Self-Determined to Exercise? Leisure-Time Exercise Behavior, Exercise Motivation, and Exercise Dependence in Youth

Danielle Symons Downs, Jennifer S. Savage, and Jennifer M. DiNallo

Background: Scant research has examined the determinants of primary exercise dependence symptoms in youth. Study purposes were to examine sex differences across leisure-time exercise behavior, motivation, and primary exercise dependence symptoms in youth and the extent to which exercise behavior and motivation predicted exercise dependence within the Self-Determination Theory framework. Methods: Adolescents (N = 805; mean age = 15 years; 46% girls) completed measures of exercise behavior, motivation, and exercise dependence in health/PE classes. Results: One-way ANOVA revealed boys scored higher than girls on leisure-time exercise behavior, exercise dependence symptoms, and most of the exercise motivation subscales. Hierarchical regression analyses indicated a) sex, exercise behavior, motivation, and their interaction terms explained 39% of the variance in primary exercise dependence; b) Integrated Regulation and Introjected Regulation were important determinants of exercise dependence; and c) sex moderated the contributions of External Regulation for predicting exercise dependence such that boys in the high and low external regulation groups had higher symptoms than girls in the high and low external regulation groups. Conclusions: These preliminary findings support the controlled dimensions of Integrated Regulation (boys, girls), Introjected Regulation (boys, girls), and External Regulation (boys only) are important determinants of primary exercise dependence symptoms. Keywords: physical activity, adolescent, psychology

While nearly 60% of youth are not sufficiently active, there is nevertheless a small but growing proportion of children who are at risk for developing unhealthy exercise patterns which can lead to poor physical and psychological well-being (e.g., increased risk for injury, illness, eating pathology, depression). Little research, however, has focused on understanding the psychological determinants of excessive exercise, or exercise dependence symptoms, in youth. Exercise dependence is operationalized as a maladaptive pattern of excessive, leisure-time exercise behavior (i.e., in absence of athletic competition training) leading to impairment as manifested by 3 or more of the following symptoms: tolerance, withdrawal, intention effects, loss of control, time, reduction of other activities, and continuance. This conceptualization is based on the Diagnostic and Statistical Manual for Mental Disorders (DSM-IV) criteria for substance dependence. Importantly, clarifying the objective of the exerciser is needed to distinguish between primary (i.e., exercise is an end in itself) and secondary symptoms (i.e., excessive exercise is secondary to eating pathology). Although these DSM-IV criteria provide a framework for understanding exercise dependence symptoms, there is no consensus in the literature for one theory to explain why exercise dependence develops. Thus, several theories have been applied to better understand the determinants of exercise dependence (e.g., General Addiction Theory; Self-Determination Theory). The goal of the present research was to use the framework of Self-Determination Theory to explain the motivational determinants of exercise dependence symptoms in youth. This research is needed to inform interventions aiming to promote healthy exercise patterns during this important developmental phase of life.

We located 2 studies examining psychological determinants of exercise pathology in youth; however, neither were based on Self-Determination Theory. McCabe and Ricciardelli identified strategies to decrease weight as a main predictor of exercise dependence among early, on time, and late maturing boys and girls. McCabe and Ricciardelli also examined the predictors of exercise dependence symptoms in a sample of boys and girls when they were in both 7th and 9th grades. They found that negative affect, body dissatisfaction, and body importance were key determinants of exercise dependence symptoms across both time periods. Another study examining the determinants of exercise dependence among adults using a self-determination...
framework found a low proportion (3%) of the sample met the criteria for exercise dependence. This study also found that most adults were classified as symptomatic (some evidence of symptoms; 59%) or asymptomatic (low evidence of symptoms; 41%); which is consistent with prior research. Symptomatics had higher levels of autonomous (Identified) motivation and more controlling (External and Introjected) regulations compared with asymptomatics. Autonomous (or intrinsic) motivation is the most self-determined type of motivation; individuals voluntarily engage in activities for the pleasure, interest, and satisfaction derived directly from the activity itself. In addition, Identified Regulation mediated the relationship between competence need satisfaction and strenuous exercise behavior for the asymptomatic group. In contrast, for the symptomatic individuals, Introjected Regulation was a marginally significant predictor of strenuous exercise behavior. The authors suggested that the obligation to exercise among this group may be a function of reduced self-determination. However, these assumptions have not been tested or confirmed among youth.

