Effects of High-Intensity Interval Training on Body Composition in Individuals with Polycystic Ovary Syndrome

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ABSTRACT
This study aimed to investigate the effects of a high-intensity interval training (HIIT) program on body composition between individuals with and without polycystic ovary syndrome (PCOS). PCOS patients have a difficult time maintaining healthy body composition. With time being a significant factor determining exercise adherence, it is vital to observe short-term training programs for any possible effect on health measures. Four participants with PCOS (21.3y ± 1.05) and six participants without PCOS (21.2y ± 1.34) volunteered to participate. All participants performed a three-week HIIT program consisting of three HIIT workouts per week. The participants submitted a 24-hour dietary recall and a self-recorded video of workout completion. Body composition was measured using dual-energy x-ray absorptiometry (DXA) and waist circumference (WC) measurements were taken. Results showed no significant difference in total body fat percentage after the three-week exercise treatment in either group (Pre: 41.73% ± 11.228; 38.25% ± 3.729, Post: 41.10% ± 10.885; 38.48% ± 4.167, p=.119). However, there was a significant difference in gynoid fat mass loss in the PCOS group post treatment (Pre: 44.4%± 9.95, Post: 43.7% ± 10.09, p=.002). Although a three-week HIIT program showed no significant impact on body composition in participants with PCOS, longer exercise periods need to be investigated to determine changes in fat mass loss within this population.

KEY WORDS: Body composition changes, exercise, interval training, fat loss

INTRODUCTION
Polycystic ovary syndrome (PCOS) is a metabolic disorder of the ovaries that affects 6% to 12% of women in the United States during their reproductive years (3). It is the leading cause of infertility but may also lead to other health issues such as diabetes, heart disease, hypertension, and stroke. Symptoms of PCOS include higher levels of androgens, which can cause acne, irregular periods due to a halt in the ovulation process, and excessive hair growth due to an increase in testosterone levels (3). There is no set cause for this disorder but there are signs that can assist in diagnosing someone with PCOS. Being overweight could be a contributing factor, as well as family history of type 2 diabetes or a resistance to insulin (3). In individuals with PCOS, increasing physical activity is highly recommended to lose total body fat and possibly decrease the risk of developing type 2 diabetes (3).
Although someone may be physically active and keep a healthy diet, it can be difficult to lose weight in PCOS individuals. High-intensity interval training (HIIT) could be a method to improve body composition parameters in these individuals. HIIT exercise protocol typically consists of high intensity exercise for short bouts, usually around 20 to 30 seconds, followed by a rest period in between each exercise. Since HIIT is a vigorous exercise program, the length of each workout requires a short duration and a frequency of no more than three times a week to be effective, which is appealing to many people (2). Other benefits include lower insulin resistance, enhanced skeletal muscle fat oxidation, and improvements in glucose tolerance. A pilot study conducted by Almenning et al. (2015) showed this type of exercise to be an effective way to reduce subcutaneous and abdominal body fat compared to other types of exercises which may be a beneficial way for individuals with PCOS to reduce body fat more effectively (1). The authors used a ten week program and saw decreases in insulin resistance without a loss of body weight. They also observed a slight decrease in fat percentage with the HIIT protocol.

The aim of this study was to investigate the effects of HIIT on body composition between individuals who have diagnosed PCOS and their healthy counterparts. The shortened treatment time of three weeks was chosen to determine if a shorter exercise protocol would begin to show improvements in body composition. Therefore, we propose that a three-week HIIT program may be advantageous for fat loss in individuals who present with PCOS.

Methods

Participants

The participants met the criteria that included females between the ages of 18-25 years. Each participant completed a Physical Activity Readiness Questionnaire (PAR-Q+) and a health history questionnaire to assure that they were cleared for exercise. An Institutional Review Board (IRB) approved informed consent form was signed prior to testing. Participants were recruited by verbal communication and through social media outlets. Participants who did not yet have a diagnosis of PCOS, yet had the signs and symptoms, were not included. This research was carried out fully in accordance to the ethical standards of the International Journal of Exercise Science (4).

