Journal of Physical Activity and Health, 2011, 8, 234-243
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Effortful Persistence and Body Mass as Predictors of Running Achievement in Children and Youth: A Longitudinal Study

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Background: Schools often include running in their physical education and health curriculum to increase physical activity and reduce childhood overweight. But having students run around may not be enough to sustain physical activity habits if motivational factors are not well understood. This study examined effortful persistence as a predictor of running. ***Methods:*** Participants were 246 5th graders, and data on their demographic information, body mass index (BMI), effortful persistence, and time to complete a 1-mile run were collected across 4 years. ***Results:*** Between 5th to 8th grades, effortful persistence predicted time to complete a 1-mile run even when BMI was taken into account at every grade except for 7th grade. Rank-order stability was found in major variables across-time, but no across-time prediction was found for effortful persistence on a 1-mile run. ***Conclusions:*** Lack of longitudinal predictions bodes well for interventions aimed at increasing physical activity, because children or youth with high BMIs or low effortful persistence are not destined for future underachievement on physically challenging activities. Given the stability of variables, interventions that target fostering self-regulatory efficacy or effortful persistence may be particularly important for getting children on trajectories toward healthy and sustained levels of physical activity.

Keywords: self-regulation, self-efficacy, running motivation, school health, childhood overweight

The prevalence of overweight in children and youth in the United Sates has tripled since the 1960s,[1] and the World Health Organization[2] declared obesity a global epidemic. To foster physical activity which may reduce childhood overweight, many schools have implemented running programs into the physical education (P.E.) curriculum.[3] Although a person's running performance is associated with their body mass, it is important for school health professionals to consider the person's self-regulatory beliefs, motivation, and behavior (eg, effortful persistence) for running. Little is known about the relative contributions of body mass index (BMI) and effortful persistence on running performance as children transition from middle childhood to adolescence.[4,5] Further, the majority of previous research has focused on the consequences of overweight or obesity with less attention on understanding the determinants of physical activity behavior. Thus, the current study examines the concurrent and longitudinal predictions of running performance from BMI and effortful persistence as well as the differential continuity of the 3 major variables from 5th to 8th grades.

There is considerable evidence documenting the health benefits of participating regularly in moderate-intensity physical activity.[6] In childhood and adolescence, the most common problems associated with obesity or overweight include increased risks for cardiovascular, metabolic (including risks for developing diabetes), orthopedic (such as foot or hip), and psychosocial (such as peer harassment and stigmatization) problems.[7] Importantly, obese children generally do not "grow out" of their obesity, with approximately 70% of obese adolescents remaining obese as adults.[7] Epidemiological studies on adults have demonstrated that physical activity serves as a protective factor against chronic diseases such as coronary heart disease, non-insulin-dependent diabetes mellitus, osteoporosis, colon cancer, anxiety, and depression.[6,8,9] Thus, identifying effective strategies that promote physical activity beginning in childhood and youth has become prominent school and public health issues.

Because overweight is a condition that typically arises when the number of calories consumed exceeds the number of calories burned,[7] one strategy to increase calorie expenditure is to promote physical activity. To promote physical activity in children and youth, many schools have adopted or established running programs in the physical education curricula.[3] Although running programs in schools could be a low-cost and effective

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way to promote physical activity in children and youth, simply having students run around may not be enough to sustain physical activity habits if motivational factors are not well understood.[5] Thus, the current study examines effortful persistence as a self-regulatory and motivational construct that predicts performance in a 1-mile run for 5th to 8th graders within- and across-grades.

