HHS Public Access

Author manuscript

Nurs Res. Author manuscript; available in PMC 2020 July 01.

Published in final edited form as:

Nurs Res. 2019 ; 68(4): 257–266. doi:10.1097/NNR.0000000000000359.

Mediators of Physical Activity Behavior Change in the "Girls on the Move" Intervention

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Abstract

Background: The minimal effect of interventions to date on increasing young adolescent girls' physical activity (PA) may be due to inadequate understanding of the mechanisms underlying behavior change, yet sparse research testing a PA intervention has examined the capacity of theories to explain PA, particularly when using objective measures.

Objectives: To examine whether constructs from the Health Promotion Model and Self-Determination Theory mediated changes in moderate-to-vigorous physical activity (MVPA) following a 17-week intervention.

Methods: The study was a secondary analysis of data from a group randomized trial, including 12 intervention and 12 control schools in the Midwestern U.S. Data were collected in 2012–2016. Girls (5^{th}-8^{th} grade; $N = 1519$) completed surveys on perceived benefits and enjoyment of PA, PA self-efficacy, social support and motivation for PA, and barriers to PA and wore accelerometers.

Results: The final path model had a good fit: $\chi^2(21) = 1712.44$, $p < .001$; GFI = 0.75; CFI = 0.32; RMSEA= 0.23; SRMR= 0.19. For MVPA change from baseline to post-intervention, enjoyment ($B = 24.48$, $p < .001$) and social support ($B = 30.48$, $p < .001$) had a positive direct effect, while the intervention had a positive indirect effect through enjoyment and social support ($B = 9.13$, $p < .001$). Enjoyment ($B = -13.83$, $p < .001$) and social support ($B = -17.22$, $p < .001$) had a negative indirect effect on MVPA change from post-intervention to follow-up.

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The authors have no conflicts of interest to report.

Ethical Conduct of Research: This study adhered to strict ethical conduct of research. The study protocol was approved by the Michigan State University IRB.

Clinical Trial Registration: ClinicalTrials.gov Identifier NCT01503333; Date of registration: January, 4, 2012; Date the first participant was enrolled: September 2012; https://clinicaltrials.gov/ct2/show/study/NCT01503333?term=01503333&rank=1

Discussion: Enjoyment of PA and social support for PA may be important mediators of PA in young adolescent girls and warrant consideration when designing interventions.

Keywords

adolescents; determinants; exercise; females; theory

Close to 80% of 9th grade girls (~14 years of age; Kann et al., 2016) fail to meet U.S. recommendations calling for at least 60 minutes a day of mostly moderate-to-vigorous physical activity (MVPA; U.S. Department of Health and Human Services, 2008), indicating a need to intervene before this academic grade is reached. Unfortunately, interventions conducted to date with young adolescent girls, especially minorities and those living in urban, low-income communities, have had minimal effect on increasing their MVPA (Voorhees et al., 2009).

Some researchers suggest that the discouraging findings may be due to inadequate understanding of the mechanisms responsible for behavior change, yet limited research testing a physical activity (PA) intervention has examined the capacity of theories to explain PA, particularly when using objective measures (Plotnikoff, Costigan, Karunamuni, & Lubans, 2013). Research in this area is particularly important for young adolescent girls to identify factors underlying their PA and explain why an intervention is effective in increasing PA (Dewar et al., 2014). In order to advance the science of PA research in this population (Atkin, van Sluijs, Dollman, Taylor, & Stanley, 2016), identification of behavioral mediators is critical for increasing awareness of how factors interrelate to predict and explain behavior. This information can then be used by researchers to guide the development of effective theory-based interventions (Dewar et al., 2013).

Several studies indicate that the Health Promotion Model (HPM; Pender, Murdaugh, & Parsons, 2015) and Self-Determination Theory (SDT; Ryan & Deci, 2000) can be useful for promoting positive behavior change among adolescent girls (Spruijt-Metz, Nguyen-Michel, Goran, Chou, & Huang, 2008; Taymoori et al., 2008). The HPM purports that cognitive and affective variables, including benefits of PA, barriers to PA, PA self-efficacy, social support for PA, and enjoyment of PA, can be modified in an intervention with a resultant increase in PA. SDT proposes that three basic needs, including competence, autonomy, and relatedness, promote motivation to drive behavior change. The HPM and SDT were integrated and applied in a 17-week Girls on the Move (GOTM) school-based intervention to increase minutes of MVPA among 5th–8th grade girls (Robbins et al., 2013). The reasons for integrating both the HPM and SDT into the intervention are: 1) self-efficacy (HPM), enjoyment (HPM), social support (HPM), and motivation (SDT) are the most significant and consistently reported correlates of PA among adolescent girls (Graham, Bauer, Friend, Barr-Anderson, & Neumark-Sztainer, 2014; Lubans, Foster, & Biddle, 2008; Sterdt, Liersch, & Walter, 2013), and 2) a single social cognitive theory (e.g., HPM, SDT, Social Cognitive Theory, Theory of Planned Behavior) only explains about 12% of the variance in objectively measured PA and 34% of the variance in self-reported PA in adolescents (Plotnikoff et al., 2013). GOTM is the first intervention integrating both HPM and SDT, so examining the mediating effects of the theoretical constructs on the intervention effects is important in