Protocol

At the initial baseline testing session, resting blood pressure and heart rate were taken after a five-minute resting period. A portable, automatic, clinical wrist blood pressure monitor was used to measure blood pressure and heart rate (Generation Guard, Miami, Fl). Height and weight were measured to calculate BMI (kg/m²). Height and weight were measured using an eye level beam scale (Detecto Webb City, Missouri). Waist circumference was measured using a standard double scale soft tape measure. Following waist circumference measurements, a dual-energy x-ray absorptiometry (DXA) (GE Healthcare, Waukesha, WI) was used to measure body composition. After baseline data was collected, a three-week HIIT program was prescribed to the participants. The program was assigned to be completed three days a week with a rest day in between. Each exercise session was monitored by video submissions. Intensity was set at 7 METs (metabolic equivalent of tasks). Duration of exercise during the first week was set at 15 minutes per session, and subsequently increased 5 minutes each week. Total exercise time per week was 45/60/75 minutes respectively. Total exercise program MET-mins equaled 1,440. Prior to each workout, a 24-hour dietary recall sheet was filled out. The time eaten, the food eaten, and the amount eaten was recorded. A diet app (Lose-It!, Boston, MA) was utilized to assess the subject's 24-hour dietary recalls. After completion of the three-week HIIT program, the participants returned for final measurements. The same measurements taken at baseline were repeated.

Statistical Analysis

Statistical analysis was completed using IBM-SPSS v. 25 for Windows (Armonk, NY). A Mixed Design ANOVA and paired-samples t-test were used and data was expressed as means (M) and standard deviation (SD). Significance was set a-priori at p<.05.
RESULTS

Subject characteristics can be found in Table 1. There were no significant differences between age, height, weight, BF%, or BMI in individuals with and without PCOS at the beginning of the study (p>.05). Body composition measures and weekly caloric intake were analyzed comparing before and after the three-week HIIT program. When compared to baseline, total BF% was not found to be significantly different between groups (p=.119). Neither group were found to have significant differences in the post exercise measures (Figure 1).

Total body weight was not significantly different for either group post exercise treatment. For the PCOS group, total body weight decreased 0.1 kg (Pre: 78.6± 20.2, Post: 78.5± 18.92, p=.876) while the without PCOS group gained 0.3 kg (Pre: 72.5± 11.13, Post: 72.8± 11.48, p=.463). Lean body mass (kg) amounts for the PCOS group (Pre: 43.1 ±7.85, Post: 43.6 ±7.02, p=.291). Lean body mass (kg) for the without PCOS group (Pre: 43±5.5, Post: 43±5.66, p=.917).

<table>
<thead>
<tr>
<th>Table 1. Subject Characteristics.</th>
<th>PCOS</th>
<th>w/o PCOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>21.3 ± 0.54</td>
<td>21.2 ± 1.34</td>
</tr>
<tr>
<td>Height (cm)</td>
<td>169.4 ± 8.96</td>
<td>158.9 ± 15.74</td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>78.4 ± 19.43</td>
<td>72.6 ± 11.31</td>
</tr>
<tr>
<td>BF%</td>
<td>41.7 ± 11.23</td>
<td>38.3 ± 3.76</td>
</tr>
<tr>
<td>BMI</td>
<td>27.5 ± 7.15</td>
<td>27.4 ± 4.82</td>
</tr>
<tr>
<td>Android fat mass (%)</td>
<td>44.1± 15.71</td>
<td>36.4± 8.73</td>
</tr>
<tr>
<td>Gynoid fat mass (%)</td>
<td>44.4± 9.95</td>
<td>41.7± 3.43</td>
</tr>
</tbody>
</table>

Data are presented as mean ± SD.

PCOS, polycystic ovary syndrome; w/o PCOS, without polycystic ovary syndrome; BF%, body fat percentage; BMI, body mass index.

Figure 1. Changes in BMI and total body fat percentage.

