

Application of the Transtheoretical Model of Behavior Change to Preadolescents' Physical Activity and Exercise Behavior

Bradley J. Cardinal, Hermann-J. Engels, and Weimo Zhu

The Transtheoretical Model of behavior change was applied to a sample of 669 preadolescents (M age = 8.2) to determine whether stages of exercise could be observed. Associations between stage of exercise classification and demographic, fitness, and cognitive variables were examined. Stage of exercise classifications, on the basis of the Children's Stage of Exercise Algorithm, were as follows: maintenance (50.8%), action (36.5%), preparation (3.1%), contemplation (4.9%), and precontemplation (4.6%). Stage of exercise was significantly related to gender, age, and grade level. Controlling for these differences, the relationship between exercise beliefs and stage of exercise was significant.

Early childhood is a time when physical activity-related lifestyle habits and attitudes are thought to develop (37). Furthermore, these habits and attitudes may track across the life span (19). *Tracking* refers to the stability of a characteristic over time (19). With regard to physical activity behaviors, evidence suggests that tracking begins during early childhood (29). Accordingly, experts have recommended that primary prevention for reducing inactivity in the population as a whole be directed toward children as well as adults (10, 31, 40).

A potentially promising approach for promoting physical activity among children is to structure interventions using the conceptual framework provided by the Transtheoretical Model of behavior change (14, 27). The Transtheoretical Model of behavior change is comprised of two dimensions: the *stages of change* and *processes of change* (33). In the model, stages of change refers to the temporal, motivational, and constancy aspects of change, whereas processes of change are those activities and events that lead to successful behavior change (e.g., consciousness raising, helping relationships, self-reevaluation). The integration of these two dimensions is the conceptual strength of the Transtheoretical Model framework. That is, once an individual's stage of change has been identified, interventions designed using the most appropriate (i.e., stage-matched) processes of change can

B.J. Cardinal is with the Department of Exercise and Sport Science at Oregon State University. H-J. Engels and W. Zhu are with the Division of Health, Physical Education, and Recreation at Wayne State University. Address correspondences to: Bradley J. Cardinal, Department of EXSS, 220 Langton Hall, Oregon State University, Corvallis, OR 97331-3303.

be delivered. The efficacy of this approach has been documented among adult samples (7, 8, 20).

For most behaviors, five stages of change are posited (33): (a) *precontemplation*, not thinking about the prospect of changing; (b) *contemplation*, thinking about the prospect of changing in the near future; (c) *preparation*, deciding, preparing, or beginning to make small changes; (d) *action*, the first 6 months of an overt behavior change; and (e) *maintenance*, sustaining a behavior change for longer than 6 months. A sixth stage, *termination*, may also exist for some behaviors (34). This stage represents the closure point in the behavior change process (i.e., the new behavior is 100% established and self-efficacy is 100% in all previously difficult situations). As people tend to have difficulty sustaining physical activity and exercise behaviors permanently (13), the termination stage may not apply to these behaviors (6, 24). That is, *relapse*, the act or instance of declining or receding (25), is considered a possibility within the model.

Various authors have used the stage of change construct to describe adult physical activity and exercise behavior (2, 6, 24, 34). Collectively, the studies conducted to date have shown that adults classified by stage of exercise differ on a number of important psychosocial and social-cognitive determinants of physical activity and exercise behavior (e.g., behavioral intention, outcome expectancy, perceived behavioral control, processes of change, self-efficacy), as well as leisure-time exercise behavior, 7-day physical activity recall, and objective markers of physical fitness.

On the basis of the tracking phenomenon and expert recommendations calling for early intervention, it seems appropriate to determine the age at which stages of exercise begin to develop. This, in turn, may assist researchers and practitioners in designing and delivering more effective physical activity behavior change, promotion, and retention interventions. That is, the age at which substantial inactivity (as determined by placement into an early stage of change) begins to develop would be a reasonable time to offer such interventions, rather than waiting until the habit and its associated psychosocial determinants are firmly in place. However, at the present time, there is no evidence to support the stage of exercise construct among young children, nor have measures of the construct been developed for young children.

The present study was an initial attempt to determine whether preadolescent school children could be classified into the precontemplation through maintenance stages of exercise using a new instrument, the Children's Stages of Exercise Algorithm, and to determine if children classified by stage using the measure differed on a number of physical fitness and cognitive variables. With regard to the study of children's physical activity and exercise behavior, Brustad (1) noted the need for research directed toward the development of new measures that are specific to children and for establishing the psychometric properties (e.g., construct validity) of any new measures that are developed.

