

# Mood and Ambulatory Monitoring of Physical Activity Patterns in Youth with Polycystic Ovary Syndrome



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## ABSTRACT

**Study Objective:** To provide initial insight into physical activity patterns and predictors of moderate to vigorous physical activity (MVPA) in youth with polycystic ovary syndrome (PCOS) by using a multisensor activity monitor.

**Design:** Cross-sectional study analyzing baseline MVPA data using real-time continuous monitoring of physical activity. Body mass index (BMI) and depressive symptoms were examined as predictors of MVPA.

**Setting:** A large, urban children's hospital in the United States.

**Participants:** Thirty-five youth (aged 12 to 21 years) previously diagnosed with PCOS (mean BMI = 38.0 kg/m<sup>2</sup>; mean age = 15.4 years, 79% white) who were participants in a behavioral lifestyle intervention.

**Main Outcome Measures:** Total steps, total MVPA, longest continuous bout of MVPA, and frequency of MVPA bouts lasting for 5 to 9 minutes and 10 or more minutes.

**Results:** Sixty percent of youth averaged at least 1 daily MVPA bout lasting 10 or more minutes, and 14% averaged a daily MVPA bout lasting 30 or more minutes. BMI was negatively correlated with MVPA bout duration ( $P = .04$ ). Parental ratings of depression, but not self-report ratings, were predictive of participants' total MVPA ( $\beta = -.46$ ;  $P = .01$ ), number of 5- to 9-minute bouts ( $\beta = -.39$ ;  $P = .03$ ), and bouts of 10 or more minutes ( $\beta = -.35$ ;  $P = .05$ ).

**Conclusion:** Youth with PCOS may benefit from being prescribed multiple bouts of MVPA lasting less than 30 continuous minutes to meet national recommendations and achieve health benefits. BMI and parental endorsement of child's depression symptoms may be important to consider when assessing and prescribing MVPA to youth with PCOS.

**Key Words:** Polycystic ovary syndrome, Physical activity, Obesity, Depression, Ambulatory monitoring

## Introduction

Polycystic ovary syndrome (PCOS) is a common endocrine disorder among females of reproductive age, and typical symptoms include hyperandrogenism, anovulation, irregular menstrual periods, and infertility.<sup>1</sup> Although not formally part of the diagnosis for PCOS, females with PCOS also frequently present with co-occurring obesity and depressive symptoms.<sup>2</sup> Excess body weight among youth with PCOS has been independently related to increased risks for metabolic syndrome and type 2 diabetes mellitus.<sup>3,4</sup> Moreover, depressed females with PCOS have been shown to have greater insulin resistance and body mass index (BMI) than nondepressed females with PCOS.<sup>5</sup> Depression among clinical samples has also been shown to increase risk for noncompliance to a medical treatment regimen.<sup>6</sup>

Participation in regular physical activity has been shown to contribute to weight loss and reduce symptoms of

depression,<sup>7</sup> yet research on physical activity as a therapeutic tool for youth with PCOS is lacking. Using self-report methods, youth with PCOS have been shown to participate in structured physical activities less often and at a lesser intensity than BMI-matched youth without PCOS.<sup>8</sup> However, an overall, objective picture of physical activity, structured and unstructured, among youth with PCOS is missing. Knowledge about how often youth with PCOS initiate a physical activity bout and how long the bout of physical activity is sustained could provide key information for providers about how to appropriately prescribe and tailor activity interventions. Furthermore, understanding the role of obesity and depression in physical activity initiation and duration should also not be ignored because both are often comorbid with PCOS and proven barriers to physical activity engagement.<sup>9,10</sup>

The present study included pilot data on a unique sample of youth with PCOS who completed ambulatory monitoring of physical activity as part of a larger-scale behavioral lifestyle intervention. The primary aim of the current study was to examine physical activity patterns among youth with PCOS using novel methodology that samples physical activity in youths' natural environment and provides real-time, objective physical activity monitoring. The secondary aim was to examine BMI and depressive symptoms as independent predictors of physical activity in youth with

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PCOS. Based on previous research, we hypothesized that there will be an inverse relationship between BMI and physical activity outcomes. Additionally, we hypothesized that higher ratings of depressive symptoms, as measured by self-report and parent report, would predict lower total physical activity and shorter durations of continuous physical activity bouts.

## Materials and Methods

The university's institutional review board approved all study procedures. Participants were youth (aged 12 to 21 years) with PCOS who were recruited at routine PCOS or adolescent medicine clinic visits at a large, urban children's hospital in the United States. Informed consent was obtained from all participants after the procedures were explained to them. Assent and parental consent were obtained for participants under age 18 years. All procedures followed were in accordance with the ethical standards of the responsible committee on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2000. Informed consent was obtained from all patients for being included in the study.