guiding future intervention efforts with adolescent girls. Therefore, the purpose of this study was to examine whether constructs, including benefits of PA, barriers to PA, PA self-efficacy, social support for PA, enjoyment of PA, and motivation, derived from the HPM and SDT mediated changes in accelerometer-measured MVPA following a school-based PA intervention for adolescent girls.

Methods

Research Design, Setting, and Participants

This study involved a secondary analysis of data obtained from a group randomized trial (GRT; 2011–2016) involving 24 schools (12 intervention; 12 control receiving usual school activities) that was designed to test the effect of a 17-week school-based intervention on young adolescent girls' MVPA at post-intervention and 9-month follow-up (Robbins et al., 2013). To minimize bias, schools were paired based on type (e.g., academic grades included), size, racial distribution, and socioeconomic status (SES) before randomization. The intervention was designed to improve girls' perceptions of the benefits and enjoyment of PA (HPM), PA self-efficacy (HPM), social support (HPM) and motivation (SDT) for PA, and barriers to PA (HPM), all of which are purported to have an effect on PA. The intervention included three components: 1) two face-to-face motivational interviewing sessions (one at beginning and other at end of intervention) with a health professional to address each girl's unique perceived PA benefits and barriers to motivate PA change (HPM, benefits and barriers; SDT, motivation); 2) an after-school PA club offered 3 days a week by club coaches to provide fun PA opportunities and coach and peer support to increase girls' PA skills (HPM, enjoyment, self-efficacy, social support); and 3) an interactive Internet-based session delivered at the intervention midpoint via an iPad to provide each girl individually tailored motivational and feedback messages based on her survey responses to encourage PA (SDT, motivation). Details of the study protocol were published elsewhere (Robbins et al., 2013).

The trial was approved by the Michigan State University Institutional Review Board, and permission to conduct the study was obtained from school administrators. Prior to any study participation, all girls and their parents/guardians provided written assent and consent, respectively. A 2-minute recruitment video was created to help recruit girls from selected public schools located in racially and ethnically diverse, low-income, urban (i.e., city schools) communities in the Midwestern U.S. Recruiters presented the study to a total of 4192 girls in 24 schools and answered questions. Of 4146 girls who received recruitment packets, 2024 agreed to participate and returned signed consent and assent forms. Girls were eligible to participate in the study if they were 1) between 10–15 years old, 2) willing to participate in the intervention activities, 3) English-speaking, 4) not involved in any organized PAs for more than 2 days/week after school, and 5) not having any health condition precluding safe PA. Following exclusion of 481 girls (e.g., not meeting eligibility criteria), 1543 remained; but 24 girls withdrew before baseline data collection (e.g., relocated). From 2012–2016, a total of 1519 5^{th}-8^{th} girls, aged 10–15 years old, participated in the GRT and provided data. The data were analyzed in 2018. A flow diagram of

participants through the GRT and results on the effects of the intervention on MVPA were published elsewhere (Robbins et al., 2018).

Measures

At baseline and post-intervention, trained data collectors, who were blinded to group allocation, collected the data on demographics, theoretical constructs, and MVPA. At 9-month follow-up, data collectors collected only MVPA data. Details regarding all measures and measurement procedures have been described in the published protocol (Robbins et al., 2013).

Demographics.—Demographic data, including age, race and ethnicity, and SES (participation in free or reduced-price lunch at school served as proxy for low SES), were obtained from responses to items listed on the consent form. At baseline, girls completed a Pubertal Development Scale (Peterson, Crockett, Richards, & Boxer, 1988) by using the following response choices to rate themselves on body hair and breast development: (1) no, not yet started; (2) yes, barely; (3) yes, definitely; and (4) development complete. They also reported about menstruation by responding either: (1) no menstruation or (4) yes, started. Girls having a summed score for the three characteristics of 2, 3, or >3 with no menstruation were in pre-, early, or middle puberty, respectively; whereas a score of ≤7 or 8 for the three characteristics with menstruation indicated late or post-puberty, respectively (Carskadon & Acebo, 1993). To determine weight status, the data collectors measured each girl's height and weight in a private room to estimate body mass index (BMI), BMI percentile, and BMI z-score (Robbins et al., 2013; Table 1).

