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Psychometric Evaluation of Three Psychosocial Measures Associated with Physical Activity among Adolescent Girls

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Abstract

The purpose of this study was to evaluate the psychometric properties of a Perceived Benefits Scale, a Perceived Barriers Scale, and a Physical Activity Enjoyment Scale with data from a group randomized controlled trial (RCT) and a test-retest study with 1-week interval. In the group RCT at baseline and Week 17, 1,012 5th–8th grade girls completed an iPad-delivered survey and wore 7-day accelerometers measuring moderate-to-vigorous physical activity (MVPA). In the test-retest study, 91 5th—7th grade girls completed the iPad-delivered survey at Time 1 and 2. Benefits, barriers, and enjoyment scales had Cronbach's alphas of .75, .86, and .78; and test-retest reliability of .83, .88, and .79, respectively. Benefits scale had a two-factor structure (physical and psychosocial benefits), while the remaining two had a one-factor structure indicating the construct validity. Barriers ($r = -.16$) and enjoyment ($r = .17$) were correlated with MVPA indicating concurrent validity. Baseline MVPA and psychosocial benefits positively, while physical benefits negatively, predicted MVPA at Week 17 indicating predictive validity. The measures demonstrated satisfactory psychometric properties.

Keywords

benefits; barriers; enjoyment; instrument validation; physical activity; school nursing

The World Health Organization (2015) and United States (U.S.) Department of Health and Human Services (2008) recommended that adolescents participate in a minimum of 60 minutes of moderate to vigorous physical activity (MVPA) every day. Globally, 80.3% of adolescents reported not participating in 60 minutes of MVPA per day (Hallal et al., 2012). In the U.S., only 32% of adolescents reported meeting the current PA recommendation (Foltz et al., 2011). PA declined dramatically from age 9 to 12 years in girls (Dumith, Gigante, Domingues, & Kohl, 2011), differing according to sex, ethnicity, race, and socioeconomic status (SES). Specifically, adolescent girls participated in less PA than boys (Lenhart, 2012); non-Hispanic Black and Hispanic girls participated in lower levels of

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accelerometer-measured MVPA, compared to non-Hispanic White and Asian girls (Gordon-Larsen, Adair, & Popkin, 2002); and adolescents of high SES engaged in higher levels of PA than those of low SES (Stalsberg & Pedersen, 2010).

Although a variety of interventions have been implemented to promote PA in adolescents, the average effect on increasing MVPA was only about 4 minutes per day (Metcalf, Henley, & Wilkin, 2013). Understanding the correlates and determinants of PA is essential for designing effective interventions to increase PA in adolescents, especially among girls of low SES. A systematic review published in the year 2000 noted that only three of 35 psychological factors, including achievement orientation, perceived competence, and intention, were positively correlated with PA (Sallis, Prochaska, & Taylor, 2000). In a recent review, motivation, body image, and perceived barriers to PA emerged as psychological correlates of PA among adolescents (Biddle, Atkin, Cavill, & Foster, 2011). These inconsistent results may be associated with the variety of measures used to assess psychological factors (Biddle et al., 2011), potential inaccuracy of self-reported PA (Adamo, Prince, Tricco, Connor-Gorber, & Tremblay, 2009), and inadequately validated instruments to assess the correlates of PA (Dishman, Hales, et al., 2010). Until these issues are addressed, evaluating PA interventions will be hampered.

Considering the lower levels of PA among girls, measures developed specifically for girls may be more effective in identifying unique determinants of PA. Evidence has supported that perceived benefits, barriers, and enjoyment of PA differed according to sex (Tergerson & King, 2002; Wenthe, Janz, & Levy, 2009). One study of 535 adolescents indicated that “to stay in shape” was the most often reported benefit of PA for girls, while “to become strong” was the most commonly perceived benefit for boys (Tergerson & King, 2002). This study also found that “lack of time” was the top barrier for girls, while “wanting to do other things” was the top barrier for boys (Tergerson & King, 2002). Another study with 205 adolescents reported that PA enjoyment was a significant determinant of PA in boys, but not in girls (Wenthe et al., 2009). Moore and colleagues (2009) suggested that factor structure of PA enjoyment varied by sex. Moreover, a systematic review concluded that interventions were more effective if they addressed the special needs of girls (Camacho-Minano, LaVoi, & Barr-Anderson, 2011). Therefore, the unique needs of each sex group should be considered in scale development.