Body Mass and Physical Activity

Typically, a person gains weight when energy intake of food mismatches energy expenditure through physical activity.[10] It has been documented that regular, moderate to vigorous physical activity is an effective prevention or treatment method of overweight and obesity because it is linked to improvements in insulin sensitivity, blood pressure, and reduced risk of health-related mortality.[11] Body mass index (BMI) has been commonly used as a simple proxy or surrogate measure of defining overweight and obesity in children and adolescents.[12,13] Although there are different ways of calculating BMI, the Centers for Disease Control and Prevention[1] used a formula of dividing weight in pounds by height in inches squared and multiplying by a conversion factor of 703 to assess BMI. Obesity and overweight for age and sex can be defined by levels of BMI relative to healthy children or adolescents in a reference population. According to the American Academy of Pediatrics, children who are at or above the 95th percentile on BMI are classified as obese while those who are between the 85th and 95th percentile are classified as overweight for their age and gender in comparison with a normative sample.[14] Thus, children's and adolescents' BMI needs to be interpreted relative to a reference population of healthy children and adolescents.[7] It is important to consider developmental and sex differences in BMI. When age and sex are taken into account, BMI scores of children have been found to provide accurate estimates of body composition.[15] Yet, BMI is an index that does not distinguish between fat mass and lean mass.[16] Nonetheless, the relatively high correlations between BMI and other measures of weight status and adiposity[13] make the use of BMI a relatively accurate, low-cost, and simple method to assess overweight in children and adolescents in the schools.

Effortful Persistence as Index of Self-Regulatory Efficacy

Although highly overweight individuals tend not to be very physically active, this does not necessarily imply that body mass causes physical inactivity particularly when body mass appears to be a relatively modest predictor of physical activity habits.[11] Factors such as self-regulatory skills, including self-monitoring and self-reinforcement, have been found to contribute to continued physical activity.[17] Human agency refers to intentional or willful behavior, and the capacity for self-regulation is partly reflected in personal agency and self-efficacy which are key features of social cognitive theory.[18] According to social cognitive theory,[18] *self-regulatory efficacy* refers to an individual's belief that she or he has the ability to mobilize and maintain effort needed to persist and achieve a goal even in the face of obstacles or challenges.[19–22] Thus, effort and persistence reflect self-regulatory efficacy that is important for achievement or performance.[23–25] Research indicates that children who are able to willfully sustain or increase their effort as well as persist in the face of difficulty are more likely to achieve challenging or long-term goals.[26,27] Hereafter, we use the term *effortful persistence* to refer to self-perceived effort and persistence, defined as self-perceptions of continued investment and overall amount of time, energy, or work expended on a task or goal.

Effortful Persistence and Achievement of Challenging Tasks

Consistent with motivational theories such as goal orientation theory and an expectancy value model of achievement choices, research indicates that effortful persistence is important for achievement or attainment of challenging or long-term goals.[26,28,29] Different theorists use slightly different terminology, but goal orientations could be broadly classified into performance and mastery goal orientations.[26] The majority of research on children's or adolescents' goal orientations tends to examine academic or school-related achievement,[29] with growing research in the area of physical activity.[30] Results on relations between performance or mastery goals and achievement have been somewhat mixed, partly because of methodological differences across studies and partly because there are approach and avoidance components within each goal orientation.[29,31] Generally, mastery (intrinsic) goal orientations are viewed as being consistently associated with indices of self-regulation such as effortful persistence toward achieving challenging or long-term goals. Thus, self-efficacy beliefs (including self-regulatory efficacy) are developed and strengthened by mastery experiences.[18,20] In contrast, performance goal orientations tend to be viewed as less consistently associated with effortful persistence.[29]

Effortful Persistence and Performance on 1-Mile Run

Rudisill[32] conducted an experiment asking children to balance on a stabilometer (ie, balance board), and found that training children to perceive that their performance was dependent on practice and effort helped them to perform better and persist longer at mastery attempts with subsequent trials. In high school students, mastery-approach goals (ie, mastering tasks, learning, and understanding) have been predictive of student reports of persistence and effort expended toward physical education.[4] Similar findings have been found in a sample of Turkish high school students,[33] with effort and persistence being positively associated with goals to master learning skills (mastery goals) and to outperform peers (performance-approach goals) or avoid performing poorly (performance-avoidance goals). There has been relatively limited research on perceived effortful persistence as a predictor of running performance in children and adolescents.[3–5,33,34] Guided by social cognitive (eg, self-regulatory efficacy) and motivational theories (eg, goal orientation theory and an expectancy value model of achievement choices), we expect that children who perceive themselves as being high on effortful persistence would derive a sense of accomplishment from challenge or intrinsic interest in a task (ie, have a mastery goal orientation). Thus, we hypothesize such children to complete a 1-mile run relatively quickly even when their BMI is taken into account. Specifically, we hypothesize that effortful persistence would provide unique prediction of time to complete a 1-mile run above and beyond contributions from body mass index within each grade. Relatively limited work has been conducted on the development of children's goal orientations especially in the context of health-related behavior or physical education,[29] so we tentatively hypothesize modest 1-year differential continuity (ie, rank-order stability) in effortful persistence across grades. However, if there is at least modest mean level stability in effortful persistence across grades, we are unsure if effortful persistence will explain additional variance in the time to complete a 1-mile run 1 year later, especially if there is no significant change in the rank-ordering of individuals' time to complete a 1-mile run across-grades.

