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A Longitudinal Study of the Effects of Instrumental and Emotional Social Support on Physical Activity in Underserved Adolescents in the ACT Trial

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Abstract

Background—Few previous studies have examined the influence of instrumental and emotional social support on physical activity (PA) longitudinally in underserved adolescents.

Purpose—This longitudinal study was a secondary analysis of the Active by Choice Today (ACT) trial examining whether instrumental social support predicts increases in PA in underserved adolescents, above and beyond emotional social support provided by family or peers.

Methods—Students in 6th grade ($N=1422$, 73% African American, 54% female, $M_{age}=11$ years) in the ACT trial participated. At baseline and 19 weeks, previously validated measures of social support (family instrumental, family emotional, and peer emotional) were completed and moderate-to-vigorous PA (MVPA) was assessed using 7-day accelerometry estimates.

Results—A mixed ANCOVA demonstrated that baseline ($p=.02$) and change in family instrumental support ($p=.01$), but not emotional support from family or peers, predicted increases in MVPA across a 19-week period.

Conclusions—Future interventions in underserved adolescents should enhance opportunities for instrumental support for PA.

Keywords

Physical activity; instrumental social support; emotional social support; African Americans; adolescence

The increasing rate of obesity in youth is a major public health concern in the United States. Approximately 32% of adolescents are overweight or obese (1), putting them at increased risk for diabetes, coronary heart disease, and other morbidities (2, 3). Overweight and obesity are particularly evident among ethnic minority groups, with nearly 37% of African American boys and 41% of African American girls ages 2-19 years classified as overweight or obese (1). Although increasing physical activity (PA) has been associated with obesity reduction in youth (4-6), less than 50% of children and only 8% of adolescents meet the recommended 60 minutes of daily moderate-to-vigorous PA (MVPA) (7, 8). Physical

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inactivity is particularly evident among minority adolescents (9, 10). To reduce disparities in the prevalence of overweight and obesity, it is important to identify factors that are associated with PA and that may be modified to promote PA behaviors in African American youth, particularly as they transition from childhood into adolescence.

The present study focuses on social support for PA, which has been identified as an important social correlate of PA in children and adolescents (11-13). Social support has been defined as the resources provided by significant others that facilitate an individual's achievement of a goal or outcome (14). Numerous cross-sectional studies have demonstrated that social support provided by family and peers is associated with youth PA (13, 15-20). However, few studies have examined these associations longitudinally or with accelerometry measures of PA in adolescents. Further, although a few cross-sectional studies have examined the association between social support and PA in underserved adolescents (i.e., low income, ethnic minorities) (13, 19, 21, 22), an understanding of the importance of social support provided by family and peers for promoting PA over time remains limited in this population.

As sources of social support, family and peers can influence children's and adolescents' PA through a variety of means (12, 14, 23). Two broad types of social support that have been identified in the literature are instrumental and emotional social support (24). Instrumental social support refers to overt behaviors that directly facilitate adolescents' involvement in PA, whereas emotional support consists of behaviors that motivate or encourage adolescents to participate in PA (14, 20). Both instrumental support and emotional social support have been found to be associated with increased PA in youth (15, 25-34). For example, encouragement and praise for PA are types of emotional social support that have been found to be associated with self-reported PA in youth (15, 25, 33, 34). A longitudinal investigation found that parental encouragement to be active reported during adolescence was associated with self-reported PA five years later (32). Transportation to places for PA, a type of instrumental social support, has been consistently linked to youth PA in cross-sectional studies, including PA that is self-reported (15, 29, 34) and measured via a PA monitor (30). Parents' provision of transportation has also been found to predict increases in habitual activity levels over 20 months in boys and girls (31).

The unique associations that have been observed among specific types of supportive behaviors and PA suggest that instrumental and emotional social support have distinct effects on PA (12). However, less is known about the importance of sources of support or the relative influence of these types of social support on promoting increases in PA, particularly in underserved adolescents. Although the family is an important source of support for PA, children spend increasing amounts of time with friends as they age (35), thereby increasing opportunities for peer influences on PA (20). Previous research demonstrates the importance of peer support for youth PA (36, 37). Moreover, findings from cross-sectional studies that simultaneously examined supportive behaviors provided by different sources have found that overall social support (i.e., instrumental and emotional support combined) is more strongly associated with PA when provided by peers than by parents (15, 18, 20). Similarly, overall social support provided by peers, but not family, has been shown to be associated with self-reported PA in African American adolescents (13).

