intrinsic motivation and have been shown to have adequate reliability and validity (McAuley, Duncan, & Tammen, 1987). In the present study, perceived enjoyment was a positive endorsement count of six items (yes or no format) with a mean of 4.19 ($SD = 2.15$) and for perceived choice was a positive endorsement count of five items (yes or no format) with a mean of 2.31 ($SD = 1.27$).

PA monitoring (Accelerometers)—Assessments of MVPA were obtained with omni-directional Actical accelerometers (Mini-Mitter, Bend, OR) at baseline, midintervention, and at 2-weeks postintervention. Actical has been shown to have moderate to high correlations between activity counts and energy expenditure of individuals measured concurrently by other empirically tested accelerometers (e.g., MTI Actigraph, Caltrac, Tritrac) (Puyau, Adolph, Vohra, Zakeri, & Butte, 2004). Participants wore an accelerometer over seven consecutive days to calculate MVPA. Each weekday of Actical data was divided into five intervals: 6–9 a.m., 9–2 p.m., 2–5 p.m., 5–8 p.m., and 8 p.m. to midnight while weekend days used intervals of 6-11 a.m. and 11 a.m. to 2 p.m. as was done in a previous national trial (Catellier et al., 2005). Data were recorded in 1-min epochs (Welk, Schaben, & Morrow, 2004) and data was converted into time spent in moderate PA (3 to <6 METS), vigorous PA (6 to <9 METS), and MVPA (3 to <9 METS) based on Actical-specific activity count thresholds where MVPA = 1,500 to <6,500 and VPA =>6,500 (Puyau et al., 2004).

Data Analysis

Mixed ANCOVAs with random effects appropriate for group randomized trials were used to assess the effect of the ACT intervention (Donner & Klar, 2000) on MVPA. Using the mixed effects notation (Pinheiro & Bates, 2000) at 2-weeks postintervention the statistical model was:

$$
\begin{aligned}
\text{MVPApost}_{ij} = \quad & \beta_0 + \beta_1 \text{MVPAbase}_{ij} + \beta_2\,\text{Female}_{ij} \\
& + \beta_3\,\text{Black}_{ij} + \beta_4\,\text{BMIbase}_{ij} \\
& + \beta_5\,\text{Treatment}_i + b_i \\
& + \varepsilon_{ij}, b_i \sim N\left(0, \sigma_b^2\right), \varepsilon_{ij} \sim N\left(0, \sigma^2\right)
\end{aligned}
$$

where MVPApost_{ij} is the realized value of MVPA at 2-weeks postintervention for individual j in the ith school, β_0 is the intercept across all schools, β_1–β_4 are the effects of covariates (sex, ethnicity, and baseline BMI were included as covariates in all analyses where MVPA was the outcome), and β_5 is the difference in means between intervention and control schools holding covariates constant. The random effect b_i allows for intercepts to differ between schools, thus accounting for any nonindependence of the outcome within schools. The random error terms are assumed to be approximately normally distributed with a mean of 0, and variances σ_b^2 and σ^2, respectively. Degrees of freedom for intervention effects were constrained by the number of schools in the analyses.

An analysis was also conducted at the midintervention to test for intervention effects during the time block when the after-school program was in session. The model was modified such that the outcome variable was minutes of MVPA in each time block:

$$
\begin{aligned}
\text{MVPA}_{ijt} = \quad & \beta_0 + \beta_1\,\text{MVPAbase}_{ijt} + \beta_2\,\text{Female}_{ijt} \\
& + \beta_3\,\text{Black}_{ijt} + \beta_4\,\text{BMIbase}_{ijt} + \beta_5\,\text{Treatment}_i \\
& + \beta_6\,\text{Program Time}_{ijt} \\
& + \beta_7\,\text{Treatment} * \text{Program Time}_{ijt} + b_{0i} + b_{7i} \\
& + b_{0ij} + b_{7ij} + \varepsilon_{ijt}
\end{aligned}
$$

where i indicates schools, j indicates individuals, and t indicates time blocks. Program time takes the value 1 if time block t was during the after-school hours on Monday, Tuesday, or Thursday (program days) and 0 otherwise. Therefore, the parameter β_5 represents the difference in MVPA between intervention and control schools when students are *not* in the after-school program, β_6 is the effect of program time for the control schools, and β_7 is the difference in MVPA between intervention and control schools during the program time. This is now a three level model, with random effects for the intercept and the interaction between intervention and program time for individuals and for schools.