Methods

Participants

Institutional approval of study protocol and informed consent from participants were obtained before data collection. At the start of data collection in the 5th grade, 533 students were recruited from 2 intermediate schools in a rural community of Texas, and 246 of those 5th graders (132 boys, 114 girls; M age = 10.88 years, SD = .49) had data from 5th to 8th grades. The community was served by a school district that included 5 elementary schools, 2 intermediate schools, 2 middle schools, and 1 high school. Analyses were conducted to compare the 246 students to the students without data from 5th to 8th grades on the demographic and study variables. Students from a particular school at 5th grade were less likely to have data from 5th to 8th grades, χ^2 (1) = 12.10, $P < .01$, but no other differences were found.

Procedures

Across 4 years (grades 5 to 8), data were primarily collected by researchers using the same procedures and measures during students' regularly scheduled P.E./wellness or athletics classes at the end of each school year. Students reported on their demographic information and perceived effortful persistence on running activities using questionnaires. Questionnaires were administered to the children during their regularly scheduled P.E./wellness or athletics classes by the researchers without the presence of physical education teachers or coaches. Specifically, each item was read aloud to the students when they were in grades 5 and 6. But when students entered 7th and 8th grades, they completed the questionnaires by themselves as they were able to read and understand all the questionnaire items. Students were encouraged to ask questions if they had difficulty understanding instructions or questionnaire items. No questions were raised while the students completed the questionnaires that took approximately 30 minutes to administer.

As part of their 5th and 6th grade P.E./wellness classes, students were required to participate in running programs. In the 7th and 8th grades, students had a choice of either enrolling in a P.E./wellness class or an athletics class (but both types of classes involved running activities). Importantly, 1-mile run was timed only in P.E./wellness classes and resulted in some missing data on 1-mile run for students in athletics classes. Students' height and weight in the 5th and 6th grades were measured by the researchers with the assistance of the P.E./wellness teachers. In the 7th and 8th grades, students' height and weight were measured by their P.E. teachers as part of their fitness testing if they were enrolled in P.E./wellness classes or were measured by the researchers if they were enrolled in athletics classes. These measurements were then used to calculate BMI through the formula defined by the Center for Disease Control and Prevention (CDCP).[1]

Measures

The same measures were collected across 4 years (from grades 5 to 8). Measures included demographic variables, BMI, effortful persistence, and time to complete a 1-mile run.

Demographic Variables

Students reported on their age, gender, grade level, school attended, and ethnicity which was coded as White-American (65.3%), Black-American (9.9%), Asian-American (9.9%), Hispanic-American (8.7%), or Other (6.2%). For school attended, students in this sample typically attended one of 2 intermediate schools and then transitioned to one of 2 middle schools at 7th grade in the community.

Effortful Persistence

Students reported on their effortful persistence in running activities on a 5-point scale (1= not like me to 5 = very much like me) using 5 items (α ranged from .69 to .87 from 5th to 8th grades) adapted from Xiang and Lee.[35] Sample items included "I overcome difficulties to participate regularly (in running)," "I spend extra time and effort trying to do well (in running)," and "I try to run as many laps as I can every time when we go out running." For each grade, scores for effortful persistence were computed as the average of the 5 items.

Body Mass Index (BMI)

BMI was calculated from 5th to 8th grades by dividing weight in pounds by height in inches squared and multiplying by a conversion factor of 703.[1] Height and weight measurements were collected at schools by the P.E. teachers or researchers using professional-grade mechanical scales. This type of scale is typically used at medical settings such as hospitals and can accurately and efficiently measure height and weight. Thus, such scales are widely used in schools by school nurses and P.E. and health instructors.

Time to Complete 1-mile Run

Time to complete a 1-mile (1.6 km) run was recorded by either the students' P.E./wellness teacher or a researcher. For students in athletics classes in 7th and 8th grades, there were missing data on 1-mile run.

