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Mediators Affecting Girls' Levels of Physical Activity Outside of School: Findings from the Trial of Activity in Adolescent Girls

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Abstract

Background—Providing after school activities is a community level approach for reducing the decline in physical activity of girls as they reach early adolescence.

Purpose—The purpose of this study was to examine psychosocial, environmental, and behavioral factors as potential mediators of after school physical activity in adolescent girls.

Methods—We assessed objectively measured levels of physical activity occurring outside of school and potential predictors and mediators of activity in girls participating in the Trial of Activity in Adolescent Girls (TAAG).

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Results—We found that the TAAG intervention had a statistically significant and positive effect on out of school activity in the 2006 cohort. Self-efficacy, friends' social support, total social support, and difficulty getting to and from community activities mediated the level of moderate to vigorous physical activity in girls.

Conclusions—Parents, communities, and schools should provide and enhance opportunities outside of the school day for adolescents to be active. Reducing transportation barriers and enlisting social support appear to be key.

Keywords

After school physical activity; Mediators of physical activity; Adolescent girls

Introduction

The relationships between health and low levels of physical activity and high levels of sedentary activity in youth are well documented [1-5]. Girls experience a decline in levels of physical activity as they reach early adolescence that is greater than the decline seen in boys [6]. This decline may be due to a number of factors including increasing time pressures, concern about appearance, feeling self-conscious about being active in front of peers, or lack of interest in competitive sports [7]. While physical education (PE) provides one opportunity for girls to be active during the school day, very few schools nationwide provide daily PE class [8], and the number of minutes that girls are active during PE class is quite low [9,10].

There is growing interest in finding ways to engage youth in activities outside of the regular school day. For example, the National Heart, Lung, and Blood Institute (NHLBI) created their Hearts and Parks Community Mobilization Guide (2001) as a way to encourage community agencies to be more involved in reaching larger segments of the population with healthful physical activity options. In addition, there have been a number of school and community-based intervention research trials attempting to increase activity levels or decrease sedentary behaviors in youth including the Girls Health Enrichment Multi-site Studies study [11-14], Lifestyle Education for Activity Program [15], the Daughters and Mothers Exercising Together intervention [16], Shape up Sommerville [17], Middle School Physical Activity and Nutrition [18], The Healthy Youth Places intervention[19], a study of 15 secondary schools in Belgium [20] and three secondary schools in Iran [21]. Results have been mixed, and the study designs have, in general, not been strong or have had limited generalizability, making it difficult to fully assess the effectiveness of the community-level approaches. Few of these studies used objective measurement tools for physical activity such as accelerometers to capture physical activity in activity outside of school, specifically in home and community settings [22].

Our understanding of what factors facilitate physical activity in youth is limited. Studies examining the relationship between psychosocial factors and activity levels of middle school age girls have suggested that placing a higher value on health, appearance, and achievement self-efficacy, self management, and perceived barriers to activity are associated with activity levels in girls [23,24]. Other research with youth suggests that outcome expectancy value and enjoyment are related to levels of physical activity [25,26]. Social influences also appear to be associated with levels of activity in youth including sociodemographic factors, parent activity level, support for activity, and parenting style [23,27,28]. Others examined policy and environmental factors related to activity and found that school policies supporting physical activity and living in a low crime neighborhood are related to levels of activity [28]. Research by Evenson et al. [29] found that the number of physical activity facilities near a girl's home was an important predictor of activity levels.

While these factors are often identified in the conceptual models that are used to design intervention research, how these factors function as mediators between intervention strategies and physical activity outcomes is just beginning to be systematically and rigorously explored. Lubans et al. [30] published a review of seven physical activity intervention studies in youth that included an examination of mediating variables. They found that self-efficacy was the most commonly examined cognitive mediator and that it frequently emerged as having a significant mediation effects. Less consistency was seen in the study of outcome expectancy, perceived benefits, and perceived barriers. An examination of interpersonal factors across the studies showed no mediation effects, and behavioral factors as mediators of change in physical activity interventions were inconsistent. Lubans et al. [30] called for additional work in this area, particularly research that uses a rigorous study design and includes an objective assessment of physical activity.

The concern for the decline in physical activity as youth transition into middle school, the low levels of activity in youth, and the potential for concomitant negative health outcomes prompted federal funding for a combined school and community-based intervention trial with a strong study design and a testable intervention. NHLBI sponsored the multi-center group-randomized Trial of Activity for Adolescent Girls (TAAG) to develop, implement, and evaluate an intervention that linked schools to community organizations to reduce the age-related decline in moderate to vigorous physical activity (MVPA) in middle school girls [31,32]. The TAAG study specifically included attempts to increase girls' levels of activity outside of the school curriculum including before school, after school, and weekend opportunities.

The outcomes of TAAG are presented in Webber et al. [31]. In brief, we found that, after a staff-directed intervention lasting 2 years, there were no statistically significant differences in adjusted metabolic equivalent (MET)-weighted MVPA between eighth grade girls in control and intervention schools. However, following the second phase of the intervention where school and community stakeholders assumed responsibility for continuing the intervention, girls in the intervention schools, as compared to the girls in the control schools, showed a mean difference of 10.9 more MET-weighted minutes of MVPA (95% CI, 0.52–21.2).

There were interesting differences in weekend and weekday physical activities and by time of day. Girls in intervention schools had an additional 13.5 min of MET-weighted weekday MVPA (95% CI, 0.3–26.7) and half of this difference (7.3 MET minutes) was seen during the afternoon (2:00–5:00$_{P.M.}$). Girls in the intervention condition also showed some positive differences in MET-weighted weekend MVPA (1.6 MET minutes) as compared to girls in the control condition, but this was not statistically significant. However, factors mediating this increase in out of school physical activity were not examined. Thus, the purpose of this manuscript is to examine psychosocial, environmental, and behavioral factors as potential mediators that might be related to out of school physical activity as observed in the TAAG intervention trial.