Theoretical variables.—At baseline and post-intervention, girls used an iPad to complete surveys reflecting the HPM and SDT constructs. To assess the positive consequences of PA and obstacles interfering with PA among adolescents, a 10-item Perceived Benefits Scale (Cronbach's α=.75 at baseline) and 16-item Perceived Barriers Scale (Cronbach's α=.86 at baseline), developed by the study team, were used. Response choices for the two scales ranged from (0) not at all true to (3) very true. Test-retest reliability among 5^{th}-8^{th} grade girls was .83 and 88, respectively (Ling & Robbins, 2017). Both measures have shown good validity with significant relationships with MVPA (Ling & Robbins, 2017). To measure adolescents' perceived assistance for PA received from others, an 8-item Social Support Scale (Cronbach's α=.83 at baseline), developed by the study team, with 4 response choices ranging from (0) never to (3) often was used. Among adolescent girls, test-retest reliability was .78, and the scale demonstrated adequate validity with significant relationships with MVPA (Robbins, Ling, Dalimonte-Merckling, Sharma, Bakhoya, & Pfeiffer, 2018). To assess adolescent girls' confidence in their ability to attain PA during their free time when facing barriers or not, a 6-item PA Self-Efficacy Scale (Cronbach's α=.78 at baseline) with response choices ranging from (0) disagree a lot to (3) agree a lot was employed (Dishman, Hales, et al., 2010). The scale has good validity with one factor structure and a significant relationship with PA among adolescent girls (Dishman, Dunn, Sallis, Vandenberg, & Pratt, 2010; Dishman, Hales, et al., 2010).

To assess adolescents' feelings regarding PA, enjoyment and motivation were measured. Enjoyment was measured using a 6-item PA Enjoyment Scale (Cronbach's α=.78 at baseline, test-retest reliability=.79), modified from a more lengthy scale by the study team (Motl et al., 2001), with response choices ranging from (0) not at all true to (3) very true (Ling & Robbins, 2017). The scale has good test-retest reliability of .79 and validity with a significant relationship with MVPA among adolescent girls (Ling & Robbins, 2017). Motivation was measured using 10 items from the 19-item Behavioral Regulation in Exercise Questionnaire–2 (BREQ-2) (Markland & Tobin, 2004; Verloigne et al., 2011; Wilson, Rodgers, Loitz, & Scime, 2006). To decrease the response burden for this young age group, six redundant items were deleted (I take part in exercise because my friends/family/partner say I should; I feel ashamed when I miss an exercise session; I can't see why I should both exercising; I don't see the point in exercising; I feel like a failure when I haven't exercised in a while; I feel under pressure from my friend/family to exercise). Three items from the 4-item intrinsic motivation subscale that were similar to those included in the PA Enjoyment Scale were also deleted (I exercise because it's fun; I enjoy my exercise sessions; I find exercise a pleasurable activity). Response choices ranged from (0) not true to (4) very true. Cronbach's α was .73 at baseline.

Objectively measured MVPA.—MVPA was measured in minutes per hour via Actigraph GT3X+ (www.Actigraph.com). Accelerometers were attached to an elastic belt and worn at each girl's right hip from the time getting out of bed in the morning to the time going to bed at night for seven consecutive days at baseline, post-intervention, and 9-month follow-up. Girls were asked to wear for seven consecutive days because 7-day monitoring provides reliable estimates of adolescents' usual PA behavior (Trost, Pate, Freedson, Sallis, & Taylor, 2000). Data re-integrated to 15-second epochs were processed based on cut-points established by Evenson and colleagues (2008): 0–25 sedentary, 26–573 light activity, 574–1002 moderate activity, and ≥1003 vigorous activity. The above cut-points have the best sensitivity and specificity, compared to others among children and adolescents aged 5–15 years old (Trost, Loprinzi, Moore, & Pfeiffer, 2011). Missing data were imputed using multiple imputation method (Robbins et al., 2018). To account for seasonal variation of MVPA, data collection in each pair of schools (one intervention school and one control school) occurred at the same time.

Data Analysis

Data were imputed in R statistical software [version 3.2.4] using multiple imputation method, and 20 imputations were performed at the individual level (Robbins et al., 2018; Rubin, 1987; White, 2011). Using R statistical software, linear mixed-effect models were applied to examine the effect of the intervention on the HPM and SDT constructs at post-intervention including benefits of PA, barriers to PA, PA self-efficacy, social support for PA, enjoyment of PA, and motivation. Models included the group variable (intervention vs. control), cluster random effect of school, and the following fixed effects: age, race, SES, ethnicity, pubertal stage, study year, baseline MVPA, and BMI z-score.

Path analysis was performed in SAS 9.4 to examine the study mediation model. Theoretical constructs' change scores from baseline to post-intervention were used as mediators. MVPA

change scores from baseline to post-intervention and from post-intervention to follow-up were used as dependent variables to indicate short-term and long-term intervention effects on MVPA. Maximum likelihood estimates were computed and unstandardized path coefficients were reported. Model fit was evaluated based on the following fit indices: 1) Goodness-of-Fit Index (GFI) ≥ .95, 2) Comparative Fit Index (CFI) ≥ .95, 3) Root Mean Square Error of Approximation (RMSEA) ≤.05; 4) standardized root mean squared residual (SRMR) ≤ .08; and 5) chi-square test $p > .05$ (Hu & Bentler, 1999).