Results

Attrition, descriptive, and correlational findings are conducted first. Concurrent and longitudinal prediction of time to complete a 1-mile run from BMI and effortful persistence were then tested with path analyses.

Variables were screened for normality and outliers, and all responses were within reasonable ranges.[36] According to cutoff values of 2 for skew and 7 for kurtosis,[37] only BMI at 6th grade was modestly positively skewed (skew statistic = 2.39 and kurtosis statistic = 12.85).

Transition From Physical Education to Athletics Classes

Recall that in the 7th and 8th grades, students had a choice of enrolling in a P.E./wellness class or an athletics class. Therefore, participants who were in athletics classes had missing data on BMI and time to complete a 1-mile run in 7th and 8th grades. Attrition analyses were conducted to examine whether there were differences in the means of major variables between participants who had versus those who had no data on the 1-mile run at 8th grade. Differences were found at 6th grade, Wilks's Fs(3, 237) = 7.49, $P < .01$. Specifically, participants who were in athletics reported higher effortful persistence and completed the 1-mile run faster at 6th grade than those who were not in athletics classes, ts(1,239) = 8.16 and 20.46, Ps < .01, respectively. Given the plausible difference between the full and subsamples, we analyzed the hypothesized path model with the full sample and then the subsample who had 1-mile run data at 8th grade to compare the pattern of results. The reason of testing the possible difference between the complete data (ie, the data only included students who had no missing values) and the full data (with all students including the ones who had missing values on 1-mile run) is to examine whether the missingness (or the missing data mechanisms) has any substantial impact on the estimation of the path model. Although we cannot directly examine the type of missing data mechanism in our data, the comparison of the 2 datasets can still provide some indirect information on the influence of the missing data.

Descriptive Statistics

Means and standard deviations for the major variables are presented in Table 1. Partial correlations controlling for age and gender among major variables are presented in Table 2.

Relations of Gender With Major Variables

To test whether boys and girls differed on (a) effortful persistence, (b) BMI, and (c) time to complete a 1-mile run, multivariate analyses of variance (MANOVAs) were conducted for variables at each grade. Gender differences were found only at the 5th grade, Wilks's Fs (3, 226) = 4.11, $P < .01$, with boys completing the 1-mile run faster than girls, Fs(1, 228) = 6.70, $P < .05$. To account for such relations between gender and major variables, paths were included for gender on time to complete a 1-mile run at 5th grade in the path analysis.

Relations of Ethnicity With Major Variables

To test whether ethnic groups differed on (a) effortful persistence, (b) BMI, and (c) time to complete a 1-mile run, multivariate analyses of variance (MANOVAs) were conducted for variables at each grade. No ethnic differences were found except for at 8th grade, Wilks's Fs(12, 220) = 1.92, $P < .05$. Yet, univariate results indicate no ethnic differences on major variables at 8th grade.

Relations of Age With Major Variables

Correlations indicate that age was generally not associated with major variables with a few exceptions. At 5th grade, older students tended to report higher levels of effortful persistence, $r(244) = .13$, $P < .05$. Among 6th graders, age was inversely correlated with BMI and with time to complete a 1-mile run so that older students tended to have lower BMI and completed the 1-mile run more quickly, rs(241) = –.14 and –.19, Ps < .05 and .01, respectively. To account for such relations between age and major variables, paths were included for age on BMI and on time to complete a 1-mile run at 6th grade in the path analysis.

Table 1 Means and Standard Deviations of Major Variables for Total Sample and by Gender

		Total Sample (N = 246–90)		Boys (n = 131–48)		Girls (n = 114–41)	
Variables		**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Effortful persistence	G5	3.12	.846	3.15	.85	3.11	.85
	G6	3.62	.98	3.61	.97	3.64	.98
	G7	3.71	.92	3.66	.93	3.78	.93
	G8	3.58	.90	3.56	.88	3.62	.92
BMI	G5	19.65	4.14	19.94	4.44	19.32	3.78
	G6	19.87	4.31	19.73	4.62	20.02	3.96
	G7	21.42	5.71	21.47	6.45	21.35	4.95
	G8	22.56	5.64	22.56	5.76	22.50	5.61
Time on mile run	G5	10.47	2.12	10.20	2.16	10.80	2.03
	G6	9.73	2.34	9.67	2.23	9.78	2.39
	G7	11.16	2.85	11.42	3.02	10.92	2.70
	G8	10.58	2.48	11.11	2.61	10.13	2.31

Abbreviations: G, grade.