Multiple imputation was used (Schafer, 1997a) to provide unbiased parameter estimates and standard errors for the intervention effect consistent with previous national trials (Catellier et al., 2005; Murray, 1998; Taljaard, Donner, & Klar, 2008). The PAN package (Schafer, 1997b) implemented within R (R Foundation, 2008) was used to generate 40 imputations with minutes of MVPA for each period log-transformed (for details see http://www.psych.sc.edu/facdocs/wilson.html). Imputation was conducted at the student level and baseline information for each student was included in the imputation model. If a student was missing for an entire assessment period, (e.g.–midintervention) then a summary score representing average minutes of MVPA for the entire period was imputed. Time block specific imputations take advantage of information from consecutive time blocks and time of day effects present in that wave; attempting to impute time block specific effects when a

student was not present for that assessment period was avoided because of highly variable and sometimes extreme estimates. All reported standard errors were adjusted for missing information, and reported intra class correlation coefficients (ICCs) were averaged across all imputations.

Results

Baseline Analyses

Table 1 presents the baseline demographics of the study sample. Students were on average 11.3 years old and an average had a BMI of 22.9. Fifty-four percent of the participants were female, and 73% were African American. Fifty-one percent of the youth were in the 85th percentile for being overweight or obese. Random effects models using multiply imputed data and incorporating clustering within schools found no significant differences between intervention and control schools for any of these variables. An additional random effects ANCOVA was conducted and examined differences in MVPA between intervention and control groups at baseline. Students in intervention schools engaged in 0.19 min per day less of MVPA (95% CI: −4.60 to 4.22) than those in control schools. This result was not greater than that expected because of chance. The ICC for MVPA at baseline with covariates was .012.

Because the time specific analyses at midpoint included only students present during midintervention, additional analyses were conducted to evaluate differential attrition for this time point. Absence at midpoint was used to predict ethnicity, sex, baseline age, baseline BMI, and baseline MVPA using multiple imputation. No differences were found on sex, baseline BMI, or baseline MVPA. Those not present at midpoint were older than those present by .07 years (95% CI: .002 to .145). There was also an effect of ethnicity on midpoint absence, African American students had a decrease in the logit of being absence at midpoint of −.40 (*SE* = .14); 28% of non-African American students and 23% of African American students were absent at midintervention.

Process Evaluation

The attendance rates across intervention and control schools were very similar and has been previously reported (Wilson et al., 2009). Averaged across intervention and control schools the attendance rates were 46% for year 1, 64% for year 2, 57% for year 3, and 55% for year 4. Eleven of the 12 intervention schools met the overall dose delivered criteria with at least 75% of components delivered (see Table 2). Nine of the 12 intervention schools met the fidelity criteria (3.0 or higher rating) for intervention implementation (see Table 2).

Analysis of Intervention Effects on MVPA

Midintervention—As expected, an examination of levels of MVPA across the course of the study (see Table 3) showed a seasonal effect. Levels of MVPA decreased from baseline to midintervention and increased from midintervention to 2 weeks postintervention. Furthermore, as the intervention took place on Mondays, Tuesdays, and Thursdays, it is notable that MVPA in the ACT intervention group appeared to increase from baseline on those program days. As compared to baseline, MVPA for the control group was lower at midintervention across every day. Differences in this trend between ACT and the control group were examined using a mixed effects ANCOVA, and demonstrated a significant intervention effect at midintervention (see Table 4). The ACT intervention was successful at reducing the seasonal decrease in MVPA; students in the ACT intervention engaged in 4.87 greater minutes per day of MVPA (95% CI: 1.18 to 8.57) than those in the control condition. The effect size for this increase across the entire week is Cohen's D = .24. The ICC for MVPA at midintervention was .024.

Further analyses were conducted to determine the effects at midintervention (including only students with actical data at midintervention, $N = 1079$). An analysis was conducted with minutes of MVPA from each of the 5 time periods per day for the week at midintervention as the outcome. The program time indicator specifies that an observation was during the after-school program and the interaction between program time and treatment ("Program Time*TX", see Table 5) indicated the treatment effect on MVPA during the time that the program was in session. Results (see Table 5) demonstrated that students in the ACT intervention schools engaged in 9.11 min (95% CI: 5.73 to 12.48) more of MVPA than those in control schools during the three time periods in which the after-school programs were conducted; indicating a 27 min per week increase in MVPA.