Method

Participants

The study sample consisted of 669 school children between the ages of 5 and 11 years ($M = 8.2$, $SD = 1.5$). The majority were Caucasian (94.2%). To be included in the study, participants must have been enrolled in the first through fifth grades at one of four Midwestern, suburban elementary schools and turned in an informed

consent form signed by a parent or guardian. The study was approved by the Wayne State University Institutional Review Board, and permission was obtained from each elementary school's principal.

Measures and Procedures

Prior to data collection, the children and their teachers attended an assembly on physical activity and fitness for health. The highlight of this assembly was a motivational presentation by a local sport and fitness celebrity. The main topics covered during this presentation included the benefits of regular exercise, information about gradual fitness changes, and the importance of having fun while participating in physical activity. Data were collected at the beginning of the school year, just after summer vacation.

The independent variable in this study was stage of exercise. In the absence of a stage of exercise measurement instrument specific to children, a new measure, the Children's Stage of Exercise Algorithm, was developed (see Figure 1). Using the instrument, classification into one of the five stages posited in the Transtheoretical Model of behavior change was possible.

The conceptual descriptors used to classify children by stage of exercise in the present study were similar to the conceptual descriptors used in previous studies to classify adults by stage of exercise (3-5, 21-23, 42). For example, Marcus and Simkin (23) used a *True* or *False* algorithm approach to classify adults by stage of exercise. In their study, an adult who stated he or she currently did not exercise and did not intend to start exercising in the next 6 months was classified as a precontemplator. An adult who stated he or she currently did not exercise but intended to start in the next 6 months was classified as a contemplator, and so on, through to the maintenance stage, which described someone who currently exercised regularly and had been doing so for the past 6 months. In their study, a total of 235 adults were classified into one of the five posited stages of exercise using this strategy, and significant between-stage differences were observed for 7-day physical activity recall.

There were 10 dependent variables in this study. Eight were measures of physical fitness. The physical fitness variables were those included in the Prudential Fitnessgram national fitness test battery (11). Under the direction of one of the authors (HJE), a team of trained exercise science students conducted physical fitness testing at the respective elementary school's gymnasium. In various adult samples, Cardinal (3-5) has reported significant between-stage differences on both cardiorespiratory fitness (i.e., $\text{VO}_{2\text{max}}$) and body mass index (BMI). Other physical fitness variables have not been studied among adult samples.

In the present study, aerobic fitness was determined using the Progressive Aerobic Cardiovascular Endurance Run (PACER). This is a multistage, 20-m shuttle run test. The objective is to run as long as possible back-and-forth a 20-m distance at a specified pace (set to music) which gets faster each minute. A project staff member served as a "PACER car" for the students. Students "off pace" were allowed to catch-up twice before their test was terminated. The test score was the total number of PACER laps completed.

Body fat percentage was determined from triceps and calf skinfold measurements taken on the right side of the body by one experienced technician using the same Harpenden skinfold caliper. Lohman's (18) equations were used to estimate body fat percentage.