Table 2 Partial Correlations Among Major Variables Within and Across Grades Controlling for Child's Age and Gender

	Effortful persistence				Body Mass Index				Mile run			
	5th	**6th**	**7th**	**8th**	**5th**	**6th**	**7th**	**8th**	**5th**	**6th**	**7th**	**8th**
Effortful persistence												
5th												
6th	.27**											
7th	.14*	.53**										
8th	.20**	.46**	.58**									
Body Mass Index												
5th	–.08	–.06	–.04	.01								
6th	–.07	–.13*	–.10	–.08	.33**							
7th	–.06	–.21*	–.23*	–.10	.51**	.76**						
8th	–.14	–.26*	–.27**	–.26*	.45**	.82**	.80**					
Mile run												
5th	–.41**	–.19**	–.12+	–.07	.41**	.14*	.25*	.21+				
6th	–.21**	–.45**	–.40**	–.39**	.29**	.43**	.50**	.56**	.39**			
7th	–.15	–.44**	–.42**	–.31**	.27**	.51**	.54**	.52**	.28**	.78**		
8th	–.09	–.39**	–.41**	–.50**	.18+	.42**	.41**	.52**	.28**	.76**	.67**	

Note. + $P < .10$, *$P < .05$, **$P < .01$.

Across-Time Mean-Level Changes in Major Variables

To examine mean-level changes in major variables from year-to-year, paired-sample *t*-tests were conducted. Results indicate that effortful persistence increased from 5th to 6th grades, $t(245) = 6.96$, $P < .01$, with no significant mean-level changes found in later grades. Beginning at 6th grade, there were at least marginal mean-level increases in BMI. Specifically, BMI increased from 6th to 7th grades, $t(97) = 3.59$, $P < .01$ and marginally increased from 7th to 8th grades, $t(78) = 1.72$, $P < .10$. For the 1-mile run, students ran faster the following year at 5th and 7th grades, ts(232, 87) = 4.61 and 2.20, Ps < .01 and .05, respectively, but not at 6th grade when students ran slower the following year, $t(96) = 3.77$, $P < .01$.

Relations Between Predictor and Outcome Variables

To examine relations between predictor and outcome variables, partial correlations among the major variables controlling for age and gender were conducted. Because results are presented in Table 2, we summarize the patterns of findings. From 5th to 8th grades, higher levels of effortful persistence were associated with less time to complete a 1-mile run concurrently and across at least 1 or more years. Higher levels of body mass were associated with more time to complete a 1-mile run within and across all grades (with the relation 4 years later being marginally significant).

Path Analyses

To handle missing data due to students being in athletics classes, full information maximum likelihood (FIML) estimation in MPlus (v5.1)[38] was used. Importantly, path analysis was conducted on the full sample (N = 246) and also on the sample of students who remained in P.E./wellness classes (ie, had 1-mile run data at 8th grade; n = 116) and patterns of prediction were the same for both models. The finding of similar pattern of results suggests that the missingness in 1-mile run data might not have substantial influence on the estimation of the path model. Thus, results are presented for the full sample which would provide greater statistical power for analyses. Path analysis was conducted using structural equation modeling (SEM) to examine the concurrent and longitudinal predictions of running performance from BMI and effortful persistence as well as the differential continuity of these 3 major variables from 5th to 8th grades. Path analysis accounted for consistencies in all measures (from 1 year prior). Based on findings from descriptive analyses, path analysis accounted for age on effortful persistence at 8th and 6th grades, age on 1-mile run at 6th grade, and gender on effortful persistence at 5th grade. To assess how well the models fit the data, we included information from 3 different model fit indices (ie, SRMR or standardized root mean square residual, CFI or comparative fit index, and RMSEA or root mean square error of approximation) as recommended by a number of methodologists.[39,40]