Methods

Study Design

The primary goal of TAAG was to reduce the decline of middle school girls' daily MET-weighted minutes of MVPA as assessed through accelerometry. Six universities participated in the study in a cooperative agreement with the NHLBI. They were the University of Arizona, San Diego State University, Tulane University, the University of Maryland, the University of Minnesota, and the University of South Carolina. The Coordinating Center was at the University of North Carolina, Chapel Hill. The NHLBI project office collaborated in the research. Six schools at each of the sites were randomized in equal numbers to either intervention or control condition after baseline measurements were collected [32,33]. The

TAAG staffdirected intervention began in fall 2003 and lasted through spring 2005 when the primary outcome data were collected. The intervention, as directed by school and community personnel ("Program Champion-directed" intervention), lasted from fall 2005 through spring 2006. Crosssectional, random samples of girls were recruited for measurement in spring 2003 (sixth grade), spring 2005 (eighth grade), and spring 2006 (eighth grade) [31]. This repeated cross-sectional design was chosen both to allow assessment of intervention effects in the entire population of girls enrolled in the participating schools at the time of the surveys and to avoid the need for substantial imputation of missing data that would be required for an intention-to-treat analysis with a cohort design [32]. Thus, eighth grade girls measured in spring 2005 received 2 years of staff-directed intervention (seventh and eighth grades), and girls measured in spring 2006 received 2 years of staff-directed intervention (sixth and seventh grades) plus an additional year of program champion-directed intervention (eighth grade).

Eligibility and Recruitment

Public middle schools in which a majority of students lived in the surrounding community were eligible to participate. Additional school eligibility criteria included (1) enrollment of at least 90 eighth grade girls, (2) yearly school withdrawal rates less than 28%, (3) at least one semester of PE required for each grade, and (4) willingness to sign a memorandum of understanding and accept random assignment of the school. TAAG schools represented the demographic and socioeconomic makeup of their school districts, with preference given to schools with greater racial/ethnic and socioeconomic diversity. Details of school recruitment are published elsewhere [34].

Parental consent and student assent were obtained prior to each measurement period. A student was excluded if she had limited English-speaking skills, was unable to participate in PE classes due to a medical condition or disability, or had contraindications for participating in a sub maximal exercise test (2005 measurements only). The parental consent and student assent forms and the protocol were approved by the institutional review boards of all participating institutions in fall 2002 and annually thereafter.

TAAG Intervention

The TAAG intervention was based on a social ecological model and was designed to establish more opportunities, improve social support and norms, and increase self-efficacy, outcome expectations and behavioral skills in order to foster greater levels of MVPA in middle school girls [35]. The intervention included four main components: (1) health education lessons offered in PE or health class; (2) health promotion throughout the school through media messages and school-wide activity promotions and challenges; (3) training of PE teachers to support greater levels of activity and choice during PE class; and (4) a school–community-linked partnership for physical activity. More detail on the intervention can be found in Elder et al. [35] and Webber et al. [31].

The school–community link was an innovative feature of the intervention that focused on bringing together school and community agencies to develop and promote physical activity programs for girls outside of the regular school day. We attempted to maximize the potential to develop sustainable linkages between community agencies and schools for the purpose of providing more activity options for girls by creating partnerships for physical activity. These partnerships included a variety of stakeholders representing the school (including teachers, students, and school staff), community agencies (for example, a local aerobics instructor, a representative from the YWCA, or a youth coordinator from a local community center), parents or parent groups, and research intervention staff. These partnerships met regularly to develop and plan for the implementation or promotion of out-of-school day physical activity opportunities and programs for youth. These programs were delivered both on and off school

property. The programs usually occurred after school, but some programs occurred before school or during lunch or study hall time. Examples of programs include “Dance Dance Revolution,” after-school step aerobics class, basketball camp, touch football, before school open gym, and weekend outdoor programs.

The TAAG Program Champion component was another innovative program that was developed to foster sustainability after the 2-year staff-directed intervention. This component was based on previous research, suggesting that youth-based health promotion programs have a greater likelihood of being sustained if individuals in the school or community take ownership of the program after the research-directed intervention phase has ended [36-38]. TAAG staff actively recruited and trained program champions (usually school or community staff previously involved in TAAG) during the staff-directed intervention phase as a way to promote maintenance of the program. Each TAAG intervention school received $3,000 to support Program Champions so that they would be able to continue TAAG programming after the staff-delivered intervention phase was completed.

Measurements

Measurements were taken during spring 2003, 2005, and 2006. Separate intervention and measurement staff were employed, and central training sessions were held to train and certify staff. Periodic re-certification ensured that performance standards were met continuously.

Race/Ethnicity—Each girl responded to two questions. The first asked whether the girl thought of herself as Hispanic or Mexican-American or of Spanish origin. The second asked whether the girl thought of herself as white, black, or African-American, Asian, Native Hawaiian or other Pacific Islander, American Indian or Alaska Native, or other.

Free or Reduced School Lunch Program—Each girl responded to a single question asking whether she received free or reduced lunch at school.

Out-of-School Physical Activity Outcome Variables—Physical activity was measured using Actigraph accelerometers (MTI model 7164, Fort Walton Beach, FL). Each girl wore an accelerometer during waking hours for seven consecutive days. Accelerometers were initialized to begin collecting data at 5:00$_{A.M.}$ on the day after they were distributed. Data for six complete days were available for analysis and were collected and stored in 30-s intervals. Girls wore the accelerometer on their right hip, attached to a belt, except while bathing, swimming, or sleeping. Each year, intervention and control schools were measured at the same time. Accelerometry data were reduced [39,40], and missing accelerometry data within a girl’s 6-day record were replaced via imputation [41]. Girls were included who had at least one full day of data out of the expected 6 days. On the average, 12 h of data (about 11%) were imputed per girl. The count threshold (counts,·30 s^{-1}) for MVPA was set at 1,500 counts·30 s^{-1} based on our previous work [40]. This count represented approximately 4.6 METs, which separates slow (<4.6 METs) and brisk (≥4.6 METs) walking.

Eight outcome variables were calculated for this paper. Average before-school minutes of MVPA were calculated by summing activity across weekdays for the pre-school period (6:00–9:00$_{A.M.}$). Average after-school minutes of MVPA were calculated by summing activity across weekdays for the after school period (2:00$_{P.M.}$–midnight). Weekend minutes of MVPA were calculated by combining all activity across the two weekend days. Total out-of-school minutes of MVPA were calculated by summing before-school MVPA, after-school MVPA, and weekend MVPA. Each of these variables was also estimated in terms of MET minutes of MVPA.

Potential Mediating Variables—Fifteen variables were identified as possible mediators for the intervention program (described in Table 1) and included a mix of psychosocial, behavioral, and environmental variables. The psychosocial variables tap the following constructs: self-efficacy for being active, outcome expectations, and outcome expectancy. The behavioral variables include self-reported participation in sport programs and in before and after school physical activity programs. The environmental variables include perceptions of barriers to being active, including perceived difficulty in getting to and from activities self-reports of access to facilities (a physical environment) as well as perceptions of support from the social environment.