Theoretical Framework and Purpose

The Health Promotion Model indicates that an individual’s past health-related behavior influences perceived benefits, barriers, and enjoyment of the behavior and all three variables, in turn, directly impact behavioral enactment (Pender, Murdaugh, & Parsons, 2014). Based on this premise and the need to address the previously discussed issues and inadequate PA among adolescent girls, this study aimed to evaluate the psychometric properties of a Perceived Benefits Scale, Perceived Barriers Scale, and PA Enjoyment Scale among adolescent girls. Details concerning the development of the Perceived Benefits Scale and Perceived Barriers Scale are reported in other studies (Robbins, Pfeiffer, Maier, Lo, & Wesolek, 2012; Robbins et al., 2013; Robbins, Wu, Sikorski, & Morley, 2008), and a previous enjoyment scale (Motl et al., 2001) was modified to develop a PA Enjoyment Scale

for adolescent girls (Robbins et al., 2013). The scales have been used in a previously conducted 6-month pilot study (Robbins et al., 2012) and an ongoing multi-site group randomized controlled trial (RCT) involving adolescent girls (Robbins et al., 2013) who wore accelerometers that measured their PA. In the pilot study, all three scales demonstrated good acceptability and internal consistency reliability at both baseline and post-intervention (Robbins et al., 2012); but their test-retest reliability and validity, especially construct and criterion-related validity, were not examined. This study will contribute toward filling this gap.

Methods

Study Design

Group RCT—The group RCT aimed to examine the effects of a 17-week theory-based, multi-component PA intervention on increasing MVPA among 5th–8th grade urban girls in the Midwestern U.S. All girls completed an iPad-delivered survey measuring their perceived benefits, barriers, and enjoyment regarding PA. MVPA was assessed by accelerometers, and height and weight were measured. For this study, two-year baseline data collected during September-December 2012 and 2013 from girls in 16 urban middle schools were used to examine the construct validity of the three scales. Longitudinal data, including information from surveys on perceived benefits, barriers, and enjoyment, and accelerometer-measured MVPA at baseline and Week 17, from girls in the control group were used to evaluate the scales' criterion-related validity.

Test-retest Study—An independent test-retest study was conducted during July-October 2013 to evaluate the scales' test-retest reliability. Ninety-one girls from one urban middle school (not involved in the group RCT) in the Midwestern U.S. participated. Girls in the test-retest study completed the same iPad-delivered survey at baseline (Time 1) and one week later (Time 2). Height, weight, and PA were not assessed in this group of girls.

Settings and Population

The inclusion criteria for the schools and girls participating in the two studies have been reported elsewhere (Ling, Robbins, Resnicow, & Bakhoya, 2014). For the 16 urban schools enrolled in the group RCT, 72.4% of the girls were enrolled in free or reduced-price lunch programs (min–max: 59.7–95.0%). On average, 52.2% (min–max: 9.8–100%) were Black, and 8.6% (min–max: 1.6–20.6%) were Hispanic (State of Michigan, 2014). For the middle school enrolled in the test-retest study, 55.7% were enrolled in the free or reduced-price lunch program. The school population included 27.5% Black, 18.9% Hispanic, and 37.0% White (State of Michigan, 2014).

Measures

Demographics—Five items, including age, grade, ethnicity, race, and enrollment status in the free or reduced-price lunch program, were used to assess girls' demographic characteristics. Enrollment in the free or reduced-price lunch program at school was indicative of low SES. Items were listed in the consent form and were completed by girls' parents or guardians in collaboration with their daughters as needed.

Height and weight—Girls' height (c*m*) and weight (*kg*) were measured to the nearest .10 by a Shorr Board (Weigh and Measure, LLC, Olney, MD) and foot-to-foot bioelectric impedance scale (Tanita Corporation, Tokyo, Japan), respectively. Each girl's height and weight were measured three times, and the average values were used to calculate body mass index (BMI; weight in *kg*/height in m^2). BMI-z score was estimated using Centers for Disease Control and Prevention (2014) growth charts.

Benefits—Adapted from a previous 10-item Perceived Benefits Scale (Robbins et al., 2008), an 11-item Perceived Benefits Scale was developed for the pilot study (Robbins et al., 2012) to assess 11–14-year-old girls' ($N = 77$) cognitive perceptions of the positive consequences of PA participation (Pender et al., 2014). Table 1 includes the 11 scale items. A higher mean score indicated a higher level of perceived benefits of PA. The response choices included: not at all true (0), not very true (1), somewhat true (2), and very true (3). In the pilot study, the scale had Cronbach's alphas of .85 at baseline and .84 at post-intervention (Robbins et al., 2012).

Barriers—Adapted from a previous 9-item Perceived Barriers Scale (Robbins et al., 2008), a 16-item Perceived Barriers Scale was developed for the pilot study to assess girls' cognitive perceptions of the unavailability, inconvenience, expense, difficulty, and time-consuming nature of PA participation (Pender et al., 2014). Table 2 depicts the 16 items. A higher mean score indicated a higher level of perceived barriers to PA. The response choices ranged from not at all true (0) to very true (3). In the pilot study, the Cronbach's alphas were .88 at baseline and .86 at post-intervention (Robbins et al., 2012).