Therefore, the objective of this initial exploratory study was to examine leisure-time exercise behavior, exercise motivation, and primary exercise dependence symptoms among adolescent boys and girls using the theoretical framework of Self-Determination Theory. The purpose was two-fold. The first purpose was to examine sex differences across leisure-time exercise behavior, motivation, and primary exercise dependence symptoms. Although the literature among youth is limited, there is evidence from the adult exercise dependence literature that men report greater symptoms than women. In addition, research suggests that adolescent boys typically engage in more vigorous-intensity activities than girls. Thus, it is possible that this early vigorous activity ‘sets the stage’ for developing primary exercise dependence symptoms as boys transition through puberty to adulthood. Therefore, we hypothesize that boys would report higher levels of leisure-time exercise behavior, greater levels of exercise motivation, and more primary exercise dependence symptoms than girls. The second purpose was to examine the moderating influence of sex on leisure-time exercise behavior and exercise motivation for predicting primary exercise dependence symptoms among adolescents within a self-determination framework. Based on prior research, we hypothesized that more time spent in leisure-time exercise behavior and higher levels of exercise motivation would predict greater exercise dependence symptoms, with leisure-time exercise behavior and motivation being stronger predictors of exercise dependence symptoms among boys than girls.

**Methods**

**Participants**

The participants were 805 high school boys and girls (mean age = 15.13 years, SD = 0.72 years; 54% boys) from 1 high school within a single school district in central Pennsylvania. Participants were in the 9th (62%) and 10th (36%) grades. Most of the participants were Caucasian (83%), followed by Asian American (4%), African American (2%), Hispanic American (2%), and other (9%). In general, this sample of adolescents is representative of the local community population.

**Measures**

**Leisure-Time Exercise Questionnaire (LTEQ).** The LTEQ assesses self-reported mild, moderate, and strenuous leisure-time exercise performed for at least 15 min in a typical week. A weekly PA index in metabolic equivalents is generated with the following formula: (3 × mild bouts) + (5 × moderate bouts) + (9 × strenuous bouts). The LTEQ has been used previously to assess adolescent physical activity and the LTEQ test-retest reliability was reported to be .84.

**Exercise Motivation Scale (EMS).** The EMS assesses autonomous and controlled motivation with the following subscales: a) External Regulation (4 items; eg, “Because other people believe it is a good idea for me to exercise”), b) Introjected Regulation (4 items; eg, “Because I must exercise to feel good about myself”), c) Identified Regulation (4 items; eg, “Because I think exercise allows me to feel better about myself”), d) Integrated Regulation (4 items; eg, “Because it is consistent with what I value”), e) Intrinsic Motivation to Learn (4 items; eg, “For the satisfaction it gives me to increase my knowledge about this activity”), f) Intrinsic Motivation to Accomplish Things (4 items; eg, “For the pleasure of mastering this activity”), and g) Intrinsic Motivation to Experience Sensations (4 items; eg, “For the pleasure it gives me to experience positive sensations from the activity”). The EMS is scored on a 6-point Likert scale ranging from 1 (strongly disagree) to 6 (strongly agree). The reliability of the EMS has been previously established. The internal consistency score for the EMS total was excellent (alpha = .95) and the subscales scores were good (alpha range = .81–.89).