Parameters were estimated if the model fit was acceptable. If fit was not acceptable, then model modification, guided by the Wald statistics, Lagrange multiplier (LM) test, and the study theoretical model (Figure 1), was performed to improve fit. A model generating approach was used: new parameters were added one at a time based on the LM values, and non-significant parameters were eliminated one at a time to increase the model simplicity and precision according to the Wald statistics.

Results

Demographics

Table 1 presents the baseline characteristics of the 1519 participants. Mean participants' age was 12.05 years ($SD = 1.01$). No significant difference in age, ethnicity, SES, and pubertal stage occurred between girls in the intervention and control groups. Compared to the intervention group, the control group had a higher percentage of Black girls (64.23% vs. 56.18, $p = .001$). Regarding weight status, the intervention group had a higher proportion of healthy weight girls, and lower proportion of obese girls than the control group (48.61% vs. 45.23%; 28.55% vs. 34.33%, $p = .046$).

Intervention Effect on HPM and SDT Constructs

As shown in Table 2, the intervention girls had higher perceived barriers ($B = .06$, 95% CI [0.00, 0.13]) and social support ($B = .23$, 95% CI [0.11, 0.35]) than control girls at post-intervention. Specifically, intervention girls' perceived barrier score increased by 0.03 while control girls' score decreased by 0.05 from baseline to post-intervention. However, intervention girls' social support score increased by 0.07 while control girls' score decreased by 0.15 from baseline to post-intervention. No between-group differences occurred for perceived benefits, enjoyment, self-efficacy, or motivation at post-intervention.

Path Model

Table 3 shows the inter-correlations among the HPM and SDT constructs (change from baseline to post-intervention) within the path model. MVPA change from baseline to post-intervention was positively and significantly correlated with the changes in social support ($r = .28$, $p < .001$), enjoyment ($r = .24$, $p < .001$), and motivation ($r = .14$, $p = .013$), whereas MVPA change from post-intervention to follow-up was negatively and significantly correlated with social support ($r = -.17$, $p < .001$) and enjoyment ($r = -.13$, $p = .004$).

Figure 1 displays the original theoretical model with poor model fit: $\chi^2_{(21)} = 1712.44$, $p < .001$; GFI = 0.75; CFI = 0.32; RMSEA = 0.23; SRMR = 0.19. Using model modification

indices, several revised models were examined. A parsimonious model, excluding the mediators of barriers and self-efficacy but adding covariance among remaining theoretical variables, provided the best model fit: $\chi^2_{(4)} = 2.48$, $p > .648$; GFI = 1; CFI = 1; RMSEA = 0; SRMR = 0.01. As shown in Figure 2, the intervention significantly increased girls' perceived benefits ($B = 0.07$, $p = .002$), enjoyment ($B = 0.07$, $p = .047$), social support ($B = 0.23$, $p < .001$), and motivation ($B = 0.09$, $p = .021$). The changes in enjoyment ($B = 24.48$, $p < .001$) and social support ($B = 30.48$, $p < .001$) had a significant and positive effect on MVPA change from baseline to post-intervention. The intervention had a negative direct effect on MVPA ($B = -13.80$, $p = .015$), but a positive indirect effect on MVPA through enjoyment and social support ($B = 9.13$, $p < .001$). Overall, the total effect of the intervention on MVPA at post-intervention was negative, though not statistically significant ($B = -4.59$, $p = .435$). Enjoyment ($B = -13.83$, $p < .001$) and social support ($B = -17.22$, $p < .001$) negatively and indirectly influenced the MVPA change from post-intervention to follow-up through the MVPA change from baseline to post-intervention. Neither the direct positive effect nor the indirect positive effect of the intervention on MVPA change from post-intervention to follow-up was significant ($B = 5.61$, $p = .263$; $B = 2.59$, $p = .436$, respectively). Thus, the total positive effect of the intervention on girls' MVPA change from post-intervention to follow-up was not significant ($B = 8.20$, $p = .172$).