Enjoyment—To reduce the response burden associated with completing the cognitive surveys, a 6-item PA Enjoyment Scale was developed (Robbins et al., 2012). The abbreviated scale was based on an original 16-item scale developed by other researchers (Motl et al., 2001) to assess girls' positive feelings or affect associated with PA participation. As noted in Table 3, the newly created 6-item PA Enjoyment Scale included three positively worded (items 1, 2, and 4) and three negatively worded (items 3, 5, and 6) items. The scale's four response choices ranged from not at all true (0) to very true (3). In the pilot study, the Cronbach's alphas were .78 at baseline and .81 at post-intervention (Robbins et al., 2012).

MVPA—Minutes of MVPA per hour were measured by the ActiGraph GT3X-plus accelerometer (www.theActiGraph.com), which is reported to have good reliability and validity when assessing MVPA among adolescents (Romanzini, Petroski, Ohara, Dourado, & Reichert, 2014). Counts thresholds used in this study were: sedentary activity ≤ 100 counts/minute; 101 ≤ light PA ≤ 2,295 counts/minute; 2,296 ≤ moderate PA ≤ 4,011 counts/minute; and vigorous PA ≥ 4,012 counts/minute (Evenson, Herring, & Huston, 2005). For this study, data were considered valid if girls wore it for a minimum eight hours per day on at least three week days and one weekend day.

Data Collection Procedures

Approval from the university Institutional Review Board and permission from the school administrators were obtained before any data collection. The data collection team visited

each school to share study information with girls, answer their questions, and distribute recruitment packets including a consent form, an assent form, and a screening tool to all interested girls. Girls were asked to share the information with their parents or legal guardians and return the signed packets in the next day or two.

Eligible girls having signed parental consent and child assent forms completed the iPad-delivered survey at their school. In addition to the iPad-delivered survey, girls in the group RCT had their height and weight measured in a private room, and they wore an accelerometer for seven days. Prior to receiving the accelerometer, girls watched a 2-minute video instructing them how to wear it. Two instruction forms (one for girls and one for parents) on wearing an accelerometer were provided to each girl. An automatic reminder phone call was delivered each morning to the girls to remind them to wear their accelerometers. Girls were asked to return their accelerometers after wearing them for seven days to the data collection team at each school so that the data could be downloaded to computers. The data collection procedure was similar at Week 17.

For the group RCT, of the 3,012 girls invited to participate, 2,021 (67.1%) returned the recruitment packets, and 1,234 (41.0%) met the inclusion criteria. Of the 1,234 eligible girls, 1,022 (82.8%) girls began participating in the group RCT based on first come, and first served basis, but 10 girls withdrew due to family relocation, pregnancy, or a personal decision to opt out of the study. For the test-retest study, 101 (67.8%) of 149 girls returned the packets, and 96 (64.4%) were eligible to participate. Ninety-one (94.8%) of the 96 eligible girls completed the iPad-delivered surveys at Time 1 and 2 due to five girls not being present during the Time 1 data collection. Girls completed all three scales in an average time of approximately 15 minutes.

Data Analysis

The SPSS 21.0 for Windows was used for all data analyses. Study variables were described using descriptive statistics [means (*M*), standard deviations (*SD*), frequencies, and percentages]. Cronbach's alpha was calculated to evaluate each scale's internal consistency reliability: the degree to which different items measure the same underlying concept (Polit & Beck, 2017). Item-total correlation coefficients, with cutoff value of .30, were employed to assess the homogeneity of each scale (Nunnally & Bernstein, 1994). Intraclass correlation coefficient (ICC), calculated by a 2-way mixed model with type consistency, was used to assess test-retest reliability (stability over time; Polit & Beck, 2017). A scale with a Cronbach's alpha greater than .70 and an ICC greater than .75 has good reliability (Nunnally & Bernstein, 1994).

Due to the lack of assumptions and examinations of the underlining factorial structures of the three scales in previous studies, principal axis factoring with correlation matrix was applied first to examine the factorial structures of the three scales (construct validity: the ability of measuring the underlying concept; Polit & Beck, 2017) using RCT baseline data. Bartlett's test of sphericity and Kaiser-Meyer-Olkin (KMO) measure of sampling adequacy (> .50) were employed to assess if a factor analysis can yield distinct and reliable factors. The two criteria used in the factor analysis to determine the number of factors retained were: (1) eigenvalue > 1; and (2) scree plot. Bivariate correlation analysis was performed to

examine interrelationships among age, BMI-z score, benefits, barriers, enjoyment, and MVPA in order to examine the scales' concurrent validity: correlation with a theoretical criterion at the same time (Polit & Beck, 2017). Hierarchical multiple regression was used to examine the predictors of MVPA at Week 17 by first entering demographics (age, ethnicity, race, enrollment status in school lunch program, and BMI-z score), and then entering baseline MVPA, benefits, barriers, and enjoyment. Results from the hierarchical multiple regression were used to examine the scales' predictive validity: longitudinal relationship with a theoretical criterion (Polit & Beck, 2017).

