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An overview of “The Active by Choice Today” (ACT) trial for increasing physical activity[☆]

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Abstract

Background: Although school-based behavioral interventions for increasing physical activity (PA) in children and adolescents have been conducted, little evidence suggests that these curriculum-based approaches lead to increases in overall activity outside of program days. The overall goal of the “Active by Choice Today” (ACT) trial is to expand the body of knowledge concerning the factors that influence long-term increases in PA in underserved adolescents (low socioeconomic status, minorities) during their middle school years.

Design and setting: An overview of the ACT study design, theoretical framework, process evaluation, and primary hypotheses is presented. The trial involves twenty-four middle schools (1560 6th graders) in South Carolina that are randomly assigned to one of two after-school programs (motivational and life skills intervention, or general health education).

Intervention: The intervention integrates constructs from Self-Determination and Social Cognitive Theories to enhance intrinsic motivation and behavioral skills for PA. The intervention targets skill development for PA outside of program days and the after-school program social environment

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(autonomy, choice, participation, belongingness, fun, enjoyment, support) is designed to positively impact cognitive mediators (self-efficacy, perceived competence), and motivational orientation (intrinsic motivation, commitment, positive self-concept).

Main hypotheses/outcomes: It is hypothesized that the 17-week motivational and life skills intervention will lead to greater increases in moderate-to-vigorous PA (based on 7-day accelerometry estimates) at post-intervention as compared to the general health education program.

Conclusions: Implications of this innovative school-based trial are discussed.

Keywords

Physical activity; Minorities; Low income; Adolescents; Intrinsic motivation; Behavioral skills

1. Introduction and rationale for the ACT trial

There have been a relatively large number of studies examining the prevalence of physical activity (PA) in children and adolescents. Only a limited number of studies, however, have examined the prevalence of PA in underserved adolescent populations (e.g., minorities and those of low socioeconomic status (SES)) [1-3]. Previous research indicates that only 50% of youth are currently meeting the national guidelines of engaging in regular PA and that underserved adolescents are less physically active than non-minorities and youth of higher SES [1-3]. Minority children and adolescents also report having fewer environmental, social, and cognitive supports for engaging in PA (opportunities, family and peer modeling, friend support, perceived health benefits) as compared to non-minority peers [3]. The present article provides an overview of the “Active by Choice Today” (ACT) study design, theoretical framework, process evaluation, and primary hypotheses for evaluating the efficacy of an innovative motivational and life skills intervention on increasing intrinsic motivation and moderate-to-vigorous PA in underserved adolescents.

Social Cognitive Theory (SCT) curriculum-based interventions have been shown to be effective for increasing PA in the context of physical education but have resulted in modest to no change in PA levels outside of class time [4-11]. Comprehensive SCT school-based interventions have typically included common behavior modification components including self-monitoring of PA, goal setting, and behavioral skills training. However, little attention has been given to involving youth in developing program ideas and PA choices that may enhance intrinsic motivation and more long-term change in behavior. Because adolescence is a time of increasing autonomy, this approach is developmentally appropriate in that it acknowledges the need for independence and self-initiated behavior change. The ACT intervention integrates principles from Self-Determination Theory (SDT) [12,13] and SCT Theory [14] in that it emphasizes increasing intrinsic motivation and behavioral skills for PA, respectively. The intervention specifically targets development of behavioral skills (communication, reciprocity of social support, group goal setting, and behavioral competence) for PA outside of program days and the after-school program social environment (autonomy, choice, participation, belongingness, fun, enjoyment, support) is designed to have a positive impact on cognitive mediators (self-efficacy, perceived competence) and motivational orientation (intrinsic motivation, commitment, positive self-concept) to promote long-term PA behavior [15].