Survey Participation

All 36 schools participated in the sixth grade measurements during spring 2003 and in the eighth grade measurements during spring 2005; however, only 34 schools participated in the eighth grade measurements during spring 2006, with two schools closed due to damage from Hurricane Katrina. During spring 2003, 60 girls per school were randomly chosen. A total of 1,721 (79.7%) of the 2,160 eligible girls consented and participated in the measurement; of that number, 1,603 (93.1%) provided accelerometry data and were included in the analyses reported here. During spring 2005, 4,123 girls were eligible for the student-level measurements, and 3,504 (85.0%) consented and participated in the measurements; of that number, 3,085 (88.0%) provided accelerometry data and were included in the analyses reported here. During spring 2006, 3,915 were eligible at the six study sites, and 3,502 (89.5%) consented and participated in the measurements; of that number, 3,378 (96.5%) provided accelerometry data and were included in the analyses reported here.

Statistical Methods

All analyses were conducted using SAS Version 9.1.3[42].

Descriptive Analyses—SAS PROC MEANS and PROC FREQ were used to calculate means and frequencies for all variables to characterize the participants in the study.

Intervention Effects—All analyses for intervention effects employed mixed-model regression methods to reflect the group randomization and the nesting of students within schools, sites, and conditions [43]. The analyses were performed separately for the two eighth grade surveys, each using the same sixth grade survey to adjust for baseline.

The analyses reported in the main results paper for TAAG were conducted in two stages as if there were no overlap among girls measured in the three cross-sectional samples [33]. In the first stage, the outcome variable was regressed on site, time (sixth or eighth grade), school within site, the interactions between time and site and time and school within site, and ethnicity, all modeled as fixed effects, and measurement week, modeled as a random effect; study condition was not included. The results of the first stage were two ethnically adjusted mean values (sixth grade, 2003 and the first eighth grade sample, 2005) for each of the 36 schools for the first set of analyses and for each of the 34 schools for the second set of analyses (sixth grade, 2003 and the second eighth grade sample, 2006). No data for schools lost due to Katrina were imputed, as their loss was unrelated to treatment; one of those schools was an intervention school and the other was a control school.

The second stage analysis was conducted on the adjusted means from the first stage. Finding no evidence of a differential intervention effect among the six sites, the follow-up school mean was regressed on condition, adjusting for the sixth grade school mean, and stratifying on site, which was modeled as a random effect. Because the second stage used school means as the data, variability in condition means was assessed against variation in school means as is

appropriate given the group-randomized design [33]. This two-stage analysis was run separately for each of the eight outcome variables.

The intervention effect analyses reported in this paper were conducted in two stages but in a manner that was slightly different from that used in Webber et al. [31]. In the first stage, baseline school means were calculated for each dependent variable. In the second stage, the individual-level data for 2005 or 2006 were analyzed, and the baseline school mean for the dependent variable was included as a covariate, with all girls in a given school assigned the same value. Potential mediators were not included in these models.

The analyses reported in Webber et al. [31] weighted each school equally as though each school mean was based on the same number of girls. The analyses reported here reflect the true distribution of girls among the participating schools. For that reasons, the intervention effects reported here are slightly different from those reported in Webber et al. [31].

Evaluation of Potential Mediators—We generally followed the procedures suggested by MacKinnon [44] to assess mediation, fitting three models to the data. We first estimated the intervention effect separately for each dependent variable and each potential mediator with regression adjustment for race, the baseline school mean of the dependent variable, and the baseline school mean for the potential mediator; the only exceptions were the two participation variables, which were not measured at baseline. That model provided an estimate of the total effect of the intervention, which MacKinnon labels C; these estimates were specific to each potential mediator and so may vary somewhat from the intervention effect estimates calculated as described above, which ignored the potential mediators. We next estimated the intervention effect for each mediator with regression adjustment for race, the baseline school mean of the dependent variable, and the baseline school mean for the potential mediator; that model provided an estimate of the effect of the intervention on the mediator, which MacKinnon labels A. Finally, we estimated the mediated intervention effect for each dependent variable by adjusting for race, the baseline school mean of the dependent variable, the baseline school mean of the potential mediator (except the participation variables), and the follow-up value of the potential mediator; that model provided an estimate of the unmediated (i.e., direct) intervention effect, which MacKinnon labels C', and the intervention-adjusted effect of the mediator on the dependent variable, which MacKinnon labels B. In all three models, we included site and school within site as random effects; in the first and third models, we also included wave within site and school as a random effect. This modeling of the random effects was consistent with the modeling of random effects in Webber et al. [31].

Results

Study Sample

The study population was well balanced by condition in each survey year (Table 2). The sample was diverse with the largest percentage of African-American girls in Louisiana and South Carolina and the largest percentage of Hispanic girls in California and Arizona. The sample was also diverse with respect to income, with 35–42% participating in the free or reduced lunch program. The percentage of African-American students was lower in 2006 as a result of the two schools, which closed in New Orleans due to damage from Hurricane Katrina.

Intervention Effects

Table 3 summarizes the results of the mixed-model regression analyses for the eight measures of out-of-school physical activity. There was no evidence of any intervention effect in the 2005 data. However, there was evidence of an intervention effect in the 2006 data. The reasons for observing the intervention effect only in the sample assessed in 2006 are discussed in Webber

et al. [31] and include the possibilities that girls in control schools measured at the baseline in spring 2005 were unusually physically active, that recruitment procedures in control schools influenced activity levels, and the possibility that the 2006 eighth grade sample entered their middle school when TAAG was already in place and experienced a change in environment with regard to attention and support for girls to be active from the day they started middle school. It is also possible that the Program Champions in the intervention schools were able to tailor and sustain the TAAG program and philosophy after the staff-directed intervention was completed.

In the 2006 data, there was a higher level of physical activity after school on weekdays, whether measured in minutes or MET minutes (Table 3). This effect was responsible for higher levels of out of school activity overall, whether measured in minutes or MET minutes.

Evaluation of Potential Mediation

With MacKinnon's approach to mediation, it is possible to observe mediation even in the absence of an initial intervention effect. Of 120 mediator–outcome combinations in the 2005 data, only two had tests of mediation with $p<0.05$ and three others had tests of mediation with $p<0.10$, well within chance levels. As such, the balance of the presentation on mediation is restricted to the 2006 data.