MVPA at 2-weeks postintervention—A mixed effects ANCOVA demonstrated no significant differences in MVPA between intervention and control groups at 2-weeks postintervention (see Table 4). The correlation between baseline and 2-week postintervention MVPA was 0.37, $p < .05$. The ICC of the outcome was .019, and there was little missing information.

Motivational measures during midintervention—Additional analyses were conducted to look at differences between ACT and control schools student perceptions of enjoyment and choice of activities based on the IMI subscales (Deci, Eghrari, Patrick & Leone, 1994) at midintervention during the after-school program. A mixed effects ANCOVA demonstrated a significant intervention effect such that students in the ACT program reported higher levels of program enjoyment than students in the control program (B = .69, $SE = .29$, $df = 22$; $p < .05$). Students in the ACT intervention also reported having greater choice of activities than students in the control program (B = .69, $SE = .29$, $df = 22$; $p < .05$). The effect sizes for both effects were Cohen's D of .32 and .29, respectively.

Postintervention Focus Groups

At postintervention three focus groups were conducted with students ($n = 19$ students) at two ACT intervention schools to determine what barriers prevented youth from continuing PA after the program ended. Students reported four themes related to barriers (1) competing demands at home, (2) not being motivated without teachers, (3) lack of parent involvement such as "could not go outside because parents were not home" and "parents made it hard to exercise at home," and (4) environmental barriers such as "bad weather" and "safety concerns."

Discussion

This is the first randomized trial to demonstrate a significant effect of increasing MVPA in low-income and ethnic minority adolescents in an after-school program using carefully measured accelerometry estimates. The intervention youth demonstrated a significant increase in MVPA as compared to control students at midintervention, however, the intervention effects were not sustained at 2-weeks postintervention. Focus group data indicated that these youth had a number of barriers in the home environment and in particular parents lack of involvement made it hard for them to continue engaging in PA.

Students in the intervention schools engaged in significantly greater minutes of MVPA per day than those in the control schools at midintervention. This finding is consistent with McKenzie et al. (2004) who evaluated a school-based physical education intervention on increasing MVPA in middle school students (55% minorities). The 2 year intervention resulted in a 3 min per session increase in MVPA based on observational evaluation methods of lessons. Our results indicated an approximate 9 min increase per day in MVPA

across program days, which was somewhat greater than the increase observed in McKenzie's et al. (2004) study. The weekly increase in the present study was equivalent to a 27 min increase in MVPA which is clinically meaningful in that it could shift youth into a higher level of health benefit based on national recommendations (Dunn et al., 1999). Although other investigators have conducted school programs to increase MVPA, they have not focused on low-income or minority populations (Simon et al., 2008) and many studies have not demonstrated intervention effects in school-based settings (Baranowski, Anderson, & Carmark, 1998; Beet, Bieghle, Erwin, & Huberty, 2009; McKenzie & Lounsbery, 2009; Salmon et al., 2007; van Sluijs, McMinn, & Griffin, 2007). Our trial further expands on previous research by utilizing accelerometry estimates rather than relying on self-report data (Beet et al., 2009).

The lack of an effect of increasing MVPA beyond the school environment is consistent with other studies that have shown substantial barriers for PA in underserved youth (Monge-Rojas, Garita-Arce, Sanchez-Lopez, & Colon-Ramos, 2009). Minority and low-income youth have been shown to have less access to safe and well-resourced PA opportunities (Molnar et al., 2004), have less family support, and greater barriers for participating in regular PA (Molnar et al., 2004; Pettit et al., 1997). Future interventions for underserved youth need to intervene in multiple contexts, such as in the school and home settings simultaneously to develop cost-effective programs that go beyond the school setting. A multiple systems approach that includes school and home environments could have a synergistic impact on increasing MVPA in underserved youth. Although some interventions have incorporated school and family components in promoting increases in PA among youth (Luepker et al., 1996; Manios, Kafatos, & Mamalakis, 1998; Sallis et al., 1997; Story et al., 2003; Warren et al., 2003) few studies have specifically done so in adolescents' (Salmon et al., 2007) and few have focused on underserved populations or have used objective measures of PA (Beet et al., 2009). Most multilevel school and family based programs have not been effective for promoting PA and have not been design to directly test synergistic effects (Caballero et al., 2003; Coleman et al., 2005; Fitzgibbon et al., 2005; Goran & Reynolds, 2005; Paradis et al., 2005).