The longitudinal model (see Figure 1), with BMI and effortful persistence as predictors of time to complete 1-mile run, provided good fit to the data, $\chi^2(53, N = 246) = 89.21$, $P = .00$; CFI = .96; RMSEA = .05; SRMR = .06. As recommended by the modification indices, the residual variances between BMI at 6th and 7th grades, BMI at 7th and 8th grades, between effortful persistence at 7th and 8th grades, and between 1-mile run at 7th and 8th grades were allowed to correlate and made theoretical sense given that these were the same measures but taken 1 year apart. Results indicate that there was 1-year differential (ie, rank-order) continuity for the 3 major variables from 5th to 8th grades. Independent of consistencies in measures from 1 year prior, model paths indicate that high effortful persistence and low BMI both provide unique prediction of faster time to complete 1-mile run in the expected directions at 5th and 6th grades. However, at 7th grade, neither effortful persistence nor BMI predicted time to complete 1-mile run. By 8th grade, effortful persistence predicts 1-mile run once again but not BMI. Given continuity in all major variables, no across-time predictions of 1-mile run were found from effortful persistence or BMI.

Discussion

In general, effortful persistence predicted performance on a 1-mile run even when BMI was taken into account. Between 5th to 8th grades, this pattern of results was found at every grade except for 7th grade. Results have implications for enhancing physical activity that may reduce the likelihood of childhood and adolescent overweight.

Effortful Persistence and Achievement of Physically Challenging Tasks

Effortful persistence was conceptualized as an index of self-regulatory efficacy,[20] or individuals' belief in their abilities to use internal resources to put forth effort and persevere at a behavior or activity even in the face of obstacles or challenges.[19] Consistent with social cognitive theory,[18] results from partial correlations controlling for age and gender indicate that effortful persistence was correlated with less time to complete a 1-mile run within and across at least 1 or more years from 5th to 8th grades (see Table 2). At all grades except for 7th, results from path analysis show that students' effortful persistence predicted less time to complete a 1-mile run, above and beyond contributions from their BMI (see Figure 1). Such findings are also consistent with goal orientation theory.[26,28,29] Because mastery goal orientations are viewed as being consistently associated with indices of self-regulation such as effortful persistence toward achieving challenging or long-term goals,[29] we speculate