Of 120 mediator–outcome combinations in 2006, eight had tests of mediation with p values with $p<0.05$, while 17 other combinations had tests of mediation with $p<0.10$. The number of tests with $p<0.05$ was about what would be expected by chance, but the total number with $p<0.10$ was about double what would be expected by chance. As a result, we will present the results for test with $p<0.10$, recognizing that the findings are suggestive rather than conclusive.

Table 4 shows the unadjusted means and ranges of the 15 potential mediators for the 2003 and 2006 samples. As noted earlier, participation in after school and before school physical activity programs were not measured in 2003.

Table 5 summarizes the results from the three models used to assess mediation in the 2006 data only showing coefficients for significant mediators and outcomes. Mediation effects were suggested for five of the 15 potential mediators and for seven of the eight outcome variables [$p(AB)<0.10$]. The patterns were consistent for each potential mediator for the outcomes in which potential mediation effects were observed. The mediation analysis shows statistically significant intervention effects, adjusting for mediation [$p(C')$], for average weekday minutes and MET minutes after school, and for average minutes out of school, consistent with the results from the mixed model regression. Percent mediation ranged from 2.9% to 45.9%.

Overall, there are two variables that emerge as consistently important mediators of the intervention and activity outcomes: friends' social support and difficulty getting from a community activity. Examining the mediation analysis by outcome, we see little evidence of mediation effects of any of the variables for before school activities. Only difficulty getting from a community activity before school emerges as having some marginal impact [$p(AB)=0.075$]. For average weekend minutes after school for both MVPA and MET minutes, difficultly getting from a community activity and friends' social support show statistically significant mediation effects. Only friends' social support is a significant mediator for average weekend minutes and MET minutes as well as total minutes and MET minutes out of school.

Consideration of the directional signs for the path from the intervention to the mediator (A) and from the mediator to the outcome (B) reveals some interesting trends. For self-efficacy, friends' social support, and total social support, A was negative, B was positive, and so the product was negative. Therefore, intervention girls reported lower efficacy and social support

than comparison girls in 2006. However, increases in efficacy and social support were related to increased activity, so when we corrected for the impact of the intervention on the mediators, we had a net increase in activity in the intervention condition (C' compared to C) and the intervention effect was stronger.

For difficulty getting to and from community activities, A was positive, B was negative, and so the product was negative. Intervention girls reported that it was more difficult to get to and from activities. However, increases in these mediators decreased activity, so when we corrected for the impact of the intervention on the mediators, we had a net increase in activity in the intervention condition (C' compared to C) and the intervention effect was stronger.

Discussion

In this study, we examined factors that may have mediated the effects of the TAAG intervention on MVPA occurring outside of the school day, including 15 potential mediating variables and limiting our exploration to the 2006 data where we observed a significant TAAG intervention effect. We found no evidence of confounding due to uneven distribution of these variables at baseline. We did find evidence of possible mediation for five of the 15 potential mediating variables: difficulty getting to community activities, difficulty getting from community activities, self-efficacy, friends' social support, and total social support. In all cases, the mediation analysis suggests that girls exposed to the intervention assessed their self-efficacy and their levels of support for activity to be lower and the difficulty getting to and from community activities greater as compared to girls in the control condition. This pattern suggests that as intervention girls became more aware of issues related to being active and attempted to initiate change, they became more realistic about factors that impact their motivation or ability to be active. For example, as the intervention promoted community activities and the girls attempted to attend activities, they became increasingly aware that, in spite of their interest, it was difficult to get to and from the activities; the girls in the control group may not have experienced that change in awareness. Specifics of difficulty related to access are unknown. It may be transportation mode (e.g., lack of an after school bus) or logistics (e.g., transportation modes were available but at an inconvenient time.) There is some evidence for these phenomena in other research; in a study of adolescent girls in the USA [45], the relationship between perceived barriers and the intervention condition was in an unexpected direction with youth in the intervention condition reporting higher levels of perceived barriers as compared to youth in the control condition.

A majority of the psychosocial, behavioral, and environmental variables examined as potential mediators showed no relationship to the intervention effect in the 2006 sample. While psychosocial theories suggest that outcome expectations and expectancies are related to behavioral outcomes, our findings show that neither of these variables were related to MVPA, and they were not influenced by our intervention.

Of the behavioral variables, none of the self-reported activity questions was related to an objectively measured physical activity outcome. Participation in sport programs showed no relationship to the outcome of interest and is surprising as, traditionally, youth-based out of school activity has occurred through school or community-sponsored sports teams [46]. In addition, even though one of the intervention objectives of the TAAG intervention was to foster non-sport, non-competitive physical activity opportunities for girls in the community, activity participation outside of school did not emerge as a mediator.

Environmental factors appeared to be the strongest mediator between the intervention and the activity level. While environmental factors related to access did not relate to after school activities, issues around transport to and from activities, especially difficulty getting from a

community activity, emerged as important. Our data cannot verify that the perceived difficulties getting to and from activities were real only that the perceptions of difficulties impacted activity levels. Research by Hoefer et al. [47] and Evenson et al. [29] showed that parental transportation to physical activity opportunities was positively related to girls' levels of physical activity and to their participation in sports and activities. Of the social variables, only friends' support and overall social support being active was significantly related to the intervention, while social support from families was not related to any of the out of school measures of activity. This finding emphasizes the importance of peer influence at this age and suggests that interventions to help adolescent girls be more physically active should concentrate on peer influence; it may be less important to engage adults as supportive agents.

This research has limitations and strengths. Some would argue that a true mediation analysis was not possible, since the attributes examined as potentially important in the causal pathway between the intervention and the outcome were only assessed pre- and post-intervention in cross-sectional samples, and there was no measure occurring during the intervention period in a cohort of youth[48]. Even so, we have employed the methods suggested by MacKinnon to the extent allowed by our design and offer our results as suggestive rather than conclusive.

Another weakness is that the schools chosen to participate were not randomly chosen from the population of all schools in the participating areas and the sample does not represent a nationally representative sample of schools or girls.

Some of the important strengths of this study are the objectively assessed outcome of physical activity, the rigorous study design, the quality of all aspects of the data, and the diverse regions and ethnicities represented in the sample.