Previous studies have provided evidence for the importance of choice and self-initiated behavior change on increasing intrinsic motivation for engaging in PA. Wilson et al. [16] conducted focus groups with underserved adolescents to identify motivational themes for increasing PA. Boys and girls most frequently stated they would participate in PA regularly if it was fun, provided a health benefit, and if there were a variety of choices offered. In another study, Ferrer-Caja and Weiss [17] examined the relationships among intrinsic motivation, and

effort and persistence in the context of physical education in high school students. Teacher ratings of PA performance demonstrated that perceived competence and goal orientations directly predicted intrinsic motivation, and intrinsic motivation directly predicted effort and persistence. Other investigators have also demonstrated that perceived PA competence was significantly related to intrinsic motivation [18], and that higher levels of self-determination maintained or increased intrinsic motivation in physical education among adolescent students. Thompson and Wankel [19] examined whether physical activities that were selected based on one's own choice, rather than externally imposed would have a more positive effect on one's intrinsic motivation in the context of implementing fitness programs. Participants, who were randomly assigned to believe their preferences were considered in their program design and development, demonstrated significantly higher attendance in the PA program than those in the no choice group. Taken together these studies suggest that perceived choice and self-initiated behaviors may be instrumental in increasing intrinsic motivation, effort, and persistence for engaging in PA.

Two novel features of the ACT trial include the integration of key elements of SDT and SCT and the development of an elaborate process evaluation methodology to evaluate dose and fidelity of program implementation. The ACT trial integrates SDT by allowing students to provide input and choice of physical activities on an on-going basis to enhance motivation for PA and integrates SCT by having the students develop behavioral strategies for making lifestyles changes in overall PA outside of the program time (i.e., in the home environment). In this study, adolescents in the ACT intervention take ownership in developing the program, select activities that generate fun and interest, and participate in developing their own coping strategies for making effective lifestyle changes in PA during a structured interview videotaped session. This methodology for videotaping students while they discuss positive coping strategies (behavioral skills) is known as strategic self-presentation [20,21] and has specifically been tested in our previous studies and shown to lead to significant increases in PA levels in underserved adolescents [22]. The methodology integrates SDT and SCT by linking motivational elements from the program to applying behavioral skills to be active outside of the program (i.e., at home).

The literature on strategic self-presentation is based on role-play and commitment [23-26], cognitive dissonance theory [27-30], and self-perception theory [28]. The theory proposes that ones' public display shapes a person's private self. That is, how adolescents present themselves to their peers has a powerful influence on how they come to conceive of themselves and subsequently behave [31]. As part of the ACT intervention, adolescents discuss positive coping strategies that they use to be successful in increasing their PA during a structured interview videotaped session that will be publicly shown to peers. Previous research has demonstrated that public self-presentation has a strong influence on private self-appraisal that in turn influences behavior [25,26,28,32-35]. Lewin showed that groups of housewives and students who publicly agreed to change their dietary habits were more likely to do so (immediately and long-term), than those who were individually lectured and who made no commitment or decision to change [24,36,37]. In several studies by Wilson and colleagues, strategic self-presentation resulted in significant positive changes in PA and diet which were significantly associated with positive increases in motivation and self-efficacy [21,22]. The ACT trial expands on previous research by testing the efficacy of this innovative intervention on increasing PA outside of program days in underserved adolescents. The specific objectives of the trial are:

1. To determine the efficacy of a 17-week motivational and life skills intervention versus a general health education program on increasing PA (primary outcome) at post-intervention in underserved adolescents.

2. To examine psychosocial variables as potential cognitive (self-efficacy, perceived competence) and motivational (intrinsic motivation, commitment, positive self-concept) mediators of the intervention on changes in PA.

2. Study design and recruitment approach

The ACT trial is a group-randomized cohort design (see Fig. 1) with three intervention and three comparison schools per cohort (year). The schools are paired prior to recruitment and randomization to condition to avoid possible bias or confounding by socio-demographic differences. The criteria on which the schools are paired includes 1) school size, 2) white versus non-white ethnicity 3) proportion of free and reduced lunch in the school and 4) urban or rural community setting. Baseline measures are obtained prior to randomizing schools in each pair. The measurement team and intervention team maintain separate entities in order to blind the measurement staff to group conditions. Data is collected by trained measurement staff for each pair of schools on the same days over a period of two weeks in a lagged timeline (pair 1, pair 2, pair 3, respectively).