Results

Participants

Group RCT—A total of 1,012 girls, including 69 in 5th grade (6.8%), 414 in 6th grade (40.9%), 412 in 7th grade (40.7%), and 117 in 8th grade (11.6%), participated in the study. The mean age was 12.2 (SD = .96, min-max: 10–15) years. Only 113 girls (11.2%, 50 missing) were Hispanic. The sample included 529 (52.3%) Black and 255 (25.2%) White girls, with the remainder being mixed-race or "other race" (n = 228, 22.5%). The vast majority of girls (n = 804, 85.5%, 72 missing) participated in the free or reduced-price lunch program at their schools. More than half of the girls (n = 564, 55.7%) were overweight or obese, with 22.3% (n = 226) being overweight and 33.4% (n = 338) being obese.

At baseline, compared to the control group (χ^2_2 = 6.72, p = .035), the intervention group included more White (n = 139, 27.3% vs. n = 116, 23.1%) and mixed/other-racial (n = 125, 24.5% vs. n = 103, 20.5%) girls. No significant grade, age, ethnic, SES (enrollment status in free or reduced-price lunch program), and BMI differences occurred between groups. At baseline, girls in the intervention group had a greater average number of minutes of MVPA per hour than those in control group (M = 2.92 vs M = 2.74, t_{932} = −2.14, p = .033).

Test-retest study—Ninety-one 5th–7thgrade girls, with an average age of 10.78 (SD = .65, min–max: 9.13–12.26) years, participated in the test-retest study. Twenty (22.2%, 1 missing) girls were Hispanic. The sample included 45 (49.5%) White, 19 (20.9%) Black, and 27 (29.7%) mixed-racial or "other race" girls. More than half of the girls (n = 45, 56.3%, 11 missing) were involved in the free or reduced-price lunch program.

Psychometric Properties

Perceived Benefits Scale

Reliability: The Cronbach's alpha for the 11-item scale was .74, with item-total correlation coefficients ranging from .23 to .54. Due to the small item-total correlation coefficient of .23 and small item-item correlation coefficients ranging from .03 to .25, item 1 "to spend time with friends or others my age" was deleted to increase the Cronbach's alpha to .75 and improve parsimony. Because the new 10-item scale had a high correlation with the original 11-item scale (r = .98, p < .001), deleting the item did not result in a great loss of variance. Assessed by the ICC, the test-retest reliability for the 10-item scale completed by the 91 girls was .83 with 95% confidence interval (CI) of [.73, .89].

Construct validity: The KMO measure of sampling adequacy was .82, and the Bartlett's test of sphericity was significant ($\chi^2_{45} = 1943.25$, $p < .001$), indicating that the factor analysis can yield distinct and reliable factors. The principal axis factoring with Varimax rotation suggested a two-factor structure: psychosocial and physical benefits (See Table 1). The first factor of psychosocial benefits, describing the psychosocial outcomes (e.g., fun, energy, and self-competence) related to PA participation, had an eigenvalue of 3.19 and accounted for 17.55% of the variance. The second factor of physical benefits, reflecting the physical outcomes (e.g., health, body shape) associated with PA participation, had an eigenvalue of 1.56 and accounted for 17.39% of the variance. The total scale explained about 34.94% of the variance in perceived PA benefits. The two factors were significantly related to each other ($r = .37$, $p < .001$).

Perceived Barriers Scale

Reliability: The 16-item scale had a Cronbach's alpha of .86 with item-total correlation coefficients of .36 to .57. As shown in Table 2, because deleting any item did not improve the internal consistency reliability, all 16 items were retained. The test-retest reliability, assessed by ICC, was .88 with 95% CI of [.82, .92] for the test-retest data.

Construct validity: The KMO measure of sampling adequacy was .92, and the Bartlett's test of sphericity was significant ($\chi^2_{120} = 3805.48$, $p < .001$), supporting the use of factor analysis. The results of factor analysis suggested a one-factor structure with eigenvalue of 5.15 and accounted for 27.75% of the variance.

Physical Activity Enjoyment Scale

Reliability: Items 3, 5, and 6 were reversely coded to: not at all true (3) to very true (0). The 6-item PA Enjoyment Scale had a Cronbach's alpha of .78, with item-total correlation coefficients ranging from .45 to .61. Table 3 demonstrates that deleting any item did not yield any improvement of the internal consistency reliability. The test-retest reliability was . 79 with 95% CI of [.68, 86] for the test-retest data.

Construct validity: The KMO measure of sampling adequacy was .80, and the Bartlett's test of sphericity was significant ($\chi^2_{15} = 1988.61$, $p < .001$), supporting that factor analysis can yield distinct and reliable factors. The results of the factor analysis suggested a one-factor structure with eigenvalue of 2.99 and explained 40.66% of the variance.