Conclusion

This research suggests that it is possible to develop a school- and community-based intervention to increase girls' levels of MVPA outside of school during the week. The fact that the physical activity results were observed primarily during the after school hours and not before school or on weekends reinforces the need to encourage school and community leaders to provide opportunities and incentives for girls to be active after school. Finding time before school may not be practical for most girls and weekends likely have family specific patterns and rhythms that make changing levels of activity more difficult.

At this age, friends' social support is important for after school activities, while parental support may be less important. This finding speaks to the important roles that peers and friends play during the young adolescent period [49,50] and to the importance of interventions that are highly social in nature for adolescent girls. While the findings seem to suggest that the intervention negatively impacted several important factors including self-efficacy, perceived support, and difficulty in access to community activities, we believe that the direction of the finding reflects the intervention girls' increased awareness and realistic assessment of barriers once prompted by the TAAG intervention. In addition, the relationships between the factor and objectively assess physical activity levels were in the expected direction helping to solidify self-efficacy, social support, and difficulty getting to and from activities (an assessment of a barrier) as important predictors of activity in adolescent girls.

Since potential activity during school, through PE classes and other activity opportunities, is increasingly limited [8], it is important that parents, schools, and communities provide and enhance opportunities outside of the school day for adolescents to be active. This research suggests that it is possible and will result in objectively assessed increased levels of physical activity. Changes in community and school environments to provide high quality, fun, easily accessible, and socially supported active programs for adolescents are recommended.

References

1. Fletcher G. Physical inactivity as a risk factor for cardiovascular disease. Am J Med 1999;107:S10–S-11.
2. Daniels SR, Arnett D, Eckel R, et al. Overweight in children and adolescents: Pathophysiology, consequences, prevention, and treatment. Circulation 2005;111:1999–2012. [PubMed: 15837955]
3. Caspersen C, Pereria M, Curran K. Changes in physical activity patterns in the United States, by sex and cross-sectional age. Med Sci Sports Exerc 2000;32:1601–1609. [PubMed: 10994912]
4. Ogden CL, Caroll MD, Curtin LR, et al. Prevalence of overweight and obesity in the United States, 1999–2004. JAMA 2006;295:1549–1555. [PubMed: 16595758]
5. Obarzanek, E. Obesity in children, adolescents and families. Futura; Armonk: 1999.
6. Kimm DY, Glynn NW, Kriska AM, et al. Decline in physical activity in black girls and white girls during adolescence. N Engl J Med 2002;347:709–715. [PubMed: 12213941]
7. Vu MB, Murrie D, Gonzalez V, Jobe JB. Listening to girls and boys talk about girls' physical activity behaviors. Health Educ Behav 2006;33:81–96. [PubMed: 16397161]
8. O'Toole T, Anderson S, Miller C, Guthrie J. Nutrition services and food and beverages available at school: Results from the School Health Policies and Programs Study (SHPPS) 2006. J Sch Health 2007;77:500–521. [PubMed: 17908105]
9. McKenzie TL, Catellier DJ, Conway TL, et al. Girls' activity levels and lesson contexts in middle school PE: TAAG Baseline. Med Sci Sports Exerc 2006;38:1229–1235. [PubMed: 16826019]
10. McKenzie TL, Stone EJ, Feldman HA, et al. Effects of the CATCH physical education intervention: Teacher type and lesson location. Am J Prev Med 2001;21:101–109. [PubMed: 11457629]
11. Baranowski T, Baranowski JC, Cullen KW, et al. The Fun, Food, and Fitness Project (FFFP): The Baylor GEMS pilot study. Ethn Dis 2003;13:S30–39. [PubMed: 12713209]
12. Beech BM, Klesges RC, Kumanyika SK, et al. Child- and parent-targeted interventions: The Memphis GEMS pilot study. Ethn Dis 2003;13:S40–53. [PubMed: 12713210]
13. Story M, Sherwood NE, Himes JH, et al. An after-school obesity prevention program for African-American girls: The Minnesota GEMS pilot study. Ethn Dis 2003;13:S54–64. [PubMed: 12713211]
14. Robinson TN, Killen JD, Kraemer HC, et al. Dance and reducing television viewing to prevent weight gain in African-American girls: The Stanford GEMS pilot study. Ethn Dis 2003;13:S65–77. [PubMed: 12713212]
15. Pate RR, Ward DS, Saunders RP, et al. Promotion of physical activity among high-school girls: A randomized controlled trial. Am J Public Health 2005;95:1582–1587. [PubMed: 16118370]
16. Ransdell LB, Taylor A, Oakland D, et al. Daughters and mothers exercising together: Effects of home- and community-based programs. Med Sci Sports Exerc 2003;35:286–296. [PubMed: 12569218]
17. Economos CD, Hyatt RR, Goldberg JP. A community intervention reduces BMI z-score in children: Shape Up Somerville first year results. Obesity 2007;15:1325–1336. [PubMed: 17495210]
18. Sallis JF, McKenzie TL, Conway TL, et al. Environmental interventions for eating and physical activity: A randomized controlled trial in middle schools. Am J Prev Med 2003;24:209–217. [PubMed: 12657338]
19. Dzewaltowski DA, Estabrooks PA, Welk GJ, et al. Healthy Youth Places: A randomized controlled trial to determine the effectiveness of facilitating adult and youth leaders to promote physical activity and fruit and vegetable consumption in middle schools. Health Educ Behav 2009;36:583–600. [PubMed: 18469366]
20. Haerens L, Cerin E, Maes L, et al. Explaining the effects of a 1-year intervention promoting physical activity in middle schools: A mediation analysis. IJBNPA 2007;4:55. [PubMed: 17996087]
21. Taymoori P, Lubans DR. Mediators of behavior change in two tailored physical activity interventions for adolescent girls. Psyhol Sport Exerc 2008;9:605–619.
22. Lytle, LA.; Schmitz, KH. Community-level influences and interventions for pediatric obesity. In: Goran, M.; Sothern, M., editors. Handbook of Pediatric Obesity. Taylor & Francis; Boca Raton: 2006.