A total of 24 middle schools (65 students per school; $N=1560$ students) in South Carolina are recruited to participate in one of the two after-school programs. To be eligible, adolescents must 1) be currently enrolled in the 6th grade, 2) have parental consent to participate, 3) agree to study participation and random assignment, and 4) be available for a 6-month follow-up. Adolescents are excluded from participation if they 1) have a medical condition that would interfere with the prescribed PA intervention plan, 2) are developmentally delayed such that the intervention materials will not be cognitively appropriate or, 3) are currently in treatment for a psychiatric disorder.

Two phases of recruitment are implemented yearly during the ACT trial. The first phase involves attending the parent orientations at each school. Brief presentations to parents and students are given at the orientation encouraging participation in the after-school program. During the presentations staff presents highlights of the program including no cost for student participation, help with homework, having fun, and making friends at their new school. The presentations are interactive and encourage students to participate in a fun question and answer session about ACT for token prizes. Following the orientation recruitment a second phase of recruitment takes place during the school day. Pep rallies and homeroom visits are two methods of recruitment that are implemented during the second phase to increase enrollment and excitement about the programs (PA and health education). Information about Project ACT is provided to students during the homeroom visits and interactive games (e.g., nutrition bingo) are played that demonstrate some of the health education principles. Randomization of schools to programs (PA intervention, general health education) occurs after recruitment and baseline assessments are completed.

3. Integration of motivational and behavioral theories in the ACT intervention

A novel aspect of the ACT trial is the integration of theoretical constructs from SDT and SCT to enhance intrinsic motivation and behavioral skills for increasing long-term PA behavior specifically in underserved adolescents. A formative evaluation of the theoretical elements was developed during year 1 of the ACT trial [15]. All of the theoretically-based elements of the ACT intervention are summarized into the ACT essential elements, which are listed and defined in Table 1. Collectively, the essential elements of the intervention are designed to increase perceived competence, intrinsic motivation, commitment, and positive self-concept.

The integration of Bandura's SCT into the ACT trial conceptualized multiple influences on behavior with a primary focus on cognitive and social factors [14]. The theory assumes that individual-cognitive factors, environmental events, and behavior are interacting and reciprocal

determinants of each other. These SCT cognitive and social factors are integrated into the development of behavioral lifestyle skills for increasing PA in the ACT intervention. These lifestyle skills include goal setting (done in a group commitment format), communication skills, providing and seeking social support (reciprocity) outside of the program, and behavioral competence. These elements of the intervention are designed to increase self-efficacy, behavioral competency, and social support (from family and peers) for making long-term lifestyles changes in PA. SDT [12,13] proposes that behavior changes that are motivated by intrinsic factors such as novel, enjoyable, self-driven, and satisfying experiences, will sustain behavior more so than those produced by extrinsic factors such as external reward or coercion. Behaviors that are based on autonomous decisions by conscious choice and personal relevance are intrinsically motivated and will be sustained. In the ACT intervention elements from SDT target the social environment during the after-school program for enhancing autonomy (choice), fun, belongingness (engagement), and competence (challenges emphasizing non-competitive play) for PA [15]. The SCT and SDT components are integrated through participation in the strategic self-presentation component of the intervention, described in more detail below. The methodology integrates SDT and SCT by linking motivational elements from the program to applying behavioral skills for being physical active outside of program time.

The ACT intervention is implemented on Mondays, Tuesdays, and Thursdays for two hours after school. On Wednesdays students practice what they have learned in the after-school program in their home environment, and then they return on Thursday to report on their progress with the “take it home” assignments. A team leader and PA leader, with expertise in implementing physical activities in youth, provides the structure for the ACT intervention components and on-going supervision of program implementation. Four additional trained school staff provide oversight and participate in the program components. The program has three main components: homework/snack, a PA component that includes activities which the students select each week of moderate and vigorous intensity (60 min), and a SCT and Motivational component during which intervention staff teach participants behavioral skills and motivational strategies to increase their PA with friends and at home. An example of a typical day of programming is presented in Table 2.

Participants in the ACT intervention participate twice in a strategic self-presentation videotape session [20,21] over the course of the 17-week intervention to generate positive coping strategies for increasing PA outside of program days with friends and family members. The goal of this motivational approach is to enhance positive self-concept and motivation for being physically active daily. To induce commitment to their public behavior, students are 1) videotaped during an interview session, 2) allowed to view the videotapes after the session and 3) given the opportunity to revise their videotapes until they approve of the quality of their presentation.