Although cross-sectional in nature, these previous findings may suggest that parents may have less of an effect than peers on PA in middle school students. However, little is known about the relative influence of social support provided by family and peers on PA over time, particularly in underserved adolescents. Thus, conclusions regarding possible causal linkages between peer and family social support and PA remain limited.

Despite cross-sectional evidence that peers are a key source of social support for PA in youth, previous studies have shown that both peers and family can provide specific types of support that appear to be important for PA in adolescents (15, 18, 20). For example, one study found that, among middle school students residing in a metropolitan area, the only specific behavior related to higher levels of PA was having either a family member or peer watch them engage in physical activities (20). In contrast, other studies that assessed the importance of similar types of supportive behaviors found that transportation to places to be active was associated with higher levels of PA among adolescents residing in a rural area, as were praise (15) and encouragement (34). Although there are inconsistencies in the types of supportive behaviors that have been found to be important for youth PA, the variability highlights the need to understand the unique characteristics and needs of subgroups to develop targeted intervention strategies for increasing PA (15, 20).

In summary, much of the evidence of the association between social support and PA is cross-sectional in nature and based on self-reported PA. Little is known about longitudinal associations of instrumental and emotional social support provided by family and peers with independently measured PA, such as that provided by accelerometry, particularly in underserved adolescents. The purpose of the current study was to examine the relative influence of social supports provided by family and peers on accelerometer-assessed PA. Specifically, cross-sectional and longitudinal associations between family instrumental, family emotional, and peer emotional social support with MVPA were examined in underserved adolescents as a secondary analysis of the Active by Choice Today (ACT) trial (38, 39). Given that peers have been shown to be an important source of support for PA in adolescents, it was hypothesized that peer but not family emotional support would be associated with PA at baseline. However, in underserved adolescents who often lack environmental resources for PA, such as access to PA facilities, the family may play a critical role in increasing PA through the provision of instrumental support for overcoming PA barriers (40, 41). Therefore, it was further hypothesized that family instrumental support would be associated with greater MVPA at baseline and that increases in instrumental support would predict greater MVPA at 19 weeks, above and beyond the effects of either family or peer emotional support.

Method

Study Design and Procedures

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 (38, 39). Prior to randomization to either the ACT intervention program or General Health Education program (comparison group), participating middle schools in South Carolina ($N = 24$) were matched on school size, percentage minorities, percentage free

or reduced lunch, and urban or rural setting. Both programs were 17 weeks in duration and implemented over the course of an academic school year for 2 hours after school on Monday, Wednesday, and Friday afternoons. Assessments were conducted in each of the schools at baseline (October), mid-intervention (at 9 weeks in December), 2 weeks post-intervention (at 19 weeks in April), and 6 months post-intervention. The ACT intervention was found to successfully increase MVPA during program hours at mid-intervention; however, no intervention effects on MVPA were observed at 2 weeks post-intervention (39). Thus, schools in each condition were collapsed in the present study, which presents data collected at baseline and at 2 weeks post-intervention (i.e., at the 19-month measurement time point). Further information about the ACT trial has been previously published, including a CONSORT diagram (38, 39).

Participants

Data for this study were collected from 6th grade students ($N = 1422$) who participated in the ACT trial (38, 39). Students were eligible to participate if they had parental consent and agreed to random assignment (38). Students were excluded from participation if they 1) had a medical condition that would interfere with the prescribed PA intervention plan, 2) were developmentally delayed such that the intervention materials would not be cognitively appropriate, or 3) were currently in treatment for a psychiatric disorder. Mandates regarding physical education (PE) were consistent across participating middle schools and required students to engage in a PE curriculum for a portion of the school year. Detailed information on sample recruitment and retention has been described previously (38, 39).

Measures

Demographics—Participants' age, sex, and race were self-reported at baseline. Height and weight were assessed objectively by trained assistants at baseline and at 19 weeks (i.e., 2 weeks post-intervention), representing the academic year during which the 17-week intervention was implemented (38, 39).

Social support for PA—Three measures assessed participants' social support for PA, including emotional support provided by family, emotional support provided by peers, and instrumental support provided by family. Correlations among social support measures were moderate (.48-.55) and significant, with significant correlations with MVPA at baseline and at 19 weeks observed for peer emotional and family instrumental support (see Table 1).