23. Schmitz KH, Lytle LA, Phillips GA, et al. Psychosocial correlates of physical activity and sedentary leisure habits in young adolescents: The teens eating for energy and nutrition at school study. Prev Med 2002;34:266–278. [PubMed: 11817924]
24. Dishman RK, Motl RW, Sallis JF, et al. Self-management strategies mediate self-efficacy and physical activity. Am J Prev Med 2005;29:10–18. [PubMed: 15958246]
25. Trost SG, Pate RR, Ward DS, Saunders R, Riner W. Correlates of objectively measured physical activity in preadolescent youth. Am J Prev Med 1999;17:120–126. [PubMed: 10490054]
26. Strauss RC, Rodzilsky D, Burack G, Colin M. Psychosocial correlates of physical activity in health children. Arch Pediatr Adolesc Med 2001;1555:897–902. [PubMed: 11483116]
27. Kamphuis C, van Lenthe FJ, Giskes K, et al. Socioeconomic status, environmental and individual factors and sports participation. Med Sci Sports Exerc 2007;40:71–81. [PubMed: 18182936]
28. Ferreira I, van der Horst K, Wendel-Vos W, et al. Environmental correlates of physical activity in youth—A review and update. Obesity Reviews 2006;8:129–154. [PubMed: 17300279]
29. Evenson K, Birnbaum AS, Bedimo-Rung A, et al. Girls perceptions of physical environmental factors and transportation: reliability and association with physical activity and active transport to school. Int J Behav Nutr Phys Act 2006;2:28. [PubMed: 16972999]
30. Revalds Lubans D, Foster C, Biddle SJH. A review of mediators of behavior in interventions to promote physical activity among children and adolescents. Prev Med 2008;47:463–470. [PubMed: 18708086]
31. Webber L, Catellier D, Lytle L, et al. Promoting physical activity in middle school girls: Trial of activity for adolescent girls. Am J Prev Med 2008;34:173–184. [PubMed: 18312804]
32. Stevens J, Murray DM, Catellier DJ, et al. Design of the Trial of Activity in Adolescent Girls (TAAG). Contemp Clin Trials 2005;26:223–233. [PubMed: 15837442]
33. Murray DM, Catellier DJ, Hannan P, et al. School-level intraclass correlation for physical activity in adolescent girls. Med Sci Sports Exerc 2004;36:876–882. [PubMed: 15126724]
34. Elder JP, Shuler L, Moe SG, et al. Recruiting a diverse group of middle school girls into the Trial of Activity for Adolescent Girls (TAAG). J Sch Health 2008;78:523–531. [PubMed: 18808471]
35. Elder JP, Lytle L, Sallis JF, et al. A description of the socialecological framework used in the trial of activity for adolescent girls (TAAG). Health Educ Res 2007;22:155–165. [PubMed: 16855014]
36. Osganian SK, Parcel GS, Stone E. Institutionalization of a school health promotion program: background and rationale of the CATCH-ON study. Health Educ Behav 2003;30:410–417. [PubMed: 12929893]
37. Parcel GS, Edmundson E, Perry CL, et al. Measurement of self-efficacy for diet-related behaviors among elementary school children. J Sch Health 1995;65:23–27. [PubMed: 7731197]
38. Smith DW, Steckler A, McCormick LK, McLeroy KR. Disseminating comprehensive school health curricula: Lesson learned from the North Carolina school health and tobacco education project. J Health Educ 1995;26:26–36.
39. Catellier D, Hannan P, Murray DM, et al. Imputation of missing data when measuring physical activity by accelerometry. Med Sci Sports Exerc 2005;37:555–562.
40. Treuth M, Schmitz KH, Catellier D, et al. Defining accelerometer thresholds for activity intensities in adolescent girls. Med Sci Sports Exerc 2004;36:1259–1266. [PubMed: 15235335]
41. Dempster A, Laird N, Rubin D. Maximum likelihood from incomplete data via the EM algorithm. J R Stat Soc Ser B 1977;39:1–38.
42. SAS Institute. SAS/STAT 9.1 user's guide. SAS Institute; Cary: 2004.
43. Murray, DM. Design and analysis of group-randomized trials. Oxford University Press; New York: 1998.
44. MacKinnon DP, Fairchild AJ, Fritz MS. Mediation analysis. Annu Rev Psychol 2007;58:593–614. [PubMed: 16968208]
45. Dunton GF, Schneider M, Cooper DM. An investigation of psychosocial factors related to changes in physical activity and fitness among female adolescents. Psychol. Health 2007;22:929–944.
46. Young DR, Steckler A, Cohen S, et al. Process Evaluation Results from a School and Community Linked Intervention: The Trial of Activity for Adolescent Girls (TAAG). Health Educ Res 2008;23:976–986. [PubMed: 18559401]

47. Hoefer WR, McKenzie TL, Sallis JF, Marshall SJ, Conway TL. Parental provision of transportation for adolescent physical activity. Am J Prev Med 2001;21:48–51. [PubMed: 11418257]

48. Kraemer HC, Wilson T, Fairburn C, Agras W. Mediators and moderators of treatment effects in randomized clinical trials. Arch Gen Psychiatry 2002;59:877–883. [PubMed: 12365874]

49. Perry, C. Preadolescent and adolescent influences on health. In: Smedley, BD.; Syme, SL., editors. Promoting health, intervention strategies from social and behavioral research. National Academy Press; Washington: 2000. p. 217-253.

50. IOM. Preventing childhood obesity: Health in the balance. Insitute of Medicine; Washington: 2005.

51. Sallis JF, Prochaska JJ, Taylor WC. A review of correlates of physical activity of children and adolescents. Med Sci Sports Exerc 2000;32:963–975. [PubMed: 10795788]