Criterion-Related Validity of the Three Scales

Concurrent validity: Both subscales measuring perceived benefits, but not the whole scale ($r = .03$, $p = .342$), were significantly correlated with MVPA at baseline with psychosocial benefits being positively ($r = .10$, $p = .002$) and physical benefits being negatively ($r = -.07$, $p = .038$) related to the behavior. The mean score of the 16-item Perceived Barriers Scale was significantly correlated with MVPA ($r = -.16$, $p < .001$) at baseline. The mean score of the PA Enjoyment Scale was significantly correlated with MVPA ($r = .17$, $p < .001$) at baseline.

Table 4 shows the pairwise correlations between the study variables among control group girls. At baseline, girls' MVPA was positively correlated with their perceived enjoyment (r = .19, p < .001); but negatively correlated with their age (r = −.22, p < .001), BMI-z score (r = −.10, p = .036), and perceived barriers (r = −.16, p = .001). Girls' MVPA at Week 17 was positively related to their baseline MVPA (r = .56, p < .001), perceived psychosocial benefits (r = .12, p = .024), and perceived enjoyment of PA (r = .12, p = .018). Girls' age was negatively correlated with both perceived enjoyment (r = −.21, p < .001) and perceived psychosocial benefits (r = −.13, p = .004). BMI z-score was positively associated with girls' perceived physical benefits (r = .19, p < .001) and barriers (r = .09, p = .045), but negatively related to their perceived PA enjoyment (r = −.14, p = .002).

Predictive validity: Table 5 presents results from the hierarchical regression analysis modeling the predictors of MVPA at Week 17. Among the demographic variables, only baseline age negatively predicted MVPA at Week 17 (β = −.26, p = .001), indicating that as girls' age increased by one year at baseline, their MVPA decreased by .26 minutes per hour at Week 17. After controlling for baseline demographics and other cognitive variables, baseline physical benefits negatively predicted MVPA at Week 17 (β = −.30, p = .014), while psychosocial benefits positively affected MVPA at Week 17 (β = .31, p = .032). Moreover, girls' MVPA at Week 17 was highly affected by their baseline MVPA level (β = .60, p < .001). The whole model explained about 36% of variance in MVPA at Week 17.

Discussion

This study aimed to evaluate the psychometric properties of a Perceived Benefits Scale, a Perceived Barriers Scale, and a PA Enjoyment Scale among urban 5th–8th grade girls. The results indicate that these three scales have acceptable internal consistency and test-retest reliability and construct and concurrent validity. Thus, the three scales may be applied in future studies to examine adolescent girls' perceived benefits, barriers, and enjoyment of PA and further explore the effects of these three factors on PA among racially diverse samples.

Perceived Benefits Scale

Compared to the previously developed 10-item Perceived Benefits Scale (Robbins et al., 2008), the new 10-item scale had better test-retest reliability. To improve the internal consistency reliability, the item describing the benefit of spending time with friends was deleted due to its weak correlation with the total scale. Although evidence supports that friends or peers play an important role in influencing adolescents' PA through support, presence, peer norms, and acceptance (Fitzgerald, Fitzgerald, & Aherne, 2012), spending time with friends may not be perceived as a primary benefit of PA or reason to participate among adolescent girls, especially Black girls. As an example, in focus groups (unpublished data) with 25 Black 6th–8th grade girls, the girls stated that they preferred to do things other than PA with their friends and did not need to engage in PA to be with their friends. A semi-structured interview study with 80 adolescent girls indicated that socializing and being part of team were more frequently reported as benefits of PA participation by White (63%) and Hispanic girls (43%) than Black girls (15%; Grieser et al., 2006). Together, these findings

indicate that racial characteristics and preferences warrant consideration in any future work focusing on scale development and evaluation.

In contrast to the previously developed 10-item Perceived Benefits Scale having outcome-orientation and personal satisfaction subscales (Robbins et al., 2008), this study's findings clearly suggested a two-factor structure, including physical and psychosocial benefits, for the Perceived Benefits Scale. Due to the heterogeneity of the two scales and study designs, comparison between the two scales was not reasonable. One possible explanation for the different factorial structures is that the previously conducted study included both girls and boys. Empirical evidence supports sex differences in perceptions, indicating that staying in shape and being healthier are greater perceived benefits for girls than boys (Robbins et al., 2008), and becoming strong is a top benefit perceived by boys only (Tergerson & King, 2002). In addition, evidence has suggested that the benefits of PA can be categorized into two groups: physical and psychosocial (Janssen & LeBlanc, 2010; Staiano & Calvert, 2011), consistent with the two-factor structure in this study.