Emotional social support: Emotional social support for PA was measured using a 12-item, modified version of the Support for Exercise Scales (42). Participants responded to each item two times, once to rate emotional support provided by family and again to rate emotional support provided by peers. In the original measure, six items were positively worded and six items were negatively worded. Because previous studies have demonstrated that negative items, when reverse-coded, may introduce a method bias (43), responses to negatively worded items were excluded in the current study. Thus, 6 positively worded items assessed family support, and 6 positively worded items assessed peer support. An example of a family emotional support item was, “In the past month, how often has your parent or another adult you live with talked about being active with you?” An example peer

emotional support item was, “In the past month, how often has a friend told you to stick with being active?” Adolescents responded to a 3-point scale from 1 (*None*) to 3 (*Many times*). The family emotional support scale has been shown to demonstrate good psychometric properties in this sample, with standardized loadings from a single factor confirmatory factor analysis ranging from .61-.81 (21). Cronbach's alpha values were .80 for both the family and the peer emotional support scales in the present study, indicating adequate reliability.

Instrumental social support: A 4-item measure was used to assess perceived instrumental social support from family (44). Participants rated how often in the past month family members took them to a place where they could be active, purchased equipment for PA (e.g., balls) for them, helped them do a physical activity, and showed them how to do a physical activity. Responses ranged from 1 (*Not at all*) to 5 (*About every day*). The instrumental support scale has been shown to demonstrate good psychometric properties in this sample, with standardized loadings from a single factor confirmatory factor analysis ranging from .60-.77 (21). Cronbach's alpha was .71 in the present study, indicating adequate reliability of this scale. Peer instrumental support was not assessed in the ACT trial.

Moderate-to-vigorous PA—PA was assessed with omnidirectional Actical accelerometers (Mini-Mitter, Bend, OR). 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, such as MTI Actigraph, Caltrac, and Tritrac (45). At each measurement time point, participants wore an Actical attached to a waistband for 7 consecutive days. Data were recorded in 1-minute epochs (46). Based on Actical-specific activity count thresholds for children identified by Puyau and colleagues (45), raw activity data were converted into time spent in moderate PA, vigorous PA, and MVPA (approximating 3-5.9, 6-8.9, and 3-8.9 METS, respectively), with MVPA 1,500 counts indicating moderate-to-vigorous PA for that block. Participants' data were 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 (47). Estimates of PA were combined for all 7 days to provide one daily measure of PA (i.e., average minutes of MVPA/day) for the data analyses.

Data Analysis

Both cross-sectional analyses at baseline and repeated measures analyses were conducted. To adjust for treatment as a school-level variable, mixed ANCOVAs with random effects were used to assess the baseline association between social support and MVPA and the effects of baseline social support and change in social support on MVPA at 19 weeks. Using the mixed effects notation (48) the statistical model at post-test was:

$$\begin{aligned} MVPA_{post} = & \beta_0 + \beta_1 Black_{ij} + \beta_2 Female_{ij} + \beta_3 BMI_{base_{ij}} + \beta_4 MVPA_{base_{ij}} \\ & + \beta_5 Treatment_i + \beta_6 InstrumentalSS_{base_{ij}} + \beta_7 PeerEmoSS_{base_{ij}} \\ & + \beta_8 FamilyEmoSS_{base_{ij}} + \beta_9 \Delta InstrumentalSS_{ij} + \beta_{10} \Delta PeerEmoSS_{ij} \\ & + \beta_{11} \Delta FamilyEmoSS_{ij} + b_i + \varepsilon_{ij}, b_i \sim N(0, \sigma_b^2), \varepsilon_{ij} \sim N(0, \sigma^2) \end{aligned}$$

where MVPA_{post} is the realized value of MVPA at 19 weeks for individual j in the i^{th} school, β_0 is the intercept across all schools, β_1 - β_5 are the effects of covariates (i.e., ethnicity, sex, centered baseline BMI, centered baseline MVPA, and condition). Although there were no significant intervention effects on MVPA at 19 weeks (39), it was prudent to include condition as a covariate to adjust for any between-group differences. Holding covariates constant, β_6 - β_8 are the effects of each type of social support at baseline, and β_9 - β_{11} are the effects of change in each type of social support from baseline to 19 weeks. The effects of baseline social support are represented by scaled summaries for each type. The effects of change in social support are represented by residuals from the simple regression of social support at post-intervention on social support at baseline for each type. The random effect b_i allows for intercepts to differ between schools, thus accounting for any non-independence of the outcome within schools. Recommended methods for assessing multicollinearity were conducted (49). An examination of bivariate correlations (see Table 1) and of structure coefficients in relation to beta weights did not indicate any issues with model interpretation. Further, analyses examining the effect of each social support variable on MVPA at 19 weeks with and without the other social support variables in the models revealed no substantive changes in the observed effects. Thus, no issues concerning multicollinearity or suppression were apparent in the present study.