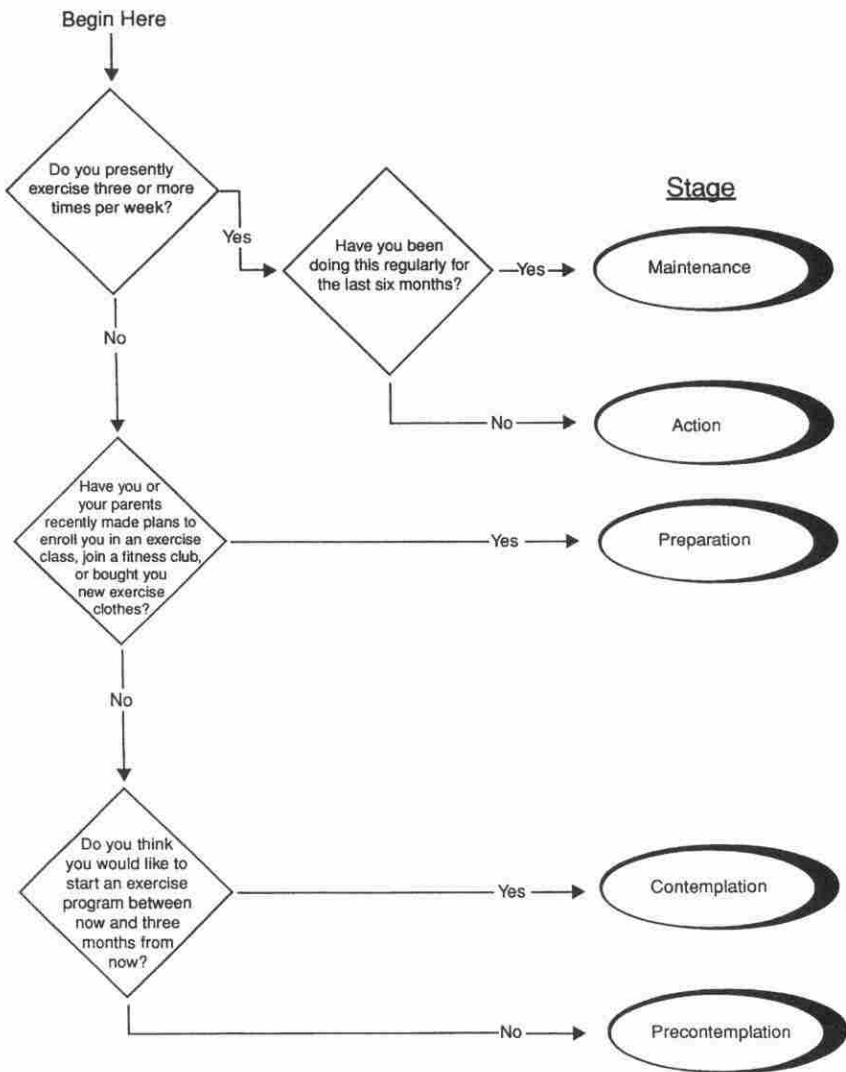


Figure 1 — Children's Stage of Exercise Algorithm

Another body fat percentage indicator employed was BMI (wt kg/ht m²). Height and weight were obtained using a standard medical scale and portable stadiometer. Participants were requested to remove their shoes and all heavy clothing before the measures were taken.

Flexibility was determined using the back-saver sit-and-reach test. A 12-in. high, standard sit-and-reach box was used. With subjects' shoes removed, four trials were given on each side of the body. Scores were recorded on the fourth trial.

The trunk-lift test was used to determine trunk extensor strength and flexibility. Laying prone, each child lifted her or his upper body as high as possible off the floor in a slow and controlled manner. Two trials were given with the highest score recorded.

Abdominal strength and endurance were assessed using the curl-up test. A slow, controlled, rhythmic pace was selected by each participant. This continued until the participant completed 75 repetitions, could no longer continue, or paused for longer than 1 or 2 s between repetitions.

Upper body strength and endurance were assessed using the push-up test. A slow, controlled, rhythmic pace was selected by each participant. This continued until the participant could no longer continue or paused for longer than 1 or 2 s between repetitions.

In addition to the eight physical fitness variables described, exercise knowledge and exercise beliefs were assessed using instruments developed for preadolescents by the Centers for Disease Control and Prevention (9). The paper-and-pencil measures were administered by the students' classroom teacher on a class-by-class basis. As needed, the meanings of questionnaire items were clarified by the classroom teachers, and students' questions were answered. Among adult samples, cognitive variables such as these have been significantly associated with stage of exercise (2, 6, 24, 34). Furthermore, increasing students' knowledge about physical activity and fostering positive beliefs toward physical activity are important goals of school- and community-based health and physical education programs (10, 40).

The *Exercise Facts* written test (Forms A and B, 15 items each) was used to assess students' knowledge (9). The test measures knowledge regarding the effects of exercise on body composition, weight reduction, and cardiorespiratory, muscular, and skeletal systems. A sample item is, "People who are thin don't need to exercise." Response options were *True*, *False*, and *Don't Know*. Scores could range from 0 (low) to 30 (high). The internal consistency of this measure within this sample was acceptable (Cronbach's $\alpha = .68$ [12]).

Exercise beliefs were measured using the 10-item "Beliefs About Exercise" questionnaire (9). This measure assesses a child's beliefs about the possible benefits associated with exercise involvement. A sample item is, "Exercise can help me stay healthy." Responses were measured using a 3-point Likert scale (*Agree*, *Not Sure*, and *Disagree*). Scores could range from 0 (low) to 30 (high). The internal consistency of this measure within this sample was also acceptable (Cronbach's $\alpha = .74$ [12]).