Discussion

Findings from the path analysis indicated that the GOTM intervention significantly changed benefits and enjoyment of PA as well as social support and motivation for PA in the expected direction. However, the anticipated outcomes did not occur for barriers to PA, which significantly increased, or for PA self-efficacy, which decreased, but not significantly. In contrast to findings of Dishman, Dunn, et al. (2010) regarding adolescent girls, our results indicated that perceived barriers were not inversely related to MVPA and self-efficacy was not significantly associated with MVPA, respectively. In another study involving girls, Lytle et al (2009) found that the intervention group reported greater perceived barriers to PA as compared to those in the control condition. Similar findings were noted by researchers in a PA intervention study that incorporated strategies to assist girls in overcoming barriers to PA but inadvertently resulted in increasing girls' perceived barriers (Dunton, Schneider, & Cooper, 2007). This recurring pattern suggests that intervention girls may be more cognizant about issues interfering with their ability to attain adequate PA as a result of their exposure, whereas girls in the control group may not experience the same level of awareness. Lack of a significant intervention effect on self-efficacy may have contributed to the increase in perceived barriers as girls had lower confidence for overcoming barriers post-intervention than at baseline, consistent with previous research (Lytle et al., 2009). Regardless, continued research is needed to design intervention components that result in the expected effects on all proposed mediating variables. This endeavor, which is essential for advancing the science in this area, may require testing unique models of behavior developed by integrating theories and models and combining constructs that have shown promise for explaining adolescent girls' PA (Dewar et al., 2013).

Although the path analysis showed that the GOTM intervention resulted in a significant increase in girls' perceived benefits of PA, the increase in perceived benefits did not

significantly result in MVPA change, consistent with the findings of other studies indicating that increasing perceptions of the benefits may not translate to improvements in MVPA (Dewar et al., 2013). Perhaps, other constructs, such as self-regulatory behaviors (Anderson-Bill, Winett, & Wojcik, 2011) mediate the relationship between perceived benefits and MVPA and warrant examination. Another possibility is that the personal value placed on the benefits of engaging in the behavior was not assessed. Although many adolescents probably recognize the numerous benefits of PA participation, this awareness may not directly translate to positive behavior change if personal value is not placed on these benefits (Dewar et al., 2013).

The GOTM intervention was designed to increase girls' enjoyment of PA, and this objective was achieved. Further, similar to another school-based intervention, the Lifestyle Education for Activity Program (Dishman, Dunn, et al., 2005), enjoyment mediated the effect of the GOTM intervention on adolescent girls' PA. Given that enjoyment may play a critical role in adolescent girls' PA (Michael, Coffield, Lee, & Fulton, 2016), research that identifies personal, behavioral, and environmental factors that can be manipulated to enhance adolescent girls' enjoyment of PA may be warranted. Some strategies that can be used in interventions to increase enjoyment include increasing the variety of PAs (e.g., team sports and individual activities) offered to help adolescent girls develop the skills and confidence needed to participate in several types of PA and identify the ones they really enjoy (Michael et al., 2016).

The significant effect of the intervention on social support may have resulted from the opportunity during the intervention to connect with PA club instructors and peers for assistance in attaining PA. Greater social support was also significantly associated with increased MVPA. Similarly, a recent systematic review focusing on the role of social support on PA among adolescent girls noted small, but significant, relationships between PA and total social support received from all available providers with the exception of teachers, as well as between the behavior and emotional, instrumental, and modeling support from some providers (Laird, Fawkner, Kelly, McNamee, & Niven, 2016). In the current study, the instrument measured total social support and did not differentiate the source of social support, as items and response choices referred to any significant other, as opposed to specific individuals, such as parents or peers only. This occurrence may have contributed to the current study's positive findings. Collectively, the findings from these studies suggest that interventions that assist various individuals to support adolescent girls in varied ways may be important for increasing girls' MVPA.

Although the GOTM intervention resulted in a significant and positive effect on girls' motivation for PA, increased motivation did not significantly improve MVPA in the final model. The former finding supports results of other studies showing that a PA intervention has the potential to increase motivation for PA among adolescents (Palmer, Bycura, & Warren, 2018). Although reasons underlying the latter finding are unclear, the possibility exists that modifications (e.g., deleting items measuring intrinsic motivation) made to the scale to increase its brevity may have contributed to the unexpected result in the final model, further indicating the importance of intrinsic motivation compared to external regulation in improving girls' PA behavior (Owen, Smith, Lubans, Ng, & Lonsdale, 2014).

The significant and negative effect of the intervention on post-intervention MVPA that continued to the 9-month follow-up period was discouraging. However, it demonstrated the difficulty with increasing girls' MVPA over time and overcoming the sharp decline in PA reported for girls as they advance in age across adolescence (Dumith, Gigante, Domingues, & Kohl, 2011). Details regarding the effect of the intervention on post-intervention and 9-month follow-up MVPA have been reported elsewhere (Robbins et al., 2018).

Strengths and Limitations

Study strengths included a large sample of girls of low SES, many of whom were Black; data obtained from a rigorously conducted group randomized controlled trial; theoretical grounding of the intervention; data collector blinding; objective measure of MVPA; and multiple imputation to address missing data from accelerometers. One study limitation is that generalizability of the findings may be reduced because the sample was obtained from a limited geographical region. Also, when surveys are used, social desirability bias may occur with resultant decreased accuracy of the responses.