Multiple imputation (50) was used to address missing data in the ACT trial, consistent with previous national trials (51). Multiple imputation is appropriate for longitudinal data (52), has been shown to provide unbiased parameter estimates and standard errors, and has been recommended for addressing missing accelerometer data (47). The PAN package (53) implemented within R (R Foundation, 2008) was used to generate 40 imputations. MVPA was coded as minutes within 5 time blocks per day (i.e., 6-9 a.m., 9 a.m.-2 p.m., 2-5 p.m., 5-8 p.m., and 8 p.m.-12 a.m.) and imputed within time block, with minutes of MVPA for each period log-transformed (see <http://src6.cas.sc.edu/psyc11/sites/default/files/Final%20ACT.pdf>). Imputation was conducted at the student level and baseline information for each student was included in the imputation model. If a student was missing data for an entire assessment period (e.g., post-intervention), then a summary score representing average minutes of MVPA for the entire period was imputed. All reported standard errors were adjusted for missing information.

Results

Sample Characteristics

Complete demographic and baseline characteristics of the ACT sample are described in detail elsewhere (39). Participants ($N = 1422$, 54% female) were, on average, 11.34 years old ($SD = 0.59$ years). The sample was 73% African American (27% Caucasian), and 51% of students were at or above the 85th BMI percentile and thus, were classified as being overweight or obese ($M_{\text{BMI}} = 22.82$, $SD = 6.01$). Students' unstandardized mean scores for each measure of social support were in the upper mid-range of the respective response scales, and their average daily MVPA at baseline and 19 weeks was approximately 44 and 36 minutes, respectively (see Table 2).

Fewer than 10% of students in the ACT trial ($N = 144$) did not participate in post-intervention measures (39). Hypothesized associations between social support and MVPA were tested using multiply imputation data, which yields unbiased parameter estimates and standard errors (47). However, because a secondary, time-specific analysis included only students who were present at post-test, additional analyses were conducted to evaluate differential attrition for this time point. Absence at the 19-week assessment was used to predict baseline age, baseline BMI, and baseline MVPA. Those not present at 19 weeks were older than those who participated at this time point by 0.16 years (95% CI: 0.08 to 0.24). No differences were found for baseline BMI or baseline MVPA.

Baseline Analyses

Social support—Separate mixed ANCOVAs were first applied to examine associations between covariates and each of the three measures of social support at baseline (see Table 3). Differences by ethnicity were observed for all three measures of social support such that African American adolescents reported higher levels of family instrumental, peer emotional, and family emotional support compared to those in other ethnic categories combined. Compared to boys, girls reported significantly lower levels of emotional support from peers. There was a significant, negative association between BMI and family emotional support. No other covariates were significantly associated with the three measures of social support. The ICC estimates for the three measures of social support at baseline ranged from .01 to .03.

MVPA—A mixed ANCOVA was applied to examine the association of social support with baseline MVPA (see Table 4). This model demonstrated that higher levels of family instrumental support and peer emotional support were associated with higher levels of baseline MVPA. A 2-standard deviation increase in family instrumental support and in peer emotional support corresponded to increases in MVPA of approximately 4.5 minutes (95% CI: 0.61 to 4.00) and 4 minutes (95% CI: 0.39 to 3.81), respectively. The association between family emotional support and baseline MVPA was not significant. The ICC estimate for baseline MVPA was .02.