Interestingly, in this study, even though girls perceived staying in shape as a top benefit of PA preceded only by having fun, hierarchical regression showed that greater perceived physical benefits of PA predicted lower future MVPA, whereas greater perceived psychosocial benefits predicted higher future MVPA, after controlling for BMI z-score and other factors. Though odd, these findings lend support to those of another study that showed psychological factors indicating minimal perceived psychosocial benefits of PA, such as loss of interest and perceptions of a lack of competence, are the primary reasons for adolescent girls to cease playing sports or participating in PA (Slater & Tiggemann, 2010). Because psychosocial benefits are easier to acquire and provide more immediate gratification than physical benefits, targeting psychosocial benefits in interventions (e.g., fun PAs, strategies to enhance competence) may be a fruitful approach to increase girls' PA.

Also of interest in this study was that higher BMI z-score was associated with not only greater perceived physical benefits of PA, but also higher perceived barriers to PA and lower PA enjoyment, among the girls. Because the majority of the sample was overweight or obese, these results may help to explain why perceived physical benefits negatively predicted future MVPA. The finding indicating that girls having a higher BMI z-score perceive more physical reasons (i.e., to be healthier, to be the weight I want to be, to look better, and to keep me in shape) to participate in PA than those having a lower BMI z-score makes intuitive sense. Girls in the latter group may not perceive a need to improve physically as a reason for their PA participation. Although girls' current weight status may be an important factor influencing their perspective, future studies examining the influence of BMI on the relationship between PA and perceptions, such as perceived benefits of PA, are needed to support these findings and tailor interventions to address the needs of various groups.

Perceived Barriers Scale

The 16-item Perceived Barriers Scale has better internal consistency reliability and test-retest reliability than the previously developed 9-item Perceived Barriers Scale (Robbins et al., 2008). In contrast to the prior study that suggested a two-factor structure among 206

boys and girls, including negative personal emotions and personal sense of immobilization (Robbins et al., 2008), the 16-item scale in this study has a one-factor structure. Dishman and colleagues (2010) reported three first-order correlated factors for their 9-item scale measuring perceived barriers to PA among 1,893 adolescent girls, while another 16-item scale had two factors among 350 boys and girls: internal and external barriers (Hsu et al., 2011). The inconsistent evidence may suggest different factorial structures of perceived barriers of PA between girls and boys. Thus, continued research with rigorous study designs is essential to further explore sex differences in the factorial structure of perceived barriers to PA.

Consistent with this study's finding, perceived barriers have been reported to be negatively associated with concurrent self-reported PA among 6^{th}–8^{th} grade boys and girls (Robbins et al., 2008), and also with concurrent accelerometer-measured MVPA among 8^{th} grade girls, even after adjusting for their initial status on PA and perceived barriers (Dishman, Dunn, Sallis, Vandenberg, & Pratt, 2010). But, in contrast, in a study with 350 7^{th}–8^{th} grade adolescents, no relationship between barriers and concurrent self-reported MVPA emerged (Hsu et al., 2011). The heterogeneity of the measures of both perceived barriers and PA may explain the inconsistent relationships between the former and latter variable. In this study, although perceived barriers were significantly correlated with MVPA at baseline, baseline perceived barriers did not predict future MVPA (Week 17) after controlling for demographics and other cognitive factors. These findings suggest that perceived barriers may be a correlate of current PA participation, but not a predictor of future PA. Conversely, one study, including 291 adolescent girls, did note that only baseline MVPA and barriers significantly predicted MVPA at follow up after adjusting for demographics, self-efficacy, enjoyment, social support, and environment (Hearst, Patnode, Sirard, Farbakhsh, & Lytle, 2012). Therefore, the longitudinal influence of perceived barriers on PA in adolescent girls warrants further investigation.

Physical Activity Enjoyment Scale

Despite having only six items, the PA Enjoyment Scale had good internal consistency reliability and test-retest reliability (Nunnally & Bernstein, 1994). Similar to Motl and colleagues' (2001) 16-item enjoyment scale, the PA Enjoyment Scale in this study has a single factor structure. But Motl and colleagues' (2001) scale was found to have a methodological effect (correlated uniqueness) of the positively worded items, that is, a model with only positively worded items fit the data better than a model with both positively and negatively worded items (Lawman, Wilson, Van Horn, Resnicow, & Kitzman-Ulrich, 2011). Therefore, the parsimonious scale reported in this study may have broader application in large-scale studies with adolescent girls to decrease their response burden, while demonstrating good reliability and validity. Response burden is likely to be high when content overlaps between instruments (a situation we tried to avoid in this study) or repeated sessions are conducted in a single study (Rolstad, Adler, & Rydén, 2011). Although concerns are noted that response burden is greater in children and certain demographic groups, which may include those of low SES (Stone, Shiffman, Atienza, & Nebeling, 2007), verification regarding this issue is lacking because no consistent relationship has been shown between compliance with completing a survey and population characteristics (Rolstad et al.,

2011). This information clearly indicates that future studies are needed to clarify response burden and ways to reduce it in diverse populations.