Analysis

Participants were first classified into one of the posited stages of exercise (frequency counts). Then relationships between participants' stage of exercise classification and their demographic characteristics were examined using chi-square (χ^2) tests of association. Next, a between-stage multivariate analysis of covariance (MANCOVA) was performed on the vector of dependent variables (covariates were age and gender). Follow-up univariate analysis of covariance (ANCOVA) were then performed for each dependent variable separately. For these analyses, the experiment error rate was adjusted using the Bonferroni technique (i.e., $.05/10 = .005$). When a significant univariate difference was found, eta-squared (η^2) was calculated and post-hoc contrasts were carried out using the Tukey HSD procedure.

Results

Using the Children's Stage of Exercise Algorithm, participants were classified into the following stages of exercise: 31 (4.6%) were in precontemplation, 33 (4.9%) in contemplation, 21 (3.1%) in preparation, 244 (36.5%) in action, and 340 (50.8%)

in maintenance. As Table 1 shows, significant associations were found between stage of exercise classification and age, gender, and grade level. Between the ages of 5 and 11 years (and first through fifth grades), the percentage of children in the maintenance stage decreased, the percentage in action increased, and those in the other stages remained fairly stable. With regard to gender, girls were more likely to be in the maintenance stage than boys, and boys were more likely to be in the precontemplation stage than girls.

The overall one-way MANCOVA revealed a significant between-stage difference on the vector of dependent variables (Wilks' Lambda [40, 1599] = .81, $p < .001$). Univariate results including adjusted mean scores and post-hoc contrasts for each variate across the stages of exercise are shown in Table 2. The only variable for which significant differences were observed was exercise beliefs. The proportion of variance accounted for by this variable was moderate (i.e., $\eta^2 = .07$).

Table 1 Associations Between Demographic Variables and Stage of Exercise Classification

Variable	Stage of exercise					χ^2_{df}	p
	PreC	Con	Prep	Act	Main		
Gender						9.33	.05
Boys	22	16	8	132	162		
Girls	9	17	13	109	178		
Age (yr)						70.18	.0001
Five	1	0	1	5	8		
Six	3	6	2	20	65		
Seven	8	3	2	28	78		
Eight	9	11	10	49	54		
Nine	5	11	5	58	61		
Ten	5	1	1	63	61		
Eleven	0	1	0	18	10		
Grade level						73.11	.0001
First	4	6	3	23	58		
Second	8	2	2	31	101		
Third	8	10	7	44	54		
Fourth	7	13	9	70	53		
Fifth	4	2	0	73	74		
Race/ethnicity						1.35	.85
Caucasian	27	30	20	204	274		
Other	1	2	1	10	20		

Note. PreC = precontemplation; Con = contemplation; Prep = preparation; Act = action; and Main = maintenance. Cell values are reported as frequencies. Frequency totals do not equal 669 due to missing data.

^aAll χ^2 results should be interpreted with caution, because several cells had expected frequencies < 5.

Table 2 Adjusted Mean Scores and Standard Deviations for Each Variable Across the Stages of Exercise

Variable	Stage of exercise					<i>F</i>	<i>p</i>
	PreC	Con	Prep	Act	Main		
Physical fitness							
PACER laps (#)	18.1 8.7 (28) ^a	22.3 12.6 (31)	18.1 10.2 (21)	19.2 10.9 (212)	20.7 11.8 (288)	1.28	.28
Body fat (%)	19.2 6.3 (27)	17.0 5.0 (32)	18.4 5.8 (21)	18.7 7.0 (206)	18.2 6.4 (292)	0.71	.58
Body mass index (kg/m ²)	17.9 3.1 (27)	15.9 3.8 (32)	18.0 4.2 (21)	17.5 4.0 (209)	17.3 3.1 (289)	1.99	.09
Sit-and-reach Left side (cm)	25.4 6.1 (27)	27.2 4.3 (32)	28.4 5.3 (21)	28.4 5.6 (204)	27.4 5.6 (279)	2.37	.05
Sit-and-reach Right side (cm)	26.4 5.3 (27)	28.2 4.8 (32)	28.4 5.6 (21)	28.7 5.6 (204)	27.9 5.3 (278)	1.23	.30
Trunk extension (cm)	27.2 5.1 (27)	28.7 6.1 (31)	26.9 8.4 (21)	28.7 7.6 (214)	29.0 7.1 (287)	0.80	.53
Curl-ups (#)	11.3 9.3 (27)	19.0 13.9 (31)	18.0 11.5 (21)	18.4 17.4 (206)	18.8 16.6 (284)	1.56	.18
Push-ups (#)	5.6 5.6 (28)	9.1 7.6 (32)	9.6 5.7 (21)	9.7 7.5 (206)	10.1 8.1 (283)	2.49	.05
Cognitive exercise beliefs ^b (0 = low, 30 = high)	23.7 _a 3.8 (30)	23.5 _a 4.1 (31)	25.6 _b 2.9 (21)	25.0 _{a,b} 3.5 (186)	26.5 _b 3.1 (179)	12.62	.001
Exercise knowledge (0 = low, 30 = high)	14.5 4.2 (27)	13.7 3.7 (33)	13.1 3.7 (21)	15.4 4.1 (221)	15.8 4.4 (286)	3.77	.01