Longitudinal Analyses

The outcomes of the intervention have been previously reported (39). Given that there were no intervention effects at 19 weeks, this study reports longitudinal analyses for the intervention and comparison groups combined. A mixed ANCOVA demonstrated a significant effect of baseline instrumental support on MVPA at 19 weeks (see Table 5), adjusting for baseline MVPA. This model also revealed a significant effect of change in instrumental support on MVPA at 19 weeks. Increases in daily MVPA at 19 weeks associated with a 2-standard deviation increase in baseline family instrumental support and instrumental support change were approximately 5 minutes (95% CI: 0.31 to 4.25) and 6 minutes (95% CI: 0.79 to 4.80), respectively. The effects of baseline peer and family emotional support and change in family emotional support on MVPA at 19 weeks were not significant. The effect of change in peer emotional social support on MVPA at 19 weeks approached significance ($p = .09$). Thus, as predicted, baseline and change in instrumental

social support predicted MVPA at 19 weeks, above and beyond family and peer emotional social support. The ICC for MVPA at 19 weeks was .02.

A follow-up analysis examined the effects of family instrumental support on MVPA at 19 weeks during regular school time and non-school time (i.e., after school and weekends) using a 3-level random effects model with time periods nested within students and students nested within schools. The proportion of minutes spent engaging in MVPA during each of the 5 time periods per day was the outcome. In addition to covariates, the model included an indicator variable specifying whether or not each observation was made during non-school time and an interaction term indicating the effect of instrumental support on post-MVPA during non-school hours. Results revealed a significant non-school time by baseline instrumental support interaction, which indicated that the effect of instrumental support on post-MVPA was greatest during non-school time. Specifically, in comparison to students whose baseline instrumental support was 1 standard deviation below the mean, students who were 1 standard deviation above the mean spent a greater proportion of minutes engaging in MVPA during non-school times (95% CI: 0.001 to 0.01), corresponding to approximately 50 additional minutes of MVPA per week. In contrast, the proportion of minutes spent engaging in MVPA during school time was similar across students, regardless of baseline instrumental support.

Discussion

This longitudinal study was a secondary analysis of the ACT trial examining the relative importance of instrumental and emotional social support provided by family and peers for promoting increases in PA in underserved adolescents. At baseline, family instrumental and peer emotional support were positively associated with MVPA. However, only instrumental support predicted increases in MVPA across a 19-week period. Thus, findings in the present study suggest that instrumental support is both a precursor and predictor of change in MVPA in underserved adolescents. Further, these findings highlight the importance of examining associations between social supports and PA using repeated measures and imply that enhancing family members' provision of instrumental support for PA should be the focus of future interventions.

Findings in the present investigation are consistent with previous studies linking instrumental social support and PA in youth (15, 30, 31, 34) and contribute to a limited literature examining this association in underserved adolescents (21). For example, previous cross-sectional studies that have examined the relative strength of associations between different types of support and PA have identified transportation to places to be active as an important correlate of PA in middle school students (15, 34). Transportation has also been shown to be a significant predictor of youth PA over 20 months in a longitudinal investigation (31). The present study expands on past research by demonstrating the importance of family instrumental support for predicting changes in MVPA across 19 weeks in underserved adolescents, above and beyond the effects of emotional support provided by either family or peers. Importantly, a secondary analysis in the present study revealed that the effect of instrumental support on post-MVPA was greatest during non-school time (e.g.,

after school and the weekend), thereby providing further evidence that family members' instrumental support for PA may be key to facilitating PA in underserved youth.

The relative importance of instrumental support for MVPA observed in the present study may reflect young adolescents' reliance on adult family members to facilitate PA opportunities that are not readily accessible. Access to environmental resources for PA, such as PA facilities, has been shown to be positively associated with youth PA (54, 55). In underserved adolescents, however, a lack environmental resources for PA may contribute to lower levels of engagement in PA (40, 41). Thus, family members' provision of instrumental supports that enable access to opportunities to engage in PA may be especially important for promoting PA in underserved adolescents. Indeed, previous cross-sectional findings indicate that instrumental support may be particularly important for PA in adolescents with limited access to PA resources, such as those who reside in a rural area (15). Future research should examine whether access to PA resources moderates the longitudinal effects of instrumental support on MVPA observed in the present study.

Neither family nor peer emotional support was associated with MVPA at 19 weeks in the present study. However, emotional support provided by peers was associated with greater baseline MVPA. This finding is consistent with previous cross-sectional studies that have found peer social support to be an important correlate of youth PA (13, 15, 18, 20). Taken together, the present findings suggest that although greater peer support is associated with greater engagement in baseline MVPA, higher levels of peer support may not be sufficient to produce substantive increases in MVPA over time. It is worth noting, however, that the effect of change in peer support on post-test MVPA approached significance ($p = .09$) in the present study, providing limited evidence that increases in peer emotional support for PA may foster increases in MVPA over time. However, given that the association between change in peer emotional support and MVPA was not significant, this interpretation is tentative.