The General Health Education Program (comparison program) focuses on nutrition, stress management, drug prevention, and drop-out prevention. The program is held on the same days and times as the PA intervention program. The health education modules are taught in an interactive format and students typically rotate from one station to then next every twenty minutes. Preliminary studies conducted by our research team demonstrated that this approach was successful in keeping students interest and participation in the after-school program at higher levels than when no interactive component is implemented.

Staff training for the ACT intervention is conducted in two levels and is based on the essential elements. Team leaders and PA leaders participate in a 12-hour training session prior to the intervention. Additionally, four intervention staff from each school (for both the PA and health education programs), participate in a 16-hour training session prior to the implementation of the intervention during which the team leaders assist. The PA training sessions provide hands-

on interactive activities that highlight understanding of the essential elements, physical activities (cooperative in nature) that are central to the ACT intervention, and injury prevention techniques.

4. Approach to process evaluation and assessment of mediators and outcomes

The ACT logic model is presented in Fig. 1 as an integrative framework for process and outcome evaluation [38,39] by illustrating how program inputs (resources) and program activities are designed to create a motivation-enhancing environment and PA behavior skill development, and how this is expected to lead to changes in mediators and PA behavior. The logic model in Fig. 2 also presents the associated measurement components for each of these elements. Note that activities in the “Inputs” and “Outputs” columns are monitored through process evaluation, whereas those in the “Outcomes/Impacts” column comprise the mediator and behavioral outcome analyses.

A novel element of the ACT trial is the elaborate process evaluation methodology that is used for monitoring and assessing program implementation [40-44]. ACT process data are collected for both formative [44-46] and summative purposes [46,47]. The formative data are used to provide timely, corrective feedback to keep the intervention “on track” and are collected by trained intervention staff. Staff also keep extensive records concerning all staff activities including recruitment efforts (see “Activities and participation” column on logic model).

Summative data are collected to assess the fidelity of intervention implementation, dose delivered (or completeness of intervention delivery), and reach of the intervention into the target population (see “Program implementation” column on logic model). Summative data are also collected by a trained, independent process evaluator using systematic observation of after-school program activities. Through observation and use of a quantitative checklist and rating scales, the process evaluator assesses the extent to which the ACT after-school social environment achieved the essential elements upon which the program is based.

After the intervention is completed each year, the process evaluation data are used to describe the program in detail and to explain program outcomes by examining fidelity and completeness of implementation. Carefully planned and collected process evaluation data are then used to help clarify relationships among theoretical constructs and enhance understanding of program effects by linking intervention exposure to study outcomes [8,43,47-50]. An overview of the study measures are provided in Table 3 (primary outcome) and 4 (cognitive and motivational mediators) [51-61]. These are the outputs that are presented in the logic model. The scale reliabilities and construct validity data are also provided in each table.

5. Data analyses plan for primary outcome

The primary aim of this study is to demonstrate an increase in moderate to vigorous physical activity (MVPA) in students assigned to the PA intervention after the completion of the after-school program. Data analysis for the main aims of this study involves two steps. The first step utilizes approaches for dealing with missing data. These analyses follow the general methodology proposed for dealing with missing accelerometer data in a previous national trial [62], in which multiple imputation is used to provide unbiased parameter estimates and standard errors for the treatment effect. Each day of Actical data is divided into five intervals – 6–9 am, 9–2 pm, 2–5 pm, 5–8pm, and 8 pm to midnight – and the average rate of PA is computed for each interval. Following the previous national multi-site trial procedures, a student's data is considered missing for a given time period if they wore the accelerometer less than 80% of the time that 70% of the students wore their accelerometers [62]. Data for the baseline,

midpoint, and posttest time periods is imputed simultaneously along with indicators of treatment condition, school, and other baseline covariates. The advantage of this procedure over listwise deletion is that it provides unbiased parameter estimates and unbiased and efficient standard errors under the assumption that data is missing at random [63,64]. Following data imputation, estimates of PA are combined across all days and time points for the baseline, midpoint, and posttest data collection periods to provide one measure of MVPA for each.