Table 1

Description of mediating variables

Measure	Source	Questions and psychometric properties
Psychosocial variables		
Self-efficacy	Dishman et al. 2002 Motl et al. 2000	Self-efficacy for physical activity was measured by asking girls to indicate on a 5-point Likert scale how well they agreed with eight statements such as "I can be physically active during my free time on most days" and "I can ask my parent or other adult to do physically active things with me." The eight statements were anchored from disagree a lot to agree a lot and were originally developed for 8th and 9th grade girls. In the TAAG study, the Cronbach alpha ranged from 0.81 to 0.84 in the 2003, 2005, and 2006 surveys; the test-retest correlation was 0.67 at 6th grade and 0.69 at 8th grade
Outcome expectation	Dishman et al. 2002 Dishman et al. 2005 Motl et al. 2000	Outcome expectation was measured by asking girls to indicate on a 5-point Likert scale how well they would agree with nine statements such as "If I were to be physically active during my free time on most days...it would help me spend more time with my friends" or "...it would put me in a better mood" or "... I would make new friends." The nine statements were anchored from disagree a lot to agree a lot. In the TAAG study, the Cronbach Alpha ranged from 0.82 to 0.84 in the 2003, 2005, 2006 surveys; the test retest correlation was 0.64 at 6th grade and 0.68 at 8th grade
Outcome expectancy	Dishman et al. 2002 Dishman et al. 2005 Motl et al. 2000	Outcome expectancy value was measured by asking girls to indicate on a 5-point Likert scale "How important are these things?" Girls responded for 9 items such as "spending more time with my friends is..." "Controlling my weight is...", "making new friends is...". Each item was anchored from very unimportant to very important. The Cronbach alpha ranged from 0.92 to 0.94 in the 2003, 2004, and 2005 surveys; the test-retest correlation was 0.58 at 6th and 8th grade
Behavioral variables		
School sport program	Developed for TAAG	Participation in school sports programs was measured by asking girls "which sports teams have you been on during the past year at school?" with 15 options and scores ranging from 0 to 15. Participation in out-of-school sports programs was measured by asking girls "which sports teams have you been on during the past year outside of school?" with 15 options and scores ranging from 0 to 15. These two items were analyzed individually, as sum scores, with values ranging from 0 to 15
Activity participation	Developed for TAAG	Participation in after school physical activity programs was measured by asking girls to answer yes or no to the question "Did you participate in any programs that were physically active (like lessons, clubs, or sports teams) after school this school year?" Participation in before school physical activity programs was measured by asking girls to answer yes or no to the question "Did you participate in any programs that were physically active (like lessons, clubs, or sports teams) before school or during lunch this school year?" These questions were included only on the 2005 and 2006 surveys, not on the 2003 survey. These items were analyzed as individual 0/1 items
Environmental variables		
After school transport	Evenson et al. 2006	Difficulty getting from a school activity was measured by asking girls to indicate on a 4-point Likert scale anchored from not at all difficult to impossible "if you stayed after school for an activity every day, how difficult would it be for you to get home afterwards?" Difficulty getting to a community activity was measured by asking girls to indicate on the same scale "If you wanted to do an after school

Measure	Source	Questions and psychometric properties
		activity someplace else besides school every day, how difficult would it be to get there?" Difficulty getting from a community activity was measured by asking girls to indicate on the same scale "If you wanted to do an after school activity someplace else besides school every day, how difficult would it be for you to get home afterwards?" For the three items, test–retest reliability among 480 girls, indicated by weighted kappa coefficients, ranged from 0.38 to 0.41. These items were analyzed individually, so we have no scale properties to report, nor do we have test-retest correlations to report
Access to facilities	Evenson et al. 2006	Access to facilities was measured by asking "Is it easy to get to and from this place from home or school?" Girls responded for 14 places such as basketball court, health club, park, or tennis court. Scores were calculated by adding the number of items, ranging from 0 to 14. The Cronbach alpha ranged from 0.80 to 0.81 in the 2003, 2005, and 2006 surveys. This measure was originally developed and piloted among 480 girls in 6th and 8th grade, with test-retest reliability of 0.78 (95% CI 0.74–0.84), indicated by an intraclass correlation coefficient
Providing social support	Developed for TAAG	Providing social support to others for physical activity was measured using a single item by asking, "During a typical week, how often do you encourage your friends to do physical activities or play sports?" The five response options ranged from never to everyday
Friend social support	Sallis et al. [51]	Friends' social support for physical activity was measured using three items from the Amherst Health and Activity Study[51]. The questions include: "During a typical week, (1) how often do your friends encourage you to do physical activities or play sports? (2) Do physical activities or sports with you? (3) Tell you that you are doing well at physical activities or sports?" Test-retest reliability for the peer scale was 0.86 and the Cronbach Alpha for those three items ranged from 0.74 to 0.79 in the 2003, 2005, and 2006 surveys
Family social support	Sallis et al. [51]	Family social support for physical activity was measured using five items modified from the Amherst Health and Activity Study with acceptable measurement properties. The questions include: "During a typical week, how often has a member of your household...(for example, your father, mother, brother, sister, grandparent or other relative): (1) encouraged you to do physical activities or play sports? (2) Done a physical activity with you?; (3) provided transportation to a place where you can do physical activities or play sports? (4) Watched you participate in physical activities or sports? (5) Told you that you are doing well in physical activities or sports?" Overall social support for physical activity was computed by summing the three social support scores

Table 2

Distribution of girls included in the analysis by survey year, condition, race, and participation in the free or reduced lunch program

	2003		2005		2006	
	N	Percent	*N*	Percent	*N*	Percent
Condition						
Intervention	817	51.0	1,540	49.9	1,664	49.3
Control	786	49.0	1,545	50.1	1,714	50.7
Total	1,603	100.0	3,085	100.0	3,378	100.0
Race/ethnicity						
White	712	44.4	1,409	45.7	1,568	46.4
African American	353	22.0	671	21.8	606	17.9
Hispanic	349	21.8	649	21.0	763	22.6
Other[a]	189	11.8	356	11.5	441	13.1
Total	1,603	100.0	3,085	100.0	3,378	100.0
Lunch program						
Yes	662	41.3	1,152	37.3	1,190	35.2
Other[b]	941	58.7	1,933	62.7	2,188	64.8
Total	1,603	100.0	3,085	100.0	3,378	100.0

[a] Asian, American Indian, Multi-ethnic, or missing

[b] No, don’ t know, or missing

Table 3

Intervention effects on eight measures of out-of-school physical activity in 2005 and 2006

		2005				2006			
		Intervention, *n*=1,540	**Control, *n*=1,545**	**I–C**	***p* value**	**Intervention, *n*=1,664**	**Control, *n*=1,714**	**I–C**	***p* value**
Average minutes of MVPA	Before school	3.77	3.95	−0.174	0.532	3.93	3.61	0.315	0.368
	After school	14.1	14.1	0.083	0.880	14.5	13.0	1.51	0.013
	Weekend	15.4	15.8	−0.400	0.494	14.4	14.4	0.014	0.978
	Out of school	17.2	17.4	−0.184	0.736	17.3	16.0	1.26	0.054
Average MET minutes of MVPA	Before school	22.0	22.9	−0.867	0.629	23.0	20.8	2.23	0.295
	After school	88.0	88.1	−0.131	0.972	89.3	80.0	9.25	0.019
	Weekend	96.8	98.2	−1.459	0.704	89.8	88.8	1.05	0.753
	Out of school	106.0	107.0	−1.250	0.726	106	97.5	8.27	0.045