Few studies have adequately reported dose and fidelity estimates of program implementation (Beet et al., 2009). One issue that requires further investigations is attendance rates, as some research has demonstrated, that students who attend 40% or greater of PA sessions show greater increases in physical fitness (Gutin, Yin, Johnson, & Barbeau, 2008; Yin et al., 2005). In the ACT trial, analyses that considered differential attendance rates did not change the overall findings presented in this report. Based on the current "state of the art" it appears that school level randomization has been lacking and extensive assessment of PA through accelerometry measures and follow up have been limited. Given that the ACT trial addressed all of these issues it provides a standard on which to promote future research efforts especially in underserved youth who are at increased risk of developing obesity and who have a number of barriers in the home environment that may limit opportunities to engage in regular PA.

There are limitations to the present study that should be noted. As summarized in this study, the dose and fidelity estimates during the first year of schools were not adequate which may have weakened the overall effects reported. However, our analytical methods using multiple imputations allowed us to utilize the maximum amount of information possible to evaluate intervention effects. Further research is needed that continues to utilize these methods for capturing missing values in an unbiased manner with accelerometry measures in youth.

This study provides evidence that a novel integration of motivational and behavioral skills into an after-school intervention was effective in increasing MVPA during the intervention

period in low-income, ethnic minority youth, but not at 2-weeks postintervention. Our study indicated a threefold great effect of the intervention on increasing MVPA than previous studies that included minority youth (McKenzie et al., 2004). Qualitative data revealed a number of barriers in the home including lack of parental involvement. Thus, future interventions are needed to intervene in multiple contexts, such as in the school and home settings simultaneously, to develop a potential synergistic impact of programs in underserved youth. Consistent with recent national recommendations for prevention of childhood obesity (Davis et al., 2007) our ACT trial used a rigorous approach to increase PA in low-income and ethnic minority adolescents. Given the alarming rates of obesity and risk for morbidity and premature mortality in this underserved population, this study sets the stage for continued scientific investigation to further enhance the impact and effects of interventions beyond the school setting on improving the health outcomes in low-income and minority youth.

Acknowledgments

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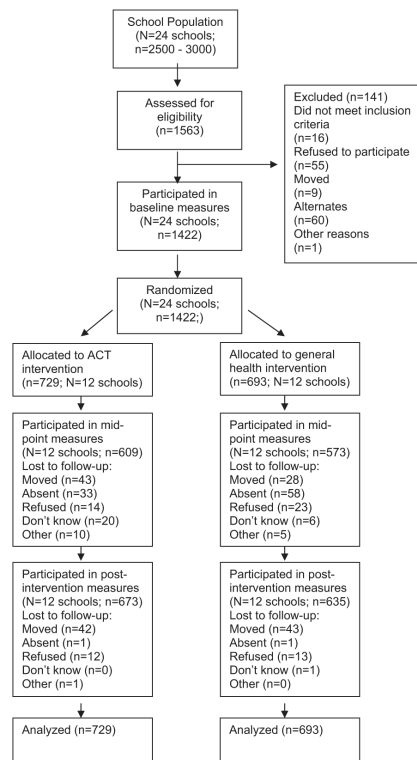
Figure 1.
Recruitment flowchart.

Table 1

Demographic and Baseline Characteristics

Characteristic	Intervention ($n = 729$)	Control ($n = 693$)
Age, years, mean (*SD*)	11.32 (0.56)	11.36 (0.61)
Girls, number (%)	407 (55.83)	363 (52.38)
African American, number (%)	557 (76.41)	481 (69.41)
Waist, cm, mean (*SD*)	70.88 (12.40)	71.15 (12.36)
BMI, kg/m^2, mean (*SD*)	22.80 (6.16)	22.86 (5.88)

Notes. Demographic characteristics were calculated using nonimputed data.

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Table 2

Completeness (Dose Delivered) and Fidelity Results

	Schools											
	Year 1			Year 2			Year 3			Year 4		
	A	B	C	D	E	F	G	H	I	J	K	L
Dose component percentage												
Snack (7 items)	60	75	65	87	91	77	91	95	94	98	89	75
Physical activity (4 items)	80	73	32	100	87	97	98	100	98	96	97	93
Group time/behavior skills (3 items)	84	94	53	100	94	88	100	100	100	95	99	95
Total dose score (mean %)	75	81	50	96	94	87	96	98	97	96	96	89
Fidelity component mean												
Physical activity (25 items)	3.0	3.2	2.7	3.5	3.3	3.0	3.7	3.7	3.7	3.7	3.7	3.5
Group time/behavioral skills (17 items)	2.5	2.6	2.5	3.2	3.0	3.4	3.7	3.7	3.9	3.2	3.4	3.4
Total fidelity score ("means of means")	2.7	2.9	2.6	3.4	3.2	3.2	3.7	3.7	3.8	3.4	3.5	3.4

Note. A–L represents the ACT intervention schools in the order that they completed the study over the course of the trial.