Note. PreC = precontemplation; Con = contemplation; Prep = preparation; Act = action; and Main = Maintenance.

^aNumbers in parentheses are frequencies. Frequencies do not total 669 due to missing data.

^bValues sharing a common subscript do not differ significantly ($p > .05$) by Tukey HSD post-hoc contrasts.

Discussion

Using the Children's Stage of Exercise Algorithm, the majority (87.3%) of 5–11-year-old children in this study were classified into the action or maintenance stages of exercise. The remaining children were fairly equally distributed between the preparation (3.1%), contemplation (4.9%), and precontemplation (4.6%) stages. Our finding that most preadolescents are active is consistent with existing data describing children's physical activity and exercise behavior (40).

Girls in the present study were more likely to be in the maintenance stage of exercise compared to boys, and boys were more likely to be in the precontemplation stage of exercise compared to girls. Most studies suggest that boys are more active than girls (36). This apparent inconsistency can only be clarified through more extensive research applying the Children's Stage of Exercise Algorithm and direct measures of physical activity or exercise behavior.

In our sample, beginning in the fourth grade or around 9 years of age, the number of children in the maintenance stage of exercise declined. This decrease was accompanied by an increase in the number of children in the action stage of exercise. While children in the action and maintenance stages of exercise may be equally active, the children in the action stage have not engaged in the behavior as long or consistently as the children in the maintenance stage. Our finding would appear to reflect the early beginnings of a decrease in the *regularity* of physical activity among preadolescent children and perhaps, as Cardinal (6) has described among adult samples, the beginnings of an exercise relapse-resumption cycle.

With age and gender controlled, participants across the stages of exercise only differed on one variable, exercise beliefs. The most pronounced between-stage differences in terms of exercise beliefs were between those in the extreme stages (i.e., precontemplation, contemplation vs. maintenance). Using the procedures outlined by Thomas, Salazar, and Landers (39), the magnitude of the differences observed between these stages was large (d s of .71 and .93, respectively). However, only between contemplation and preparation did adjacent adjusted mean scores differ significantly. The magnitude of this difference was moderate ($d = .57$).

Conceptually, the Children's Stage of Exercise Algorithm developed for use in this study is a theoretically-based instrument that is consistent with stage of change descriptions posited in the Transtheoretical Model. However, the measure failed to differentiate between preadolescents on 9 of the 10 variables studied. There may be four reasons for this. First, the notion of stages of exercise among preadolescents may be inappropriate. That is, the Transtheoretical Model was originally developed to explain adult smoking behavior, alcohol use, and drug addiction (33). While it has successfully been applied to a number of other health behaviors among adult samples (35), it simply may not be appropriate for the study of preadolescents' physical activity and exercise behavior. On the contrary, early prevention strategies directed toward curtailing substance abuse among youths have been designed using the Transtheoretical Model framework (41), and physical education professionals have been encouraged to consider using the model to enhance physical activity and exercise behavior change, promotion, and retention efforts (27).

Second, outcome variables other than those selected for inclusion in this study may better relate to preadolescent's stage of exercise (e.g., direct measures of physical activity). For example, while it is generally agreed that children's physical activity and physical fitness are interrelated, there also appears to be a high

degree of independence between the two attributes (16). In a study conducted by Pate, Dowda, and Ross (30), the relationship between children's 1.6-km run-walk performance and sum of skinfold measurements were at best only moderately related to parent and teacher ratings of physical activity. In a recent paper on the topic, Pangrazi, Corbin, and Welk (28) concluded, "The relationship between activity and fitness is small among children."