Data were adjusted for race/ethnicity, school and site; averages are per day

I–C adjusted mean difference calculated as Intervention minus Control, *MVPA* moderate or vigorous physical activity, *MET* metabolic equivalent

Table 4

Descriptive values of potential mediators at 2003 and 2006 (means, ranges)

Potential mediator	Mean (range) 2003 (*n*=1,603)	Mean (range) 2006 (*n*=3,378)
Difficulty getting home from a school activity	1.51 (1, 4)	1.47 (1, 4)
Difficulty getting to a community activity	1.84 (1, 4)	1.86 (1, 4)
Difficulty getting home from a community activity	1.74 (1, 4)	1.74 (1, 4)
Access to facilities	6.23 (0, 14)	6.76 (0, 14)
Participation in school sports programs	0.86 (0, 14)	0.74 (0, 14)
Participation in out-of-school sports programs	2.12 (0, 14)	1.40 (0, 14)
Self-efficacy for physical activity	29.6 (8, 40)	29.1 (8, 40)
Outcome expectations	36.6 (9, 45)	36.6 (9, 45)
Outcome expectancy value	156.5 (9, 225)	158.1 (13, 225)
Provide social support to others for physical activity	2.83 (1, 5)	2.63 (1, 5)
Friends social support for physical activity	9.19 (3, 15)	8.65 (3,15)
Family social support for physical activity	17.0 (5, 25)	15.8 (5, 25)
Social support for physical activity	29.0 (9, 45)	27.1 (9, 45)
Participation in after school physical activity programs	NA	0.61 (0, 1)
Participation in before school physical activity programs	NA	0.20 (0, 1)

Table 5

Results in mediation analysis

Outcome	Potential mediator	C	*p*(C)	A	B	AB	*p*(AB)	C’	*p*(C’)	Percent
Average	Difficulty getting to a community activity									
Weekday	Difficulty getting from a community activity	0.348	0.328	0.105	0.152	0.016	0.075	0.342	0.325	4.4%
Minutes	Self-efficacy for physical activity									
Morning	Friends social support for pa									
	Social support for pa									
Average	Difficulty getting to a community activity	1.418	0.018	0.078	−0.576	−0.045	0.066	1.465	0.015	3.0%
Weekday	Difficulty getting from a community activity	1.430	0.018	0.106	−0.697	−0.074	0.022	1.508	0.013	4.7%
Minutes	Self-efficacy for physical activity	1.520	0.013	−0.582	0.205	−0.119	0.073	1.591	0.012	7.0%
Afternoon	Friends social support for pa	1.499	0.015	−0.229	0.411	−0.094	0.041	1.524	0.017	5.8%
	Social support for pa	1.504	0.014	−0.509	0.159	−0.081	0.066	1.517	0.015	5.1%
Average	Difficulty getting to a community activity									
Weekend	Difficulty getting from a community activity									
Minutes	Self-efficacy for physical activity	0.040	0.939	−0.587	0.209	−0.123	0.075	0.196	0.692	38.5%
	Friends social support for pa	−0.013	0.980	−0.228	0.400	−0.091	0.049	0.107	0.837	45.9%
	Social support for pa	0.019	0.971	−0.509	0.171	−0.087	0.069	0.131	0.799	39.9%
Average	Difficulty getting to a community activity									
Minutes	Difficulty getting from a community activity	1.210	0.068	0.106	−0.470	−0.050	0.067	1.295	0.050	3.7%
	Self-efficacy for physical activity	1.268	0.054	−0.587	0.194	−0.114	0.072	1.363	0.038	7.7%
	Friends social support for pa	1.207	0.067	−0.221	0.415	−0.092	0.050	1.260	0.063	6.8%
	Social support for pa	1.243	0.056	−0.504	0.159	−0.080	0.069	1.283	0.049	5.9%
Average	Difficulty getting to a community activity									
Weekday	Difficulty getting from a									

Outcome	Potential mediator	C	*p*(C)	A	B	AB	*p*(AB)	C’	*p*(C’)	Percent
	community activity									
MET minutes	Self-efficacy for physical activity									
Morning	Friends social support for pa									
	Social support for pa									
Average	Difficulty getting to a community activity	8.552	0.025	0.077	−3.480	−0.267	0.084	8.840	0.022	2.9%
Weekday	Difficulty getting from a community activity	8.699	0.025	0.105	−4.334	−0.455	0.030	9.178	0.019	4.7%
MET minutes	Self-efficacy for physical activity	9.380	0.019	−0.578	1.372	−0.793	0.076	9.862	0.017	7.4%
Afternoon	Friends social support for pa	9.236	0.022	−0.226	2.526	−0.571	0.044	9.397	0.024	5.7%
	Social support for pa	9.260	0.020	−0.507	0.991	−0.503	0.069	9.360	0.021	5.1%
Average	Difficulty getting to a community activity									
Weekend	Difficulty getting from a community activity									
MET minutes	Self-efficacy for physical activity	1.290	0.695	−0.586	1.445	−0.847	0.075	2.333	0.452	26.6%
	Friends social support for pa	0.948	0.774	−0.229	2.609	−0.598	0.049	1.804	0.586	24.9%
	Social support for pa	1.113	0.736	−0.509	1.090	−0.555	0.071	1.896	0.560	22.7%
Average	Difficulty getting to a community activity									
MET minutes	Difficulty getting from a community activity	7.842	0.058	0.106	−3.173	−0.338	0.069	8.390	0.042	3.9%
	Self-efficacy for physical activity	8.412	0.040	−0.585	1.328	−0.776	0.073	9.059	0.028	7.9%
	Friends social support for pa	8.009	0.051	−0.226	2.598	−0.588	0.047	8.363	0.048	6.6%
	Social support for pa	8.229	0.043	−0.508	1.009	−0.512	0.068	8.512	0.038	5.7%

C unadjusted intervention effect on outcome, *p(C) p* value for unadjusted intervention effect from the first mixed-model regression analysis, *A* intervention effect on mediator, *B* mediator effect on outcome, *AB* mediation effect, *p(AB) p* value for Sobel s test for mediation, *C’* unmediated intervention effect on outcome, *p(C’) p* value for unmediated intervention effect from the third mixed-model regression analysis, % the proportion of the absolute total effect that is mediated, |AB|/(|AB| + |C’|). Averages are per day