In contrast to the literature reporting no concurrent relationship between PA enjoyment and accelerometer-measured PA in adolescent girls (Lawman et al., 2011), this study found a positive relationship between PA enjoyment and MVPA. The inability of baseline enjoyment to significantly predict future MVPA at Week 17 in this study may be due to the adjustment of other cognitive factors, especially benefits and barriers, both of which were moderately correlated with enjoyment at baseline. This explanation is also supported by research demonstrating that enjoyment is positively correlated with PA after controlling for demographics (Bengoechea, Sabiston, Ahmed, & Farnoush, 2010), but not correlated with PA after adjusting for self-efficacy and motivation (Lawman et al., 2011), or barriers, social support, and environment (Hearst et al., 2012). Although enjoyment may not significantly predict MVPA after adjusting for demographics and other cognitive variables, evidence does show that girls with lower PA enjoyment at baseline benefit more from a PA intervention (Schneider & Cooper, 2011). Therefore, targeting PA enjoyment still remains a promising strategy to increase PA.

Implications for School Nursing

Since adolescents spend most of their daily waking time at schools, school nurses play a vital role in promoting regular PA at schools (Mehrley & Leibold, 2013). Moreover, promoting PA at schools is really an important school nursing responsibility, because PA can help prevent cardiovascular disease, diabetes, obesity, hypertension, osteoporosis, and depression (Warburton, Nicol, & Bredin, 2006). This study provides school nurses with three reliable and valid measures for use in their daily practice to assess adolescents' perceptions relative to PA. The acquired information can then be used by school nurses to tailor intervention strategies, which can include motivational interviewing sessions as one example (Missouri Department of Health and Senior Services, 2015), to assist adolescents in overcoming specific barriers to PA and enhancing their perceived benefits and enjoyment of the behavior as a means to help them achieve the recommended minimum of 60 minutes of MVPA daily. Additionally, the psychometric evaluation methods used in this study provide school nurses a foundation for choosing a reliable and valid assessment tool.

Strengths and Limitations

The study had both limitations and strengths. One limitation is that the findings can only be generalized to urban low-SES 5^{th}–8^{th} grade girls. Although Black and Hispanic girls were well-represented, representation of other minority girls, such as American Indian, Asian, or Native Hawaiian, was limited. Another limitation is that the demographic characteristics were not balanced between the intervention and control groups, even though, in the group RCT, two schools at a time were matched based on demographics and then randomly assigned to receive one or the other condition. Despite these limitations, the study's findings are trustworthy due to the inclusion of a large diverse sample of girls and objective measurement of PA via accelerometry. Though more research efforts are needed to further examine the psychometric properties of the three scales in other populations, the study offers

three important measures that may be used by school nurses to promote PA among adolescent girls.

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Table 1

Item and Exploratory Factor Analyses for the Perceived Benefits Scale among Adolescent Girls (N = 1,012)

Item	Item Analysis				Factor Analysis		
	M	*SD*	Item-Total Correlation	Alpha if Item Deleted	Psychosocial (LC)	Physical (LC)	Communality (h^2)
1. To spend time with friends or others my age.	2.10	.87	.23	.75	–	–	–
2. To be healthier.	2.56	.65	.35	.73	.22	**.42**	.22
3. To be the weight I want to be.	2.25	.98	.34	.73	−.01	**.59**	.35
4. To put me in a better mood.	2.06	.91	.47	.71	**.57**	.19	.36
5. To have fun.	2.68	.62	.28	.74	**.59**	−.09	.36
6. To have a chance to move around.	2.37	.79	.39	.72	**.63**	.09	.41
7. To get better at sports or other activities.	2.38	.78	.38	.73	**.43**	.22	.24
8. To look better.	2.00	1.06	.35	.73	.08	**.49**	.25
9. To have more energy.	2.44	.79	.54	.70	**.48**	.43	.41
10. To prove to myself what I can do physically.	2.41	.79	.50	.71	**.42**	.40	.34
11. To get or keep me in shape.	2.59	.71	.52	.71	.15	**.74**	.57

Note. *M*=mean; *SD*=standard deviation; LC=loading coefficient.