**Exercise Dependence Scale-Revised (EDS-R).** The EDS-R is a 21-item measure of excessive exercise symptoms scored on a 6-point Likert scale ranging from 1 (never) to 6 (always), producing a total score (higher score = more symptoms of primary exercise dependence). The EDS-R consists of the following 7 subscales: Tolerance, Withdrawal, Continuance, Lack of Control, Reduction in Other Activities, Time, and Intention Effects. Examples of EDS-R items include “I spend most of my free time exercising” and “I think about exercise when I should be concentrating on school/work.” The EDS-R is based on the DSM-IV criteria for substance dependence. A total score is generated by summing the individual item scores. Participants can also be descriptively classified with the EDS-R into the following 3 categories: at risk for EDS (scoring 5–6 on the Likert scale on 3 or > subscales), nondependent symptomatic (scoring 3–4 on the Likert scale on 3 or > subscales), or nondependent asymptomatic
scores (scoring 1–2 on the Likert scale on 3 or > subscales). The reliability for the EDS-R has been previously established.4,23 In the current study, the internal consistency score for the total EDS-R was excellent (alpha = .94).

Screening Tool: Body Areas Satisfaction Scale (BASS). BASS is a 9-item subscale of the Multidimensional Body Self Relations Questionnaire that assesses perceived body satisfaction.22 Using a 5-point Likert scale ranging from 1 (very dissatisfied) to 5 (very satisfied), participants are asked to rate their degree of body satisfaction with specified body parts (eg, thighs, face, stomach) as well as their height, weight, and overall muscle tone. The reliability (ie, test-retest of r = .86) and validity of the BASS has been previously established.23,24 The internal consistency reliability alpha for the BASS in the current study was good (alpha = .82). To control for the potential confounding effect of secondary EDS, participants scoring 16 or lower on the BASS were excluded from the analyses based on the assumption that they may have comorbid body dissatisfaction and eating pathology symptoms.25

Design and Procedure

This study was part of a larger longitudinal study assessing health behaviors in youth from 1 high school in a single school district in Central Pennsylvania. The school district includes both rural and suburban communities. The University’s Institutional Review Board and the School District’s Board of Education approved this study. Informed consent was obtained in accordance with university guidelines. Personalized letters with original signatures written on the school’s letterhead sent home to parents were used to request consent.26 The parents giving consent for their child to participate in the study returned the consent form in a sealed envelope to their health/physical education teacher. These forms were then collected by a member of the research team. The response rate was 62.1% (825/1329) which is similar to other studies examining health behaviors in a volunteer sample of youth.27 Participants completed the study measures in their health/physical education class. Completion of the measures took approximately 45 minutes. Students not participating in the study worked quietly on in-class or homework assignments. To control for the confounding effect of possible eating disorder pathology, 20 participants with low BASS effect of eating pathology (ie, second-homework assignments. To control for the confounding of leisure-time exercise behavior and exercise motivation for predicting exercise dependence symptoms. The

Data Analyses

Pearson correlations were used to examine the associations and one-way ANOVA was used to examine sex group differences on the study variables. All statistical tests were conducted with alpha set at .05. A hierarchical regression analysis was used to examine the contributions of leisure-time exercise behavior and exercise motivation for predicting exercise dependence symptoms. The order and content of the blocks of variables were based on previous research28 and regression including sex interaction terms.29-31 The total score for the EDS-R (DV) was regressed on Sex (Block 1), the total LTEQ (Block 2), the EMS subscales (Block 3), and the interaction terms for Sex (eg, LTEQ × Sex) in Block 4. Based on hierarchical regression analyses with multiple predictor variables, a priori power (.80, and alpha .05, adequate power was obtained to conduct these analyses. Examination of the mean scores revealed that the LTEQ data were slightly but not significantly skewed; and thus, the assumption of normal distribution was not violated. The tolerance values, however, revealed multicollinearity among the independent variables (values > .20). To reduce multicollinearity, the variables were centered (ie, subtracting the mean for each predictor variable), which resolved this issue.

Results

Descriptive Prevalence of Exercise Dependence Symptoms

For descriptive purposes, the participants were categorized by level of self-reported symptoms on the EDS-R. In the total sample, the prevalence of symptoms based on the EDS-R classifications among the adolescents was 6% classified as at risk for exercise dependence, 65% as nondependent symptomatic, and 29% as nondependent asymptomatic. Among boys only 8% were classified as at risk for exercise dependence symptoms, 68% as nondependent symptomatic, and 24% as nondependent asymptomatic. Among girls only 4% were classified as at risk exercise dependence, 61% as nondependent symptomatic, and 35% as nondependent asymptomatic.