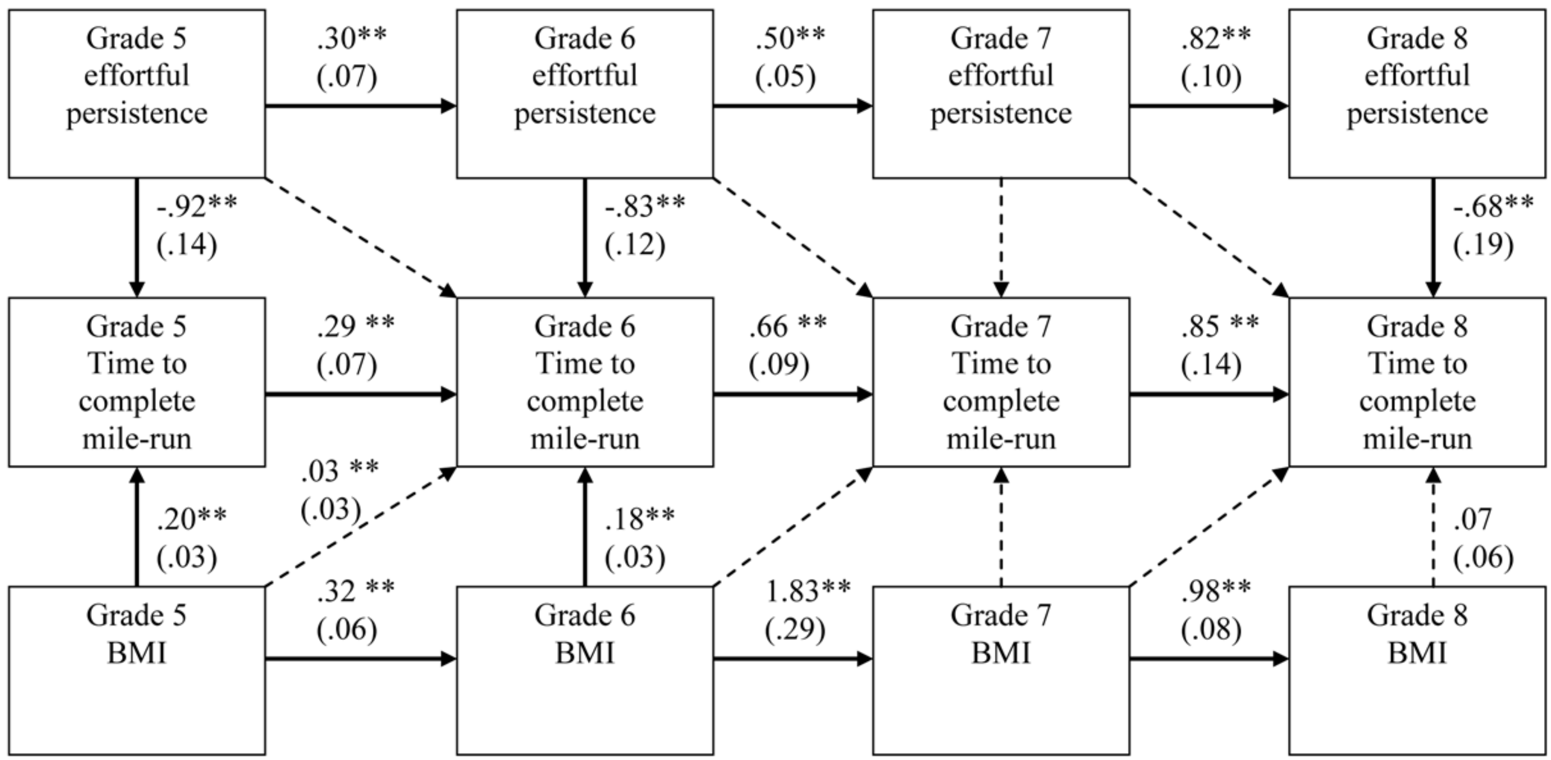

Figure 1 — Path analysis of effortful persistence and BMI as predictors of time to complete the 1-mile run within and across grades 5 to 8. χ^2 (53, N = 246) = 89.21, P = .00, CFI = .96, RMSEA = .05 (90% CI = .03 to .07), SRMR = .06. Unstandardized coefficients are presented above parentheses; the numbers in parentheses are standard errors. For readability of figure, paths from age on effortful persistence at 5th and 6th grades, age on 1-mile run at 6th grade, and gender on effortful persistence at 5th grade were tested but not included in figure. + $P < .10$, * $P < .05$, ** $P < .01$.

that students with high levels of effortful persistence are also likely those with mastery goal orientations toward physical activity and running. Further, such a finding would be compatible with the notion that self-efficacy beliefs (such as self-regulatory efficacy) are developed and strengthened when children are offered opportunities for mastery experiences.[18,20] In the current study, the 1-mile run for 5th to 8th graders was a task that requires sustained physical exertion for at least approximately 10 minutes (range = 9.73 to 11.16 minutes; see Table 1). Even when body mass was taken into account, effortful persistence continued to contribute to less time to complete the 1-mile run. Thus, findings suggest that students who are able to self-regulate by putting forth effort and persistence are not only able to accomplish the 1-mile run, but accomplish it in less time. Such a view would be consistent with results from Guan and colleagues[4] who found that mastery-approach goals significantly contributed to student reports of persistence and effort expended toward physical education. The lack of findings at 7th grade is likely associated with the fact that students had a choice of either enrolling in a physical education class or an athletics class beginning at the 7th grade. Recall that attrition analyses indicated that participants who were in athletics reported higher effortful persistence and completed the 1-mile run faster at 6th grade than those who were not in athletics classes. Importantly, we verified that the patterns of prediction that were found remained the same even when path analysis was conducted on the subsample of students who remained in P.E./wellness classes.