Conclusion

Enjoyment of PA and social support for PA may be important mediators of MVPA in underserved young adolescent girls. Future interventions aimed at increasing MVPA may need to include approaches to help girls enjoy engaging in the behavior. Innovative strategies to involve peers, parents, and others as ongoing sources of assistance and encouragement for adolescent girls, especially for those who are underserved, may be important for increasing their MVPA and worthy of investigation. Effort may also need to be directed toward identifying effective approaches to decrease girls' perceived barriers to PA. Nurse researchers may need to consider integrating theories or augmenting existing theoretical models in future studies to advance the field and gain a more comprehensive understanding of the mechanisms underlying PA behavior in this population.

Acknowledgement:

Research reported in this publication was supported by a 5-year grant, Award Number R01HL109101, $3,657,706, from the National Heart, Lung, and Blood Institute (NHLBI) at the National Institutes of Health (NIH); PI: L. B. Robbins, Michigan State University College of Nursing. The funding agency was not involved in the study design; data collection, analysis, or interpretation; writing of the manuscript or the decision to submit it for publication. The content presented in this paper is solely the responsibility of the authors and does not necessarily represent the official policy or views of the NIH.

The authors thank the school administrators, nurses, teachers, and other staff members for their assistance during the time of the "Girls on the Move Intervention" study. Their commitment to promote the health of their students is laudable. We want to acknowledge several research team members for effectively managing their respective areas: Stacey Wesolek, who served as Project Manager throughout the intervention phase; Kelly Bourne, Project Manager after the intervention phase and Measurement Coordinator during all phases of data collection; and Patrice Patrick-Banks (intervention year 1) and Ann Kostin-McGill (intervention years 2 and 3), who served as Intervention Coordinators. We are also very grateful to the Michigan State University undergraduate and graduate nursing and kinesiology students for their assistance during the study. Lastly, we thank the young adolescent girls and their parents/guardians for allowing their daughters to participate.

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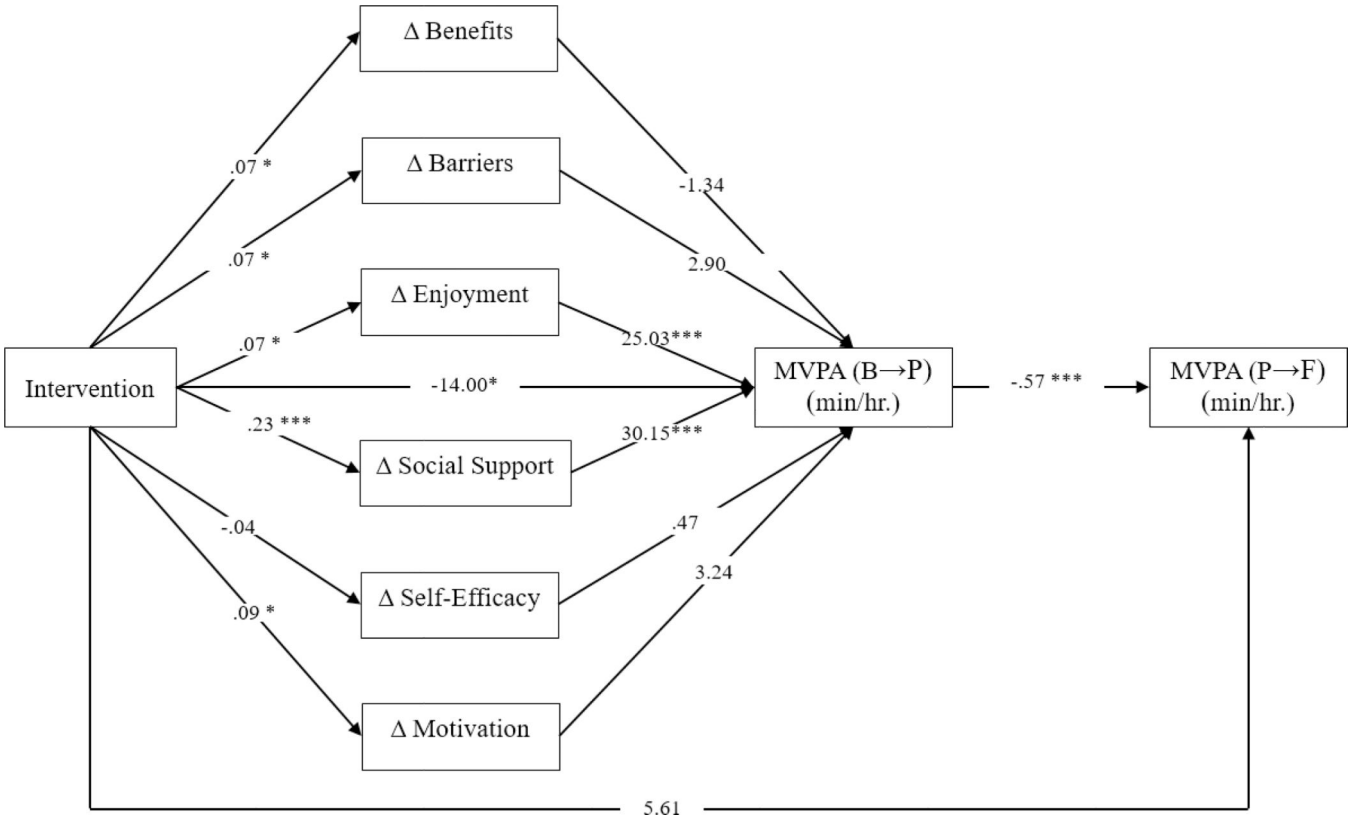