Correlations for Study Variables by Sex

Pearson correlations were used to examine the associations among the total scores for the EDS-R, LTEQ, and EMS and the EMS subscales for boys and girls (Table 1). Boys who scored higher on the EDS-R Total also scored higher on the LTEQ Total and all of the EMS subscales. Girls who scored higher on EDS-R Total also scored higher on the LTEQ Total and all of the EMS subscales.

Sex Differences Across the Study Variables

Sex group differences were found with boys scoring significantly higher than girls on the total EDS-R, LTEQ, and EMS scores and the EMS subscales: External Regulation, Integrated Regulation, Intrinsic Motivation to Learn, and Intrinsic Motivation to Accomplish Tasks (P < .05; see Table 2). No sex group differences were observed for Introjected Regulation, Integrated Regulation, or Intrinsic Motivation to Experience Sensations (P > .05).
<table>
<thead>
<tr>
<th></th>
<th>LTEQ total</th>
<th>EMS total</th>
<th>ERE</th>
<th>INJ</th>
<th>IDR</th>
<th>IGR</th>
<th>IML</th>
<th>IMA</th>
<th>IMS</th>
</tr>
</thead>
<tbody>
<tr>
<td>EDS-R total</td>
<td>.26**</td>
<td>.33**</td>
<td>.62**</td>
<td>.61**</td>
<td>.46**</td>
<td>.47**</td>
<td>.46**</td>
<td>.51**</td>
<td>.56**</td>
</tr>
<tr>
<td>LTEQ total</td>
<td>.22**</td>
<td>.27**</td>
<td>.10*</td>
<td>.11*</td>
<td>.06</td>
<td>.13*</td>
<td>.20**</td>
<td>.16**</td>
<td>.21**</td>
</tr>
<tr>
<td>EMS total</td>
<td></td>
<td>.67**</td>
<td>.64**</td>
<td>.80**</td>
<td>.77**</td>
<td>.82**</td>
<td>.85**</td>
<td>.91**</td>
<td>.86**</td>
</tr>
<tr>
<td>ERE</td>
<td>.72**</td>
<td>.66**</td>
<td>.34**</td>
<td>.37**</td>
<td>.43**</td>
<td>.47**</td>
<td>.48**</td>
<td>.40**</td>
<td>.32**</td>
</tr>
<tr>
<td>INJ</td>
<td></td>
<td></td>
<td>.54**</td>
<td>.63**</td>
<td>.62**</td>
<td>.70**</td>
<td>.53**</td>
<td>.47**</td>
<td>.55**</td>
</tr>
<tr>
<td>IDR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.85**</td>
<td>.83**</td>
<td>.65**</td>
<td>.62**</td>
<td>.82**</td>
</tr>
<tr>
<td>IGR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.75**</td>
<td>.74**</td>
<td>.86**</td>
</tr>
<tr>
<td>IML</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>.78**</td>
<td>.78**</td>
</tr>
<tr>
<td>IMA</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Abbreviations: EDS-R total, Exercise Dependence Scale-Revised; LTEQ total, Leisure-Time Exercise Questionnaire; EMS total, Exercise Motivation Scale; ERE, External Regulation; IJR, Introjected Regulation; IDR, Identified Regulation; IGR, Integrated Regulation; IML, Intrinsic Motivation to Learn; IMA, Intrinsic Motivation to Accomplish Things; IMS, Intrinsic Motivation to Experience Sensations.
Predicting Exercise Dependence Symptoms

For predicting EDS-R Total, Block 1 (Sex) explained 1% of the variance in EDS-R Total (see Table 3). When LTEQ Total was included in Block 2, an additional 9% of the variance in EDS-R Total was explained, with LTEQ Total emerging as the only significant predictor. When the EMS subscales of External Regulation, Introjected Regulation, Identified Regulation, Integrated Regulation, Intrinsic Motivation to Learn, Intrinsic Motivation to Accomplish Tasks, and Intrinsic Motivation to Experience Sensations were included in Block 3, an additional 28% of the variance in the EDS-R Total was explained. The LTEQ Total maintained its significant contribution, while Integrated Regulation emerged as the strongest EMS subscale predictor followed by Introjected Regulation. An additional 2% of the variance was explained when the interaction terms were included in Block 4. The main effects for LTEQ Total, External Regulation, Introjected Regulation, and Integrated Regulation maintained their significant contributions; however, the interaction term for External Regulation × Sex emerged as the strongest determinant.