Since ACT is a group randomized trial, primary analyses are conducted using statistical models that include a random effect for schools [65]. The outcome variable for the primary analyses will be MVPA at posttest, to adjust for baseline values of MVPA these will be included as a covariate. Because a student's sex and BMI are expected to be related to PA, baseline values for these are included as covariates in the analyses. The analytic model for assessing intervention effects for student i in school j is:

$$\text{Posttest MVPA}_{ij} = B_{00} + B_{10}\text{Baseline MVPA} + B_{20}\text{BMI} + B_{30}\text{Female} + B_{01}\text{TX} + e_{ij} + r_{0j}$$

Where B_{10} – B_{30} capture the effects of baseline values of MVPA, BMI, and sex on the outcome. B_{01} captures the effects of the ACT intervention on MVPA at posttest adjusted for the baseline covariates. The term e_{ij} is an individual error term and captures individual differences from the school mean of adjusted posttest MVPA, and the term r_{0j} is a second random error term that captures school differences from the grand mean, inclusion of this term assures an unbiased estimate of the standard error for the treatment effect (B_{01}). The significance of the treatment effect will be assessed with a t -test for the difference of the treatment effect from zero with degrees of freedom based on the number of schools in the study.

6. Study implications

During the past several years our research team has conducted a series of preliminary studies that demonstrate the feasibility of the ACT intervention [15,21,22]. Process evaluation data reveal that the program elements were acceptable to 6th grade students and promote increases in PA and participation. Thus, the next step in our program of research is to test the efficacy of this innovative intervention as part of the group randomized trial. This trial allows us to more clearly document the effects of the intervention after the 17-week program is completed and at a 6-month follow-up in a larger sample of participants. In addition, the trial allows for more clearly defined intervention components and documents the fidelity of the intervention in a larger sample of participants. Most importantly, the innovative approach of integrating SCT and SDT to enhance intrinsic motivation and behavioral skills for increasing long-term PA behavior allows us to more clearly define the important theoretical mediators of the ACT intervention (see Table 4). The theoretical perspective is based on reciprocal determinism, which suggests that multi-level factors are important and may work synergistically in changing behavior. The results of the proposed efficacy study and summative process evaluation will provide the necessary data to further our understanding of the key theoretical elements that may be successful for demonstrating change in long-term PA lifestyles in underserved adolescents.