Figure 1.

Original Path Analysis Model of the Intervention Effect on Theoretical Mediators and Moderate-to-Vigorous Physical Activity (MVPA): United States, 2001–2016

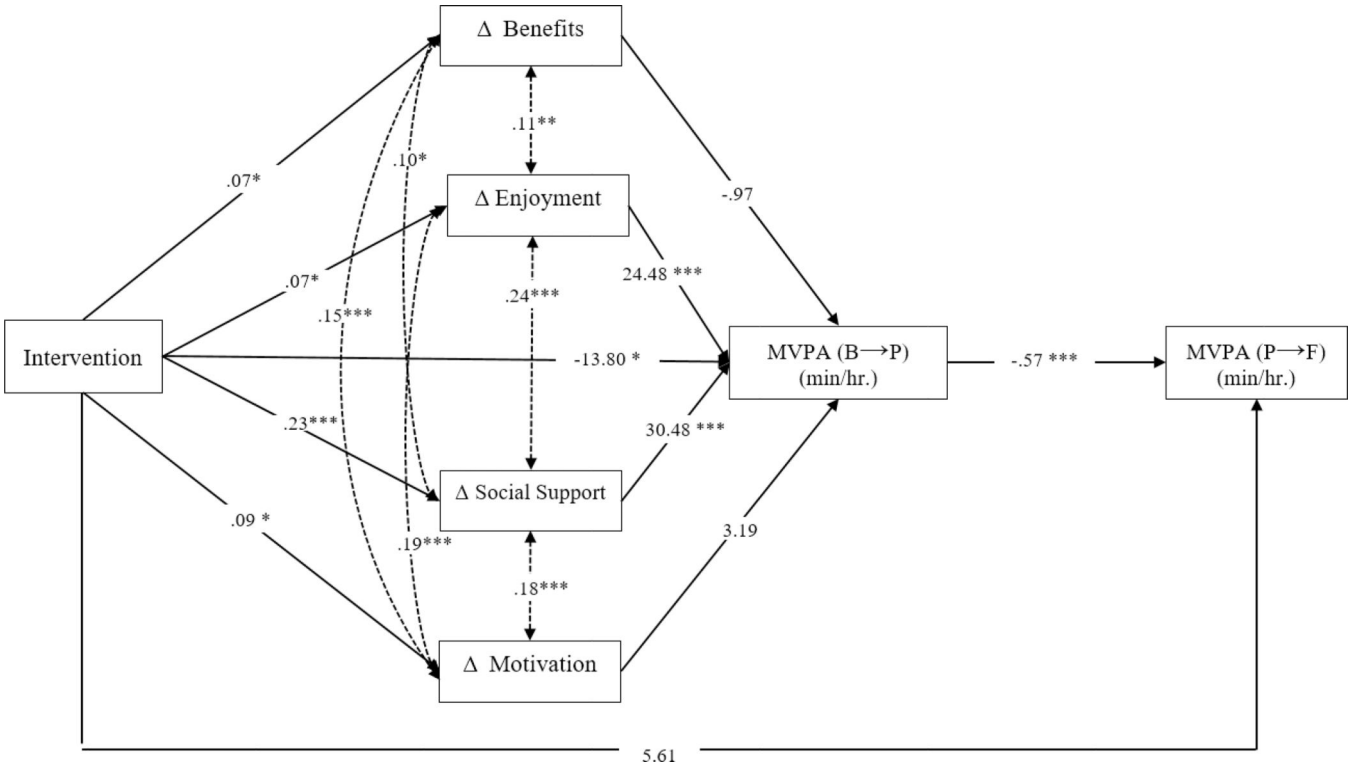

Figure 2.