To further examine the interaction for External Regulation × Sex, mean tertile splits on the EDS-R were conducted. We examined the high external regulation score for boys (mean = 64.68, SD = 20.99) and girls (mean = 57.10, SD = 19.16) and the low external regulation scores for boys (mean = 50.85, SD = 18.85) and girls (mean = 48.11, SD = 18.82). Figure 1 illustrates the moderating effect of sex such that boys in the high external regulation group and the low external regulation group reported more EDS compared with girls in the high and low external regulation groups.

Discussion

The objectives of this initial exploratory study were to examine a) sex differences across leisure-time exercise behavior, exercise motivation, and primary exercise dependence symptoms, and b) the moderating influence of sex on leisure-time exercise behavior and exercise motivation for predicting primary exercise dependence symptoms among adolescent boys and girls using the theoretical framework of Self-Determination Theory. We found the majority of adolescents displayed some symptoms of exercise dependence. Compared with girls, the boys reported more leisure-time exercise behavior and exercise dependence symptoms and they scored higher on most of the exercise motivation subscales. In addition, Integrated and Introjected Regulation emerged as important motivational determinants of exercise dependence symptoms for both adolescent boys and girls. Finally, sex significantly moderated the contribution of External Regulation for predicting exercise dependence symptoms among adolescents. Several findings warrant further discussion.

Consistent with past research on adult populations, the proportion of youth classified with exercise dependence symptoms was low for boys (8%) and girls (4%). However, it is important to note that the majority (60%) of youth scored within the symptomatic range on the EDS-R. This finding is concerning because it suggests that many adolescents in this sample show early signs of exercise pathology even after controlling for symptoms of eating pathology (ie, participants with high levels of body dissatisfaction were excluded from the analyses). Because the majority of studies measure overall physical activity levels (eg, total min/week)
Table 3  Hierarchical Regression Analyses Predicting the Exercise Dependence Scale-Revised Total Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>$R^2$</th>
<th>$F_{change}$</th>
<th>df</th>
<th>$\beta_1$</th>
<th>$\beta_2$</th>
<th>$\beta_3$</th>
<th>$\beta_4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Block 1</td>
<td>.01</td>
<td>7.32</td>
<td>1, 518</td>
<td>–.12**</td>
<td>–.06</td>
<td>–.03</td>
<td>.02</td>
</tr>
<tr>
<td>Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 2</td>
<td>.10</td>
<td>47.88</td>
<td>1, 517</td>
<td></td>
<td>.30***</td>
<td>.16***</td>
<td>.17***</td>
</tr>
<tr>
<td>LTEQT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 3</td>
<td>.39</td>
<td>33.32</td>
<td>1, 510</td>
<td>.03</td>
<td>.16*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERE</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INJR</td>
<td>.21***</td>
<td>.20*</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDR</td>
<td>–.13</td>
<td>–.16</td>
<td></td>
<td>.27***</td>
<td>.27**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGR</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IML</td>
<td>.12</td>
<td>.05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMA</td>
<td>.09</td>
<td>.20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMS</td>
<td>.04</td>
<td>–.07</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Block 4</td>
<td>.40</td>
<td>1.63</td>
<td>1, 502</td>
<td>–.01</td>
<td>–.32**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LTEQT×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ERE×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>INJR×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IDR×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IGR×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IML×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMA×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IMS×Sex</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* $P < .05$; ** $P < .01$; *** $P < .001$.

Abbreviations: LTEQT, Total score for the Leisure-Time Exercise Questionnaire; ERE, External Regulation; INJR, Introjected Regulation; IDR, Identified Regulation; IGR, Integrated Regulation; IML, Intrinsic Motivation to Learn; IMA, Intrinsic Motivation of Accomplish Things; IMS, Intrinsic Motivation to Experience Sensations.