Third, on the basis of the adjusted mean scores observed in the present study, it seems that if indeed stages of exercise do exist for preadolescents, perhaps different stages may be more appropriate than those posited in the Transtheoretical Model. Perhaps, too, the conceptual descriptors contained within the Children's Stage of Exercise Algorithm may require modification. Before dismissing the Transtheoretical Model or refining the new measurement instrument, however, future research will be necessary. The Transtheoretical Model has been confirmed in several adult studies (2, 6, 24, 34) and at least one study of high school students (26). Also, the questions developed for inclusion in the Children's Stage of Exercise Algorithm were carefully worded to insure conceptual consistency between the measure and the Transtheoretical Model.

Fourth, while the term *exercise* was described at the student and teacher assembly, a standardized, operational definition was not given on any of the paper-and-pencil inventories used in this study. Thus, the term *exercise* in this study was limited by each child's conceptual understanding of the word. In future studies, we recommend that a standardized, professionally acceptable, and age-appropriate definition of the word *exercise* be provided to the participants (28).

With particular reference to the Children's Stage of Exercise Algorithm, the frequency, regularity, and context of exercise are operationalized in the questions. However, the components of intensity and duration of activity are not accounted for by the measure. As we begin to learn more about children's understanding of the word *exercise* and the context in which children's exercise and physical activity occurs, the phrasing of each question and the measure itself may ultimately be improved. As presented in Figure 1, the measure is written at a fifth-grade reading level (17). Accordingly, when the measure is used with children unable to read or understand material written at this level, the measure should be supplemented with verbal reinforcement, teacher encouragement, and answers to students' questions (all of which were done in the present study).

While we have commented on some limitations of the Children's Stage of Exercise Algorithm, it does appear to have done a fairly decent job of categorizing preadolescent children in terms of activity status. For example, 9.6% of the children in our sample were categorized as being in either the precontemplation or contemplation stages of exercise (i.e., inactive). In the 1992 National Health Interview Survey–Youth Risk Behavior Survey, 8.1% ($\pm 2.4\%$) of 12-year-old children reported no recent vigorous or light-to-moderate physical activity (40). This finding, along with the differences observed between stages of exercise for the belief scores, provides at least modest support for the validity of the measure.

The majority of physical activity interventions designed for children have been conducted through schools and have used Social Cognitive Theory as a conceptual framework (15, 38). Research, however, is lacking on ways to tailor interventions to the needs and interests of children and youths (10, 40). The conceptual framework provided by the Transtheoretical Model has the potential to provide the tailoring quality that appears to have been lacking in previous interventions. The

efficacy of tailored interventions based on the Transtheoretical Model has been demonstrated among adult samples (7, 8, 20). Prior to adopting this framework with children, however, additional research will be necessary.

A particularly attractive quality of a measure such as the Children's Stage of Exercise Algorithm is that it may provide a method for expeditiously characterizing children's exercise and physical activity behavior while simultaneously assessing their behavioral intentions. Following this assessment, prescriptive strategies or protocols may then be matched to a child's stage of exercise. Similar protocols have been developed for use by physicians to counsel adults regarding their physical activity and exercise behavior (32). DuRant and Hergenroeder (14), among others (10, 36), have suggested that this strategy may also be effective with adolescents and preadolescents. In this regard, the present study may serve as a stimulus for additional research on this topic.

While we believe this study offers some new insights regarding childhood physical activity and exercise behavior and the potential role stage of exercise may play, it does have a number of limitations. Most notably, this was a cross-sectional investigation and therefore the temporal sequencing between stage of exercise and the physical fitness and cognitive variables studied cannot be determined. Second, only the stage dimension of the Transtheoretical Model of behavior change was studied. Future research should examine the processes of change as well. Third, while we have speculated about some possible intervention and prescriptive strategies on the basis of the Transtheoretical Model framework, there is no evidence as to the efficacy of these approaches among preadolescents. Fourth, the ethnic and racial diversity of this sample was limited, and all of the participants were residing in one geographic area.

Clearly, additional research is warranted before any definitive statements can be made regarding the construct validity of the Children's Stage of Exercise Algorithm or the notion of stages of exercise among preadolescents. In this regard, the present study should serve as a useful reference point.

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