Body Mass and Achievement of Physically Challenging Tasks

Although BMI is an index that does not distinguish between fat mass and lean mass,[16] BMI is a relatively low-cost, simple, and accurate method to assess overweight in the schools.[12,13] Because regular moderate to vigorous physical activity is part of an effective prevention or treatment method of overweight,[11] body mass, and performance on the 1-mile run would likely be associated with one another. As expected, results from partial correlations controlling for age and gender indicate that higher BMI was correlated with more time to complete the 1-mile run within and across all grades (with the relation BMI at 5th grade and time to complete the 1-mile run at 8th grade being marginally significant; see Table 2). However, results from path analysis suggest that body mass appear to become increasingly less predictive of achievement of physically challenging tasks such as the 1-mile run from 5th to 8th grades. Although higher BMI predicted more time to complete the 1-mile run at 5th and at 6th grades, above and beyond contributions from effortful persistence, BMI no longer predicted performance on the 1-mile run at 7th or at 8th grades. In fact, by 8th grade, it was effortful persistence, not BMI, that predicted performance on the 1-mile run (see Figure 1).

Developmental Changes and Stability From 5th to 8th Grades

There were mean-level changes in effortful persistence, BMI, and time to complete a 1-mile run. Effortful persistence increased from 5th to 6th grades, with no mean-level changes in later grades. Starting at 6th grade, there were at least marginal mean-level increases in BMI. For 1-mile run, students ran faster the following year at 5th and 7th grades, but not at 6th grade when students ran slower the following year. This is consistent with the fact that students had a choice of enrolling in athletics classes at 7th grade and those who transitioned to athletics classes also completed the 1-mile run faster than those who were not in athletics classes at 6th grade. Furthermore, this transition and shift in motivational pattern may be exemplified by those experienced by adolescents in high school who pursue their own goals while balancing competing goals from their parents, teachers, or peers.[5,41] One-year differential (ie, rank-order) continuity was found for effortful persistence, BMI, and time to complete a 1-mile run. Such stability in the major variables likely contributed to the lack of across-time prediction from effortful persistence or BMI on time to complete a 1-mile run a year later. Thus, early interventions that target children's self-regulatory efficacy such as increased motivation, effort, and persistence or children's overweight are important as these factors appear to remain relatively stable over time without special intervention or treatment.

Study Limitations and Future Directions

A strength of the current study is its longitudinal design that allowed for the examination of stability and changes in measures, as well as the relative contributions of self-regulatory efficacy and BMI on achievement of a physically challenging task within- and across-time in children and youth. However, note that timings of the 1-mile run were measured by either the P.E. teacher or a researcher, and interrater reliabilities could not be calculated. Although it may require greater resources from researchers, future studies could have both a P.E. teacher and a trained research assistant simultaneously time students' 1-mile run so interrater reliabilities could be calculated. And while extremely challenging due to the lack of extra time in students' schedules, future studies could consider ways to continue collecting data on the achievement of the 1-mile run from students who are no longer enrolled in P.E./wellness classes. Furthermore, participants were transitioning from middle childhood to early adolescence between 5th to 8th grades. Thus, additional research is needed to understand the developmental (eg, psychological, physical, and social) changes that children undergo as they transition from childhood to adolescence which may influence the stability or change in, as well as the relations between, their effortful persistence, BMI, and performance on the 1-mile run. And while the 1-mile run was used as an index of achievement of a physically challenging activity, there are many other developmentally appropriate physical activities that may be implemented for children and youth to enhance physical activity in the schools. Future research may examine whether similar patterns of results are found for other types of physical activity.

Implications for Policy and Practice

It is important to note that neither effortful persistence nor BMI predicted time to complete a 1-mile run across-time when accounting for consistencies in measures. Recall that physical activity has been found to be one component of an effective prevention or treatment method of overweight and obesity. Thus, a lack of longitudinal predictions actually bodes well for efforts aimed at increasing physical activity in children and youth. In other words, children or youth who begin with high BMIs or low levels of effortful persistence are not destined for future underachievement on physically challenging activities. Yet, stability was found for all major variables from 5th to 8th grades, partly because children's behaviors tend to be relatively resistant to change without intervention.[42] Thus, school health and early childhood intervention strategies for maintaining and enhancing self-regulatory efficacy for physical activity might be particularly important in starting children on trajectories toward healthy and sustained levels of physical activity. For example, health educators could help foster students' self-regulatory efficacy for physical activity by emphasizing and rewarding participation, effort, and persistence. Because running does not require special equipment or facilities, schools often implement running programs into their P.E. curriculum.[5] Regardless of the type of physical activity, activities should be developmentally appropriate and foster a sense of mastery and self-efficacy including instilling a sense of choice and purpose.[43]

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