Figure 1 — Illustration of External Regulation Group × Sex Classification for predicting Exercise Dependence Scale-Revised (EDS-R) total score.
and focus on the proportion of Americans that are not sufficiently active, the population of exercisers with potentially harmful exercise patterns is often overlooked. That is, individuals with primary exercise dependence symptoms are usually classified as “meeting exercise guidelines” or assumed to be “healthy.” However, few, if any epidemiological studies have examined the psychological profiles of adolescent exercisers or those classified as meeting exercise guidelines to better understand the link with exercise dependence symptoms and eating pathology. In this study, we aimed to measure primary exercise dependence symptoms in youth by screening out the participants that had symptoms of secondary exercise dependence symptoms, however, our screening procedure was likely not rigorous enough to capture all of these youth. In other words, some of the boys and girls in this sample may be at the early stages of eating pathology onset, and therefore, identifying how primary exercise dependence symptoms in youth overlap with eating pathology is an important area for future research.

Also as hypothesized and consistent with previous research on adult populations,15 boys scored significantly higher than girls on measures of leisure-time exercise behavior and total exercise dependence symptoms and on most of the dimensions of exercise motivation. The observed sex differences, with boys engaging in more leisure-time exercise behavior than girls, is consistent with prior research.32–35 While researchers have found that adult men score higher than women on exercise dependence symptoms,14,36 there has previously been scant evidence of this pattern in adolescence. Our study is among the first to observe that adolescent boys reported more exercise dependence symptoms than girls. While it has historically been thought that men develop exercise dependence in early adulthood as they hit their peak fitness level,37 our study findings illustrate that primary exercise dependence may be evident at an earlier age. It is possible that compared with girls, boys are more likely to develop primary exercise dependence symptoms because of their greater involvement in leisure-time play, youth sports, and the types of vigorous activities (eg, running, weight lifting) that can perpetuate over-exercising. As a result, they develop a stronger desire to exercise as an end in itself compared with using exercise to control their weight.7 Additional research is needed to examine the longitudinal patterns of youth leisure-time exercise behavior and exercise dependence symptoms to better understand these sex differences.

Moreover, boys scored higher than girls on the motivational subscales of External Regulation, Integrated Regulation, Intrinsic Motivation to Learn, and Intrinsic Motivation to Accomplish Tasks. Pubertal timing may be one explanation for why girls reported lower Exercise Motivation scores than boys. For example, there is evidence that earlier maturing girls may be less likely to report exercise motivation because they are less physically active than adolescent boys.38 Also, McCabe and Ricciardelli11 found that early pubertal timing was more likely associated with greater exercise dependence symptoms than on-time and late pubertal timing both for boys and girls. One explanation for these contrasting findings for sex differences on exercise dependence symptoms may be due to the fact that McCabe and Ricciardelli11 did not distinguish primary from secondary exercise dependence. Thus, the influence of pubertal timing on primary and secondary exercise dependence symptoms warrants further investigation.

Also as predicted, more time spent in leisure-time exercise behavior and higher levels of exercise motivation significantly predicted greater primary exercise dependence symptoms; however, the significant contributions of the motivational constructs were slightly different for boys and girls. Similar to the findings of Duncan and colleagues,39 while Integrated Regulation was the strongest determinant of primary exercise dependence symptoms followed by Introjected Regulation and leisure-time exercise behavior for both boys and girls, External Regulation emerged as a significant predictor for boys only. The contribution of Integrated Regulation for predicting primary exercise dependence symptoms in youth in this study illustrates that exercise is an important part of their identity and it is consistent with their personal values. Duncan et al39 suggested that people are more likely to engage in greater exercise frequency/duration when exercise is part of their identity. Over time, this pattern of higher exercise volume may lead to elevated primary exercise dependence symptoms which are consistent with the high proportion of adolescents in this study who were symptomatic. Several factors have been shown to facilitate higher leisure-time exercise behavior in youth including the influence of parents.40 For example, some types of parental support have been positively associated with children’s physical activity including direct support (eg, facilitating activity via transportation),41 serving as models (eg, active parents),42 and emotional support.43,44 These collective factors may facilitate leisure-time exercise behavior to be a central part of children’s identity, and thus, efforts to identify unhealthy exercise identity and other moderating influences of exercise dependence symptoms may be needed.