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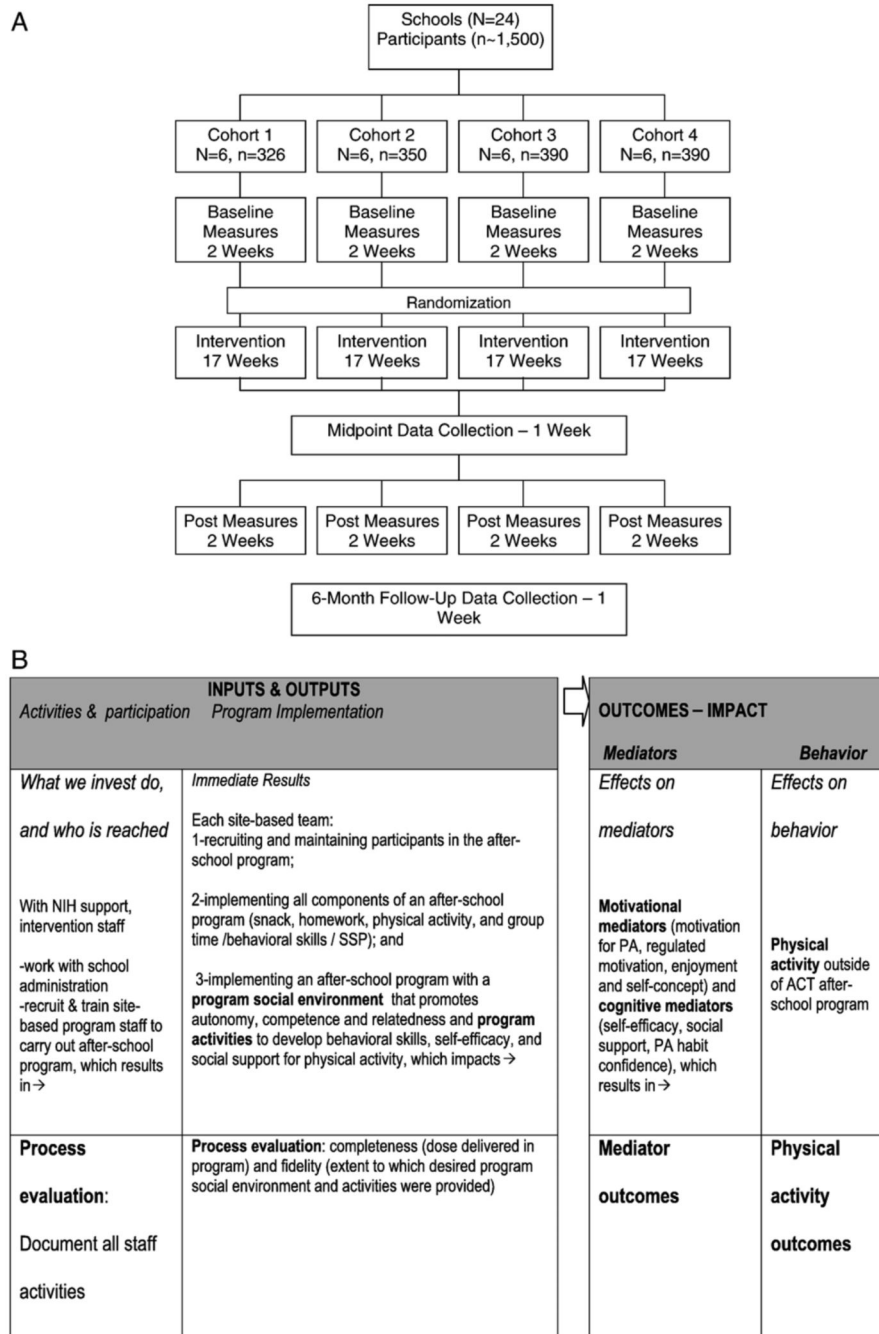


Fig. 1. (A) Project ACT study design. (B) ACT logic model.

Table 1

ACT Intervention Essential Elements

Theoretical construct	Essential element (EE)	Description of EE
Physical activity	Being physically active	-Participants are physically active during the PA component of the program
SDT: autonomy supportive environment	Input and choice	-Participants provide meaningful input, have influence on what happens in program -Participants have choices in physical activities -Participants know what is expected of them
SDT: intrinsic, identified, internalized motivation	Fun and enjoyment	-Participants enjoy being physically active and being in the program
SDT: relatedness supportive environment	Belonging	-Participants feel that they belong and are part of the group
	Respect (positive interactions)	-Participants get along with each other, show respect for each other
SDT: competence supportive environment	Engaged and interact Successful and confident	-Participants are engaged and involved in the program -Participants feel capable and able to participate successfully with others (decrease competition)
SCT: self-efficacy	Successful and confident	-Participants feel confident that they can be physically active at home as well as in the program
SCT: behavioral skills	Life skills	-Participants have specific behavioral skills that enable them to be physically active at home
SCT: social support	Support	-Participants have the social support needed to be physically active at home (reciprocity)
SSP/public commitment and Self-presentation theory: self concept/ motivation	Self-motivated	-Participants provide self-generated positive coping strategies for PA for self and others

Table 2

Daily activity plan for the ACT intervention

Duration	Activity	Setting	Task	Leader
10 min	Snack/attendance announcements	Setting options 1) Classroom 2) Cafeteria 3) Gym 4) Outside or in a classroom	Provide snack, collect attendance, and announce the day's activities	Team leader and intervention staff
60 min	Choice of PA activities: 1) Hip hop dance 2) 5-pass basketball 3) Double Dutch jump rope	Setting options 1) Classroom 2) Cafeteria 3) Gym 4) Outside or in a classroom	1) 3–5 min warm-up/stretching 2) 50 min of MVPA 3) 3–5 min cool down	PA leaders and intervention staff
20 min	Motivational strategies and behavioral skills training	Setting Options 1) Classroom 2) Cafeteria 3) Gym 4) Outside or in a classroom	See Fig. 1 for logic/theoretical model	Intervention staff
30 min	Homework	Setting Options 1) Classroom 2) Cafeteria 3) Gym 4) Outside or in a classroom	Math, English, Reading etc.	Intervention staff