The sample included 35 females who were a subset of individuals enrolled in a larger-scale intervention that used cognitive-behavioral therapy and motivational interviewing to assist with changes in physical activity, nutrition, and mood (Healthy Bodies, Healthy Minds).<sup>11</sup> As part of the intervention, participants met with a lifestyle coach for 11 sessions, including 4 weekly, 4 biweekly, and 3 monthly sessions. Parents were invited to participate in sessions 1, 4, and 8. Data collected from baseline measures of physical activity, mood, and BMI were used in the current study.

The age of each participant was obtained from the medical record, and BMI percentile was calculated using baseline height and weight and nationally recommended age-adjusted guidelines.<sup>12</sup> Participants rated their baseline depressive symptoms using the Child Depression Inventory (CDI). Parent ratings of their child's depression were also collected given that they were accessible as part of the intervention. All except 1 parent ( $n = 34$ ) was available to rate their child's depressive symptoms using the Child Depression Inventory–Parent Version (CDI-P).<sup>13</sup>

Physical activity was measured by having participants wear the Body Media SenseWear Pro armband (Body Media, Inc, Pittsburgh, PA), which includes a multisensor system and allows for continuous ambulatory monitoring of activity. To collect multiple data points across days, physical activity data are averages collected on 1 weekday and 1 weekend day during the second week of the lifestyle intervention. Youth who wore the armband for 75% or more of each 24-hour monitoring period were included in the analyses. Physical activity outcomes included: total steps, total moderate to vigorous physical activity (MVPA; activity =  $\geq 3.0$  metabolic equivalents), and longest continuous bout of MVPA. Consistent with previous research examining physical activity duration in youth,<sup>14</sup> frequency of bouts lasting for 5 to 9 minutes and for 10 or more minutes were also measured to examine preferred durations of physical activity.

All analyses were completed using Statistical Package for the Social Sciences (SPSS, version 21.0). Descriptive information and frequencies were examined for all study variables. Pearson correlations were used to examine relationships between participant age, BMI, depressive symptoms, and physical activity outcomes. Linear regression analyses were then used to examine baseline BMI and depressive symptoms as predictors of physical activity outcomes. Separate regression models were run with the following outcome variables: total steps, total MVPA, longest continuous bout of MVPA, number of 5- to 9-minute bouts, and number of 10-minute or longer bouts. Baseline BMI and child and parent depression scores were entered into each regression model in a stepwise fashion. All predictor variables were centered prior to being entered into the regression models. Because age was not significantly correlated with physical activity outcomes, it was not included in the regression models.

## Results

Baseline age, BMI, and depressive symptoms for the sample are shown in Table 1. Participants were on average 15.4 years old and white (79%), with an average BMI of 38.1 kg/m<sup>2</sup> and BMI percentile of 95.7%. The majority of youth (32 patients) were overweight (BMI  $\geq 85$ th percentile). Most youth rated themselves as having a moderate depression risk score (mean = 16.4), while average parent ratings (mean = 18.4) were indicative of a moderate and slightly higher risk for depression.

Table 1 also displays average daily physical activity totals for the sample. On average each day, participants took 8110 steps and participated in 88.1 minutes of total MVPA. When the longest bout of MVPA was examined per day, participants averaged 15.9 minutes of continuously accumulated MVPA. Overall, 30 participants (85.7%) averaged at least 1 daily bout lasting 5 to 9 minutes, and 21 participants (60%) averaged at least 1 daily bout lasting 10 or more minutes. On further exploration, only 5 (14%) participants averaged a daily continuous MVPA bout lasting 30 or more minutes.

Table 2 displays correlations between age, BMI, depression ratings, and physical activity outcomes. BMI was significantly negatively correlated with longest MVPA bout ( $r = -35$ ;  $P = .04$ ) but not significantly correlated with other

**Table 1**  
Descriptive Characteristics of the Sample

	n	Mean	Minimum	Maximum
Baseline ratings				
Age (yr)	35	15.4	12	21
BMI (kg/m <sup>2</sup> )	35	38.1	21.7	69.3
BMI percentile	35	95.7	54.6	99.7
CDI	35	16.4	2	33
CDI-P	34	18.4	1	38
Average daily physical activity				
Total steps	35	8,110	1.5	13,188
Total MVPA (min)	35	88.1	0	250
Longest bout of MVPA (min)	35	15.9	0	50.5
Total 5- to 9-min bouts	35	3	0	11
Total $\geq 10$ -min bouts	35	1.5	0	6.5

BMI, body mass index; CDI, Child Depression Inventory; CDI-P, Child Depression Inventory–Parent Version; MVPA, moderate to vigorous physical activity ( $\geq 3.0$  metabolic equivalents).

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