Revised Path Analysis Model of the Intervention Effect on Theoretical Mediators and Moderate-to-Vigorous Physical Activity (MVPA): United States, 2001–2016

TABLE 1

Participant Characteristics at Baseline: United States, 2011–2016

Characteristics	Total (*N* = 1519) N (%)	Intervention (*n* = 753) *n* (%)	Control (*n* = 766) *n* (%)
Age in years *M* (*SD*)	12.1 (1.0)	12.1 (1.0)	12.1 (1.0)
Race *			
Black	915 (60.2)	423 (56.2)	492 (64.2)
Non-black	604 (39.8)	330 (43.8)	274 (35.8)
Ethnicity			
Hispanic	201 (13.2)	111 (14.7)	90 (11.8)
Non-Hispanic	1232 (81.1)	603 (80.1)	629 (82.1)
Missing	86 (5.7)	39 (5.2)	47 (6.1)
Free/reduced price lunch			
Yes	1182 (77.8)	577 (76.6)	605 (79.0)
No	234 (15.4)	113 (15.0)	121 (15.8)
Missing	103 (6.8)	63 (8.4)	40 (5.2)
Pubertal stage			
Pre-puberty	59 (3.9)	34 (4.5)	25 (3.3)
Early puberty	143 (9.4)	64 (8.5)	79 (10.3)
Mid-puberty	601 (39.6)	298 (39.6)	303 (39.6)
Late puberty	708 (46.6)	353 (46.9)	355 (46.4)
Post-puberty	2 (0.1)	1 (0.1)	1 (0.1)
Missing	6 (0.4)	3 (0.4)	3 (0.4)
Weight status *			
Underweight	18 (1.2)	8 (1.1)	10 (1.3)
Healthy weight	687 (45.2)	366 (48.6)	321 (41.9)
Overweight	305 (20.1)	154 (20.5)	151 (19.7)
Obese	478 (31.5)	215 (28.6)	263 (34.3)
Missing	31 (2.0)	10 (1.3)	21 (2.7)

Note. Table includes non-imputed data; *M* = Mean; *SD* = Standard deviation; *N* or *n* = Number.

* $p < .05$, calculated with chi-square test.

TABLE 2

Unadjusted Means and Linear Mixed Effects Model Results for Theoretical Variables: United States, 2011–2016

	Unadjusted Means		Adjusted Differences[a] (I − C)		
	Baseline	Post-Intervention			
Variables	***M* (*SD*)**	***M* (*SD*)**	**Difference**	**95% CI**	***p*-value**
Benefits			.07	[0, .14]	.066
Intervention	2.35 (0.45)	2.29 (0.53)			
Control	2.36 (0.44)	2.22 (0.51)			
Barriers			.06	[0, .13]	.041
Intervention	1.23 (0.60)	1.26 (0.63)			
Control	1.19 (0.60	1.14 (0.60)			
Self-Efficacy			.04	[−.04, .12]	.320
Intervention	2.17 (0.59)	2.12 (0.64)			
Control	2.23 (0.57)	2.14 (0.60)			
Social Support			.23	[.11, .35]	<.001
Intervention	1.80 (0.70)	1.87 (0.82)			
Control	1.88 (0.72)	1.73 (0.86)			
Enjoyment			.07	[−.03, .17]	.163
Intervention	2.25 (0.58)	2.11 (0.67)			
Control	2.32 (0.58)	2.11 (0.72)			
Motivation			.08	[−.01, .17]	.098
Intervention	3.60 (0.65)	3.48 (0.68)			
Control	3.67 (0.61)	3.48 (0.69)			
MVPA			−.08	[−.21, .05]	.207
Intervention	3.03 (1.32)	3.27 (1.49)			
Control	2.92 (1.29)	3.27 (1.49)			
MVPA	Post-Intervention	Follow-up	−.03	[−.14, .08]	.556
Intervention	3.27 (1.49)	2.59 (1.19)			
Control	3.27 (1.49)	2.64 (1.15)			

Note. I = Intervention group; C = Control group; MVPA = moderate to vigorous physical activity; *M* = Mean; *SD* = Standard deviation; CI = Confidence interval.

[a]Differences between intervention and control group at post-intervention or follow-up for MVPA after adjusting for demographics and random effect of school.

TABLE 3

Inter-Correlations of Theoretical Variables within the Path Model: United States, 2011–2016

Variables	1	2	3	4	5	6	7	8
1. Δ Benefits	-	.06	.33***	.24*	.30**	.43***	.09	−.05
2. Δ Barriers		-	.00	−.02	−.24**	−.03	−.03	.01
3. Δ PA Self-Efficacy			-	.32***	.35***	.42***	.12	−.06
4. Δ Social Support				-	.43***	.32***	.28***	−.17***
5. Δ Enjoyment					-	.41***	.24***	−.13**
6. Δ Motivation						-	.14*	−.07
7. MVPA (B→P)							-	−.62***
8. MVPA (P→F)								-

Note. The delta symbol (Δ) denotes change from baseline to post-intervention. B, P, and F denotes baseline, post-intervention, and follow-up, respectively.

* $p < .05$

** $p < .01$

*** $p < .001$.