Table 2

Item and Exploratory Factor Analyses for the Perceived Barriers Scale among Adolescent Girls (N = 1,011[a])

Item	Item Analysis				Factor Analysis	
	M	*SD*	Item-Total Correlation	Alpha if Item Deleted	LC	Communality (h^2)
1. I feel embarrassed about the way I look whenever I exercise.	1.26	1.15	.46	.85	.50	.25
2. I feel too lazy to exercise (not motivated).	1.09	1.02	.52	.85	.57	.33
3. I am too busy.	1.02	.94	.38	.85	.41	.17
4. I would have to exercise alone.	1.13	1.10	.50	.85	.54	.29
5. I need to have better skills.	1.52	1.09	.43	.85	.46	.21
6. I have some pain from activity.	1.22	1.06	.43	.85	.46	.21
7. I am tired.	1.29	.97	.51	.85	.56	.32
8. I have a bad day.	1.14	1.01	.47	.85	.51	.26
9. I think exercise is hard work – “too much” for me to do.	.65	.86	.57	.84	.62	.38
10. I hate to sweat during the school day.	1.53	1.17	.43	.85	.47	.22
11. I want to do things other than physical activity with my time.	1.25	1.05	.54	.85	.59	.34
12. The weather is bad.	.94	1.02	.36	.85	.39	.15
13. It costs too much to do physical activities that I like.	.99	1.02	.50	.85	.54	.29
14. It is hard to find good places to do physical activities that I like.	1.22	1.05	.57	.84	.62	.38
15. Some people want me to do things other than physical activity with my time.	1.20	1.06	.50	.85	.54	.29
16. It is hard to find physical activity programs or classes that I like to do.	1.39	1.08	.54	.84	.59	.35

Note.

[a]One girl did not complete the survey;

M=mean; *SD*=standard deviation; LC=loading coefficient.

Table 3

Item and Exploratory Factor Analyses for the Physical Activity Enjoyment Scale among Adolescent Girls (N = 1,008[a])

Item	Item Analysis				Factor Analysis	
	M	*SD*	Item-Total Correlation	Alpha if Item Deleted	LC	Communality (h^2)
1. It's fun.	2.46	.64	.56	.75	.72	.51
2. I like it.	2.43	.68	.56	.74	.73	.53
3. I feel upset or frustrated.	2.20	.90	.45	.77	.45	.20
4. I enjoy it.	2.43	.72	.61	.73	.78	.62
5. I feel bored.	2.22	.91	.56	.74	.56	.31
6. I feel as if I would rather be doing something else (other than physical activity or exercise).	2.00	1.0	.51	.73	.52	.27

Note.

[a]Four girls did not complete the survey;

M=mean; *SD*=standard deviation; LC=loading coefficient.

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Table 4

Interrelationships among Study Variables in Adolescent Girls

Variable	*N*	*M*	*SD*	1	2	3	4	5	6	7	8
1. Age	502	12.19	.98	—							
2. BMI-z	501	1.10	1.06	.14**	—						
3. Baseline MVPA	462	2.74	1.22	−.22**	−.10*	—					
4. Physical benefits	502	2.37	.58	−.02	.19**	−.08	—				
5. Psychosocial benefits	502	2.39	.52	−.13**	−.05	.08	.41**	—			
6. Barriers	502	1.15	.59	.08	.09*	−.16**	.13**	−.03	—		
7. Enjoyment	499	2.34	.56	−.21**	−.14**	.19**	.06	.33**	−.48**	—	
8. Week 17 MVPA	379	2.88	1.50	−.08	.09	.56**	−.07	.12*	.00	.12*	—

Note. Data from control group girls in the group RCT were used.

* $p < .05$,

** $p < .01$;

M=mean; *SD*=standard deviation; BMI=body mass index; MVPA=moderate to vigorous physical activity.

Table 5

Hierarchical Regression Analysis Evaluating the Predictors of MVPA at Week 17 among Adolescent Girls (n = 326)

Model/Variables	β	95% CI of β	*t*-statistics	*p*-value	ΔR^2	F_{df}	*p*-value
Model 1					.04	$F_{5,320} = 2.77$	.018
Age	−.26	[−.41, −.10]	−3.25	.001*			
Hispanic	−.06	[−.56, .43]	−.25	.80			
Race	.05	[−.15, .24]	.48	.629			
School lunch program	.27	[−.15, .70]	1.29	.20			
BMI-z	−.06	[−.21, .08]	−.85	.394			
Model 2					.32	$F_{5,315} = 31.16$	< .001
Age	−.05	[−.18, .09]	−.66	.513			
Hispanic	.10	[−.31, .51]	.49	.625			
Race	.04	[−.12, .21]	.51	.61			
School lunch program	−.08	[−.43, .28]	−.43	.666			
BMI-z	.02	[−.11, .14]	.25	.802			
Baseline MVPA	.60	[.50, .70]	11.51	< .001*			
Physical benefits	−.30	[−.54, −.06]	−2.46	.014*			
Psychosocial benefits	.31	[.03, .59]	2.15	.032*			
Barriers	.24	[−.01, .48]	1.91	.057			
Enjoyment	.13	[−.15, .42]	.92	.357			

Note. Data from control group girls in the group RCT were used.

*significant;

CI=confidence interval; MVPA=moderate to vigorous physical activity.