The absence of significant associations between family emotional support and MVPA at baseline and 19 weeks in the present study is consistent with numerous previous cross-sectional studies (13, 15, 18, 20, 21). The disparate influence of emotional social support from peers and family on youth PA may reflect the growing importance of the peer group in adolescence (35). Unlike emotional support provided by peers, adolescents may perceive family emotional support as controlling rather than encouraging as has been reported in a previous qualitative study with underserved adolescents (56). Nonetheless, findings in the present study indicate that families play a key role in promoting PA among adolescents in middle school through the provision of transportation or other forms of instrumental social support for PA.

There are several limitations to the present study that warrant discussion. First, family instrumental support items asked participants about support provided by "a family member." Therefore, it is not possible to elucidate the unique role of each parent or other caregivers in supporting adolescent PA. This may be particularly relevant in African American youth given extended kin-structured networks that are characteristic of African American families (57). A related limitation concerns the lack of a measure of peer instrumental support for

PA. Given the period of development assessed in the ACT trial, adult family members may have been more likely than peers to provide some of the types of instrumental support assessed in the present study (e.g., transportation). However, peers may also be a source of instrumental support for PA in adolescents. Future studies should aim to further examine family members and peers as sources of instrumental support for PA to better understand their respective roles in youth PA.

Overall, this study found that family instrumental support is a precursor and predictor of change in MVPA in underserved middle school students. These findings expand previous cross-sectional studies of the association between social supports provided by family and peers and highlight the importance of examining these relationships using repeated measures. Further, the present study brings attention to the relative importance of family members as a source of social support for PA in youth. Specifically, the findings indicate that although peers appear to be an important source of emotional social support for PA, family members facilitate increases in levels of youth PA through the provision of transportation and other forms of instrumental social support. Although the effect of instrumental support on increasing MVPA in underserved youth was relatively small in the present study, its contribution has the potential to impact public health. A 2-standard deviation increase in family instrumental support corresponded to a nearly 6-minute increase in average daily MVPA at 19 weeks. Such increases in instrumental support for PA could translate to nearly 42 additional minutes of MVPA each week in adolescents. These findings may aid in the development of effective family-based programs that support family members' attempts to foster PA engagement by scaffolding their efforts to provide instrumental support for PA. Given that parents and caregivers may have limited instrumental resources, including a lack of transportation and means of providing monetary support for PA, efforts should also be focused at developing community-level strategies to ensure that adolescents in underserved families have access to opportunities for PA.

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Table 1
Bivariate Correlations Among Variables of Primary Interest

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
|--------------------------|--------|--------|--------|--------|--------|------|--------|
| 1 BL instrumental SS | | | | | | | |
| 2 BL family emotional SS | 0.52** | | | | | | |
| 3 BL peer emotional SS | 0.48** | 0.55** | | | | | |
| 4 Instrumental SS | 0.01 | 0.12** | 0.17** | | | | |
| 5 Peer emotional SS | 0.15** | 0.11** | 0.01 | 0.33** | | | |
| 6 Family emotional SS | 0.17** | 0.02 | 0.09** | 0.42 | 0.54** | | |
| 7 BL MVPA | 0.12** | 0.04 | 0.12** | 0.07* | 0.07* | 0.00 | |
| 8 Post-MVPA | 0.12** | 0.03 | 0.09** | 0.12** | 0.11** | 0.03 | 0.44** |

Note. Correlations calculated using a single imputation. BL = Baseline assessment time point; SS = Social support; = Change in; MVPA = Moderate-to-vigorous physical activity; Post = 19-week assessment time point.

* Denotes significance at $p < .01$.

** Denotes significance at $p < .001$.

Table 2
Means (SD) of Social Support and Moderate-to-Vigorous Physical Activity (MVPA) at
Baseline and at 19 weeks

| | Baseline | | 19 weeks | |
|---------------------|----------|---------|----------|---------|
| Social support | | | | |
| Family instrumental | 2.84 | (0.96) | 2.75 | (0.99) |
| Peer emotional | 1.92 | (0.53) | 1.90 | (0.54) |
| Family emotional | 1.90 | (0.52) | 1.88 | (0.55) |
| MVPA (minutes/day) | 43.89 | (27.51) | 36.29 | (29.18) |

Note. Non-standardized means (SD) calculated using a single imputation.

