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Mood and Ambulatory Monitoring of Physical Activity Patterns in Youth with Polycystic Ovary Syndrome (PCOS)

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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) using a multi-sensor activity monitor.

Design—Cross-sectional study analyzing baseline MVPA data using real-time continuous monitoring of physical activity. 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 (ages 12-21) previously diagnosed with PCOS (mean BMI: 38.0 kg/m^2, 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 5-9 minutes and ≥10 minutes

Results—Sixty percent of youth averaged at least one daily MVPA bout lasting ≥ 10 minutes, and 14% averaged a daily MVPA bout lasting ≥ 30 minutes. BMI was negatively correlated with MVPA bout duration ($p = 0.04$). Parental ratings of depression, but not self-report ratings, were predictive of participants' total MVPA ($\beta = -0.46$; $p = 0.01$), number of 5-9 minute bouts ($\beta = -0.39$; $p = 0.03$), and bouts ≥ 10 minutes ($\beta = -0.35$; $p = 0.05$).

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Conclusions—Youth with PCOS may benefit from being prescribed multiple bouts of MVPA lasting <30 continuous minutes in order 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.

Keywords

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[1]. Although not formally part of the diagnosis for PCOS, females with PCOS also frequently present with co-occurring obesity and depressive symptoms.[2] Excess body weight among youth with PCOS has been independently related to increased risks for metabolic syndrome and type 2 diabetes mellitus.[3, 4] Moreover, depressed females with PCOS have been shown to have greater insulin resistance and BMI than non-depressed females with PCOS.[5] Depression among clinical samples has also been shown to increase risk for non-compliance to a medical treatment regimen.[6]

Participation in regular physical activity has been shown to contribute to weight loss and reduce symptoms of depression,[7] 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.[8] 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.[9,10]

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 polycystic ovary syndrome (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 (ages 12-21) 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.

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).[11] 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.[12] 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 but one parent (n = 34) was available to rate their child's depressive symptoms using the Child Depression Inventory-Parent Version (CDI-P).[13]

Physical activity was measured by having participants wear the Body Media SenseWear Pro armband (Body Media, Inc., Pittsburgh, PA), which includes a multi-sensor system and allows for continuous ambulatory monitoring of activity. In order to collect multiple data points across days, physical activity data are averages collected on one weekday and one weekend day during the second week of the lifestyle intervention. Youth who wore the armband for ≥ 75% 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 ≥ 3.0 metabolic equivalents), and longest continuous bout of MVPA. Consistent with previous research examining physical activity duration in youth,[14] frequency of bouts lasting for 5-9 minutes and ≥10 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 5-9 minute bouts, and number of ≥10 minute 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, White (79%), with an average BMI of 38.1 kg/m^2 and BMI percentile of 95.7%. The majority of youth (n = 32) were overweight (BMI ≥ 85th 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 8,110 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 one daily bout lasting 5-9 minutes, and 21 participants (60%) averaged at least one daily bout lasting ≥ 10 minutes. Upon further exploration, only five participants (14%) averaged a daily continuous MVPA bout lasting ≥ 30 minutes.

Table 2 displays correlations between age, BMI, depression ratings, and physical activity outcomes. BMI was significantly negatively correlated with longest MVPA bout (r = −0.35; p = 0.04) but not significantly correlated with other physical activity outcomes. Self-ratings of depressive symptoms were not significantly correlated with physical activity outcomes. However, parental ratings of youth's depressive symptoms were inversely correlated with total minutes of MVPA (r = −0.46; p < 0.01), number of 5-9 minute bouts (r = −0.39; p = 0.02), and number of bouts ≥ 10 minutes (r = −0.35; p = 0.04).

Regression analyses showed that BMI was predictive of the longest bout of MVPA (β = −0.37; p = 0.04; f^2 = 0.16) but not other MVPA outcomes. Parental ratings of youth depressive symptoms were predictive of total MVPA (β = −0.46; p = 0.01, f^2 = 0.27), number 5-9 minute bouts (β = −0.39; p = 0.02, f^2 = 0.18), and bouts ≥ 10 minutes (β = −0.35; p = 0.04, f^2 = 0.14) but not of total steps or longest bout of MVPA. Interactions between demographic variables and predictor variables were not significantly predictive of MVPA outcomes.

Discussion

This study provides initial insight into physical activity patterns and predictors of physical activity for youth with PCOS. Given the small sample size, findings from the current study should be considered preliminary, yet are informative given the moderate to large effect sizes.