Table 3

Mean Levels of Activity for Students in Treatment and Control Conditions

	Treatment						Control					
	Baseline		Midintervention		Posttest		Baseline		Midintervention		Posttest	
	Mean	(SE)	Mean	(SE)	Mean	(SE)	Mean	(SE)	Mean	(SE)	Mean	(SE)
Sunday	35.17	(2.82)	29.29	(2.33)	37.42	(3.26)	34.76	(2.37)	31.81	(2.67)	37.29	(4.07)
Monday	42.53	(2.41)	47.16	(3.58)	44.74	(3.46)	45.57	(2.34)	37.71	(1.91)	42.20	(2.11)
Tuesday	45.24	(2.95)	50.54	(2.82)	45.85	(3.93)	43.43	(2.24)	38.21	(2.39)	46.83	(2.50)
Wednesday	43.49	(2.49)	37.96	(2.61)	47.34	(2.45)	44.43	(1.93)	39.17	(1.78)	47.10	(2.60)
Thursday	44.69	(2.31)	47.03	(2.45)	48.72	(2.90)	43.51	(2.31)	37.44	(1.96)	48.07	(2.25)
Friday	46.69	(2.28)	47.40	(3.59)	50.53	(3.91)	48.76	(2.05)	42.84	(2.58)	51.36	(3.56)
Saturday	47.54	(2.90)	36.44	(2.94)	37.61	(3.43)	47.88	(3.01)	36.13	(2.79)	39.93	(4.13)
Average	43.44	(1.64)	40.79	(1.93)	43.56	(1.92)	43.97	(1.39)	36.47	(1.07)	43.56	(1.92)

Note. SEs are adjusted for clustering within schools and for multiple imputation.

Table 4

Differences in Minutes of MVPA Between Treatment and Control Students

Parameter	Midintervention				Posttest			
	Estimate	(SE)	df	MI	Estimate	(SE)	df	MI
Intercept	**44.49**	(3.51)	331.84	0.35	**53.01**	(4.37)	700.03	0.24
Female	**−9.78**	(1.34)	470.21	0.29	**−14.34**	(1.74)	742.41	0.23
Black	−1.70	(1.47)	552.92	0.27	1.54	(2.03)	460.19	0.29
Baseline BMI	**−0.63**	(0.11)	632.36	0.25	**−0.67**	(0.14)	1417.00	0.17
Baseline MVPA	**0.29**	(0.03)	116.74	0.59	**0.28**	(0.04)	129.19	0.56
TX	**4.87**	(1.78)	22.00	0.10	0.25	(2.29)	22.00	0.12

Note. (*SE*) is the standard error of the parameter estimate; adjusted for the use of multiple imputation, *df* is the estimated *df* adjusted for use of multiple imputation; MI is the fraction of missing information, estimates with $p < .05$ are in bold.

Table 5

Effects of Treatment on Minutes of MVPA at Midintervention During and Outside of the Time Block of the ACT Program

Parameter	Estimate	(SE)	df	MI	Lower CI	Upper CI
Intercept	**9.05**	(0.79)	319.46	0.29	7.49	10.59
Female	**− 2.06**	(0.31)	372.19	0.26	−2.67	−1.45
Black	−0.55	(0.35)	350.43	0.27	−1.23	0.14
Baseline BMI	**− 0.13**	(0.02)	643.66	0.17	−0.16	−0.08
Baseline MVPA	**0.06**	(0.01)	98.36	0.58	0.04	0.08
TX	**0.25**	(0.35)	22.00	0.16	−0.47	0.98
Program Time	**2.30**	(1.17)	109.40	0.08	0.01	4.59
Program Time*TX	**9.11**	(1.63)	22.00	0.06	5.73	12.48

Note. (*SE*) is the standard error of the parameter estimate; adjusted for the use of multiple imputation, *df* is the estimated *df* adjusted for use of multiple imputation; MI is the fraction of missing information, estimates with *p* < .05 are in bold, CI is the 95% confidence intervals. Program time is a dummy variable which is 1 when the ACT program was in session during a Monday, Tuesday, or Thursday after-school time block and 0 otherwise.