Table 3
Effects of Covariates on Each Measure of Social Support at Baseline

| Parameter | Estimate | (SE) | df | Lower CI | Upper CI |
|---------------------|--------------|-------|-----------|----------|----------|
| Family instrumental | | | | | |
| Intercept | -0.21 | 0.07 | 320775.6 | -0.34 | -0.08 |
| Black | 0.33 | 0.06 | 339230.4 | 0.21 | 0.45 |
| Female | -0.09 | 0.05 | 676742.8 | -0.19 | 0.02 |
| BMI | -0.001 | 0.004 | 889624.4 | -0.01 | 0.01 |
| Treatment | 0.04 | 0.06 | 1103159.2 | -0.09 | 0.16 |
| Peer emotional | | | | | |
| Intercept | -0.06 | 0.08 | 1642270.8 | -0.21 | 0.10 |
| Black | 0.13 | 0.06 | 462392.1 | 0.01 | 0.25 |
| Female | -0.13 | 0.05 | 2364645.1 | -0.24 | -0.03 |
| BMI | 0.001 | 0.004 | 1220447.8 | -0.01 | 0.01 |
| Treatment | 0.06 | 0.09 | 7003212.7 | -0.11 | 0.23 |
| Family emotional | | | | | |
| Intercept | -0.25 | 0.08 | 1763230.7 | -0.42 | -0.09 |
| Black | 0.22 | 0.06 | 530615.1 | 0.10 | 0.34 |
| Female | 0.08 | 0.05 | 2279665.8 | -0.02 | 0.18 |
| BMI | 0.01 | 0.004 | 1189712.7 | 0.01 | 0.02 |
| Treatment | 0.09 | 0.09 | 9469217.2 | -0.09 | 0.27 |

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

Table 4
Effects of Social Support on Minutes of Daily Moderate-to-Vigorous Physical Activity (MVPA) at Baseline

| Parameter | Estimate | (SE) | df | Lower CI | Upper CI |
|-------------------------|---------------|------|---------|----------|----------|
| Intercept | 51.14 | 2.09 | 994.69 | 47.05 | 55.24 |
| Black | 0.99 | 1.75 | 827.26 | -2.46 | 4.43 |
| Female | -15.05 | 1.43 | 2461.25 | -17.85 | -12.25 |
| Baseline BMI | -0.78 | 0.12 | 1733.61 | -1.01 | -0.54 |
| Treatment | -0.60 | 1.97 | 6904.55 | -4.46 | 3.27 |
| Baseline social support | | | | | |
| Family instrumental | 2.30 | 0.86 | 2457.73 | 0.61 | 4.00 |
| Peer emotional | 2.10 | 0.87 | 3476.34 | 0.39 | 3.81 |
| Family emotional | -0.18 | 0.94 | 1457.66 | -2.01 | 1.66 |

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

Table 5
Effects of Social Support on Minutes of Daily Moderate-to-Vigorous Physical Activity (MVPA) at 19 Weeks

| Parameter | Estimate | (SE) | df | Lower CI | Upper CI |
|-------------------------|---------------|------|---------|----------|----------|
| Intercept | 50.47 | 2.29 | 654.34 | 45.96 | 54.97 |
| Black | 0.27 | 1.91 | 380.56 | -3.49 | 4.04 |
| Female | -13.02 | 1.65 | 558.93 | -16.26 | -9.78 |
| Baseline BMI | -0.57 | 0.13 | 797.25 | -0.82 | -0.31 |
| Baseline MVPA | 0.34 | 0.04 | 223.33 | 0.27 | 0.41 |
| Treatment | -0.23 | 2.26 | 1704.95 | -4.67 | 4.21 |
| Baseline social support | | | | | |
| Family instrumental | 2.28 | 1.00 | 523.24 | 0.31 | 4.25 |
| Peer emotional | 0.33 | 0.99 | 689.42 | -1.60 | 2.27 |
| Family emotional | -0.78 | 1.04 | 543.79 | -2.83 | 1.27 |
| Social support change | | | | | |
| Family instrumental | 2.80 | 1.02 | 614.99 | 0.79 | 4.80 |
| Peer emotional | 1.83 | 1.06 | 543.23 | -0.26 | 3.92 |
| Family emotional | -0.45 | 1.08 | 733.32 | -2.56 | 1.66 |

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