Moreover, Introjected Regulation, a non-self-determined form of controlled motivation, was also a significant determinant of primary exercise dependence symptoms in boys and girls. According to prior research in adults,39 intense exercise may be driven more by a sense of obligation to exercise rather than personally significant motives. Similarly for predicting primary exercise dependence, particularly among women, even if they do not enjoy intense or long bouts of leisure-time exercise behavior, they may exercise because they feel that they should.39 This finding suggests that among adolescent boys and girls, leisure-time exercise behavior that is performed to avoid guilt or to increase pride is a determinant of exercise dependence. This is important because introjected behavior has been linked to pathology which draws comparisons to obligatory running and anorexia nervosa.45 This is particularly important during adolescence when adverse signs of excessive exercise (eg,
chronic injuries, illness, depression) may have short and long-term health consequences.

Lastly, a significant moderation effect for sex was observed for the association between External Regulation and exercise dependence symptoms. That is, External Regulation influenced exercise dependence to a greater extent for boys than girls. One explanation for this finding may be that parental encouragement is also an important aspect of External Regulation for boys. For example, a recent study by Savage and colleagues\textsuperscript{46} found that boys reported greater encouragement for physical activity from their fathers than from their mothers, and this greater encouragement from fathers predicted greater body satisfaction and physical activity among the boys but not the girls. This past evidence in combination with the current study findings suggests that boys may have more controlled motivation for physical activity than girls. On one hand, controlled motivation and parental encouragement may facilitate more leisure-time exercise behavior in boys. However, on the other hand, it is possible that external motivators (parental encouragement) may also inadvertently increase the risk for exercise dependence, particularly for boys. This interpretation, however, should be taken with some caution since we did not measure parent encouragement for physical activity in the current study. Future research is needed examining the complex interactions of the personal and environmental factors of youth leisure-time exercise behavior and the onset of potential exercise dependence symptoms during this phase of life.

While this study has contributed to the literature by better understanding the determinants of EDS and it is one of the first studies to examine the extent to which leisure-time exercise behavior and motivation predicted exercise dependence symptoms in youth, there are some study limitations. The study participants are largely homogeneous (eg, middle-class, non-Hispanic White from Central Pennsylvania); and thus, the study findings may not be easily extrapolated to youth from more diverse ethnic and income backgrounds. Research is needed examining the moderating influence of demographic factors (eg, race, income) on our study findings. In addition, the study assessments were obtained from self-report measures which are at risk for the influence of social desirability. These measures have also not been extensively validated with youth, and thus, this is an area of future research. We also did not assess pubertal development or parental influence, both of which warrant future investigation in context of exercise dependence symptoms. Lastly, due to the scant research examining the motivational determinants of exercise dependence symptoms among youth, these study findings are preliminary and our conclusions should be taken in this context. Future studies are warranted to test and confirm our study findings before more definitive conclusions can be made.

In summary, while the rate of primary exercise dependence symptoms in boys and girls was low, we found evidence that boys engage in more leisure-time exercise behavior, have stronger exercise motivation, and have greater exercise dependence symptoms than girls. Of particular interest, the controlled dimensions of Integrated Regulation (boys and girls), Introjected Regulation (boys and girls), and External Regulation (boys only) were important predictors of primary exercise dependence symptoms. Because exercise motivation and behavior are primary targets for intervention in adolescents, it is important to acknowledge that these factors may also facilitate excessive exercise in some youth; therefore warranting attention in preventive interventions.

Acknowledgments

We would like to acknowledge Drs. Guy LeMasurier, George Graham, and Sandy Bargainnier, and Stephen Yang, Jay Vasil, Margie Swoboda, and the students, parents, administrators, teachers, and staff from State College Area School District in State College, PA for their assistance with this study.

References