Table 3

Physical activity and anthropometer outcome measures for the ACT trial

Measure	Primary or secondary	Description	Construct validity	Reliability coefficient
PA estimates (acticals) [51, 52]	Primary	Actical is an omni-directional accelerometer. Recorded in 1 min epochs [51]. Wore the device for 8 consecutive days, raw activity data was converted into METs by previously validated cutpoints [52].	$r=0.93$ Actiwatch $r=0.87$ physical activity ratio	$r=0.62$
PA 3DPAR (self-report) [53]	Secondary	Self-reported PA in youth. Activity (from 55 common activities) and intensity (light, moderate, hard, very hard) are selected throughout the day from 6 am until 12 am in 30 min intervals	$r=0.88$ pedometer $r=0.77$ Caltrac	$r=0.99$ $r=0.98$ inter-rater
Height [54]	Secondary	Measured to 0.1 cm, Shorr Height measuring Board	$r=0.20$ age	$r=0.98-0.99$ inter-rater
Weight [54]	Secondary	Measured to 0.1 kg, SECA 880 scale	$r=0.92$ waist circ	$r=1.0$ inter-rater
Waist [55]	Secondary	Measured to 0.1 cm using natural waist protocol and flexible measuring tape	$r=0.92$ weight	$r=0.99$ inter-rater

Table 4

Psychosocial (mediator) measures from SDT and SCT including motivation, enjoyment, self-efficacy, social support, and self-concept

Measure	Theory	Description	Construct validity	Reliability coefficient
Motivation for PA [12,22]	SDT	Motivation for Exercise Scale 16 items, 4 subscales: external regulation, introjected regulation, identified regulation, and intrinsic motivation	Significant increases in PA were demonstrated in response to a 4-week intervention where participants also increased in motivation and self concept.	$r=0.90$
Enjoyment of PA [56]	SDT	15 items	Significant decreases in enjoyment were demonstrated in a laboratory exercise session where participants scored higher in boredom.	$r=0.87-0.94$
Regulatory motives for PA [21,22]	SDT/SCT	10 item scale	The motivation scale was significantly, positively correlated with the Lifestyle Profile Scale.	$r=0.70$
Self-efficacy for PA [21,22, 57]	SDT/SCT	Self-Efficacy for Exercise Behavior 10 item scale	PA self-efficacy was significantly correlated with intention to be physically active.	$r=0.54-0.71$
Self-concept for PA [21,22]	SDT	10 item scale	The self-concept for PA scale was positively correlated with the PA component of the Lifestyle Profile Scale.	$r=0.63-0.90$
Social provision [58,59]	SDT/SCT	8 items	Structural equation modeling of a 1-year sampling period showed that increases in social provision were associated with increases in MVPA.	$r=0.91$
Instrumental support for PA [60]	SCT	4 item scale	Instrumental social support was reported to be higher in males than females and was associated with an increase in fruit and vegetable consumption in a family-based intervention.	$r=0.95-0.96$ for fruit and vegetable
Emotional support for PA [21,22]	SCT	Support for Exercise Scales 2 support scales: family and friends	Emotional support from family and friends were both significantly correlated with vigorous exercise.	$r=0.84$ positive family; $r=0.60$ negative family; $r=0.79$ positive friend; $r=0.72$ negative friend

Measure	Theory	Description	Construct validity	Reliability coefficient
Exercise habits confidence [21,22]	SCT	10 items	Significant increase in exercise habits self confidence compared to control groups after month intervention.	$r=0.96$
Environmental measure of PA [61]	SCT	4 items	Using structural equation modeling, statistically significant relationships were shown for environmental variables and PA.	$r=0.78-0.79$