The primary aim of the present study was to investigate physical activity patterns among youth with PCOS using novel methodology. The main finding was that most youth with PCOS participated in at least a ten-minute bout of MVPA each day in the context of an activity intervention. Overall, youth showed a preference for bouts of activity lasting at least

5-10 minutes and less than 30 minutes. Additionally, total average minutes of daily MVPA were greater than minimum nationally recommended guidelines for children (ages 6-17 years; 60 minutes daily) and adults (≥18 years; average 150-300 minutes per week).[15] Further confirmation of the current findings would support the idea of tailoring future activity interventions for youth with PCOS to include multiple periods of activity in order to meet daily national recommendations for MVPA. The current findings also highlight the need to understand the minimal duration of MVPA bouts in order to confer health benefits for youth. National guidelines for adults recommend periods of physical activity lasting at least 10 minutes, yet there is no minimally recommended duration of activity bouts for individuals younger than 18 years.[15]

Body weight and the duration of a physical activity bout were inversely related in the current study, which is interesting in light of the fact that most participants were overweight or obese. Thus, even within the overweight and obese body weight range it is possible that the severity of obesity affects how long youth choose to be physically active. Although the current findings do not allow for understanding the mechanism of how body weight is related to activity duration, existing research suggests that physical fitness may influence the relationship between BMI and physical activity.[16] Additionally, because regular participation in physical activity has been shown to improve fitness over time, there is further reason that youth may especially benefit from gradually incorporating short bouts of physical activity in order to build endurance for longer bouts.

Consistent with previous work suggesting parents are the primary agents for youth behavior change,[17] we found that parents may play an important role in physical activity promotion. Specifically, when parents reported greater youth depression symptoms youth showed poorer participation in MVPA. Participants' self-reported depression symptoms were not significantly associated with physical activity participation. Taken together, parental insight and assessment may be a key factor when identifying youth depressive symptoms as a barrier to participation in physical activity interventions. Research from our larger sample of youth with PCOS showed that over the course of an intervention parents' baseline self-report of their own motivation at baseline predicted reduction in youth's BMI; however, adolescent's baseline self-report of their motivation at baseline did not predict positive change.[18] Future interventions may benefit from addressing co-occurring depressive symptoms as a barrier to participation in MVPA. Additional work may also benefit from understanding if there are mediators and moderators of the relationship between parent report and child behavior, such as child's age, child's severity of depression, and maternal depression status.

Further understanding of the patterns and predictors of physical activity across childhood and young adulthood will likely inform health promotion and intervention. Additionally, for youth with PCOS it also may be important to further understand physiological factors that influence participation in MVPA. Limitations of the study include a small sample of females only (due to the nature of PCOS) and use of time points only at the beginning of the intervention. Future research should utilize multiple time points in order to further understand the bidirectional relationship between mood and activity. Strengths of the study include novel methods that objectively measure physical activity in youth and young adults

with physical and mental health profiles that put them at risk for sedentary behavior. The present findings contribute to the larger research literature by identifying factors that may influence physical activity participation for youth and young adults as well as possible methods of tailoring future physical activity interventions.

Informed Consent

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.

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Table 1

Descriptive Characteristics of the Sample

	n	Mean	Minimum	Maximum
Baseline Ratings				
Age (years)	35	15.4	12	21
BMI (kg/m^2)	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 (minutes)	35	88.1	0	250
Longest bout of MVPA (minutes)	35	15.9	0	50.5
Total 5-9 minute bouts	35	3	0	11
Total ≥ 10 minute 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 (≥ 3.0 metabolic equivalents)

Table 2

Correlations between study variables and physical activity outcomes

	Age	BMI	BMI percentile	CDI	CDI-P
Total Steps	0.00	−0.07	−0.01	0.00	−0.28
Total MVPA	−0.13	−0.12	0.02	−0.14	**−0.46****
Longest bout of MVPA	−0.04	**−0.35***	−0.23	−0.20	−0.16
Total 5-9 minute bouts	−0.10	−0.11	0.06	0.01	**−0.39***
Total ≥ 10 minute bouts	−0.22	−0.04	0.13	0.03	**−0.35***

* $p < 0.05$,

** $p < 0.01$

BMI: Body mass index; *CDI:* Child Depression Inventory; *CDI-P:* Child Depression Inventory – Parent Version; *MVPA:* moderate to vigorous physical activity (≥ 3.0 metabolic equivalents)