Examining body composition measures obtained from DXA scans, the gynoid fat % measure within the PCOS group was found to be significantly different after the three-week exercise period (Pre: 44.4 ± 9.95, Post: 43.7 ± 10.09, p=.002). The android fat % measure in the PCOS group showed a decrease in fat percentage post treatment, however did not show a significant difference between time periods (Pre: 44.1 ± 15.71, Post: 42.3 ± 15.99). No significant differences were seen between groups in the gynoid or android measures (p=.137; p=.066)(Figure 2).
Figure 2. Changes in android and gynoid fat percentages. * p= .002

There was no significant difference between participant’s caloric intake each week (p>.05). Energy balance data can be found in Table 2.

Table 2. Reported and Estimated Caloric Intake and Expenditure.

<table>
<thead>
<tr>
<th></th>
<th>PCOS</th>
<th>w/o PCOS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weekly Caloric Expenditure (kcal)</td>
<td>12,118</td>
<td>11,970</td>
</tr>
<tr>
<td>Weekly Caloric Intake (kcal)</td>
<td>11,389</td>
<td>13,036</td>
</tr>
<tr>
<td>Weekly Exercise Expenditure (kcal)</td>
<td>576</td>
<td>533</td>
</tr>
<tr>
<td>Total Exercise Calories (kcal)</td>
<td>1,728</td>
<td>1,599</td>
</tr>
<tr>
<td>Total Predicted Weight Change (lbs)</td>
<td>-0.62</td>
<td>0.91</td>
</tr>
</tbody>
</table>

PCOS, polycystic ovary syndrome; w/o PCOS, without polycystic ovary syndrome; kcal, kilocalories; lbs, pounds.

DISCUSSION

After the three-week HIIT program, BMI and total BF% were not found to be significantly different in either groups with or without PCOS. A slight decrease in total BF% was observed (0.6%) in the PCOS population only, which equates to 1.2 lbs. This correlates with the significant decrease (0.7%) in gynoid fat percentage seen in the PCOS group post treatment. With the estimated energy balance, it was determined that the PCOS group would have lost 0.62 lbs over the three week period. Lean body mass in the PCOS group increased 1.1 lbs after treatment, based on DXA results. As total body weight remained steady over the three-week period, the decrease in gynoid fat mass percentage and subsequent increase in lean body mass could be contributed primarily to the activity of the HIIT program in the PCOS participants. It was also observed that the android fat mass percentage decreased 1.8% in the PCOS group, however this was not a significant finding according to our statistical analysis.

As diet was not a controlled factor, the varying daily caloric intakes of the participants could have played a role in the body composition outcomes. In addition to the difference in the WCI between the participants with and without PCOS, the caloric intake of each participant each week was not consistent. A controlled diet among the participants would increase the strength of the results.

According to the participants’ energy balance reports, we estimated outcomes of the three week program. In the PCOS participants, we did not see any significant body weight change after the exercise intervention. In the individuals without PCOS, we saw a gain of 0.7 lbs over the three-week period. No significant changes in body composition were seen in the group without PCOS, however all fat measures (total BF%, fat lbs, android and gynoid fat %) trended upward. Lean body mass remained the same for the group without PCOS. Even though PCOS is not a rare condition, it is one that is regularly undiagnosed in college-aged females, leading to a limited subject pool. In addition, while three weeks was not a significant amount of time for body composition changes to occur, if the HIIT program were to be continued, values could compound over time to achieve significant results.

Currently, there is no significant evidence regarding the superiority of strength or aerobic training over any other training type to promote changes to body composition in individuals with PCOS (1). Both HIIT and strength training have resulted in a decrease in total body fat percentage in participants with PCOS (1). In relation to strength training, HIIT has been shown to be a time efficient strategy for women with PCOS to decrease abdominal and visceral fat-mass deposits or promote changes to their android/gynoid ratio AGR (8). One study showed HIIT to be a more effective way to reduce subcutaneous and abdominal body fat (3). However, another study has shown that there were no significant differences in visceral fat among individuals with PCOS after HIIT (6).
Other studies that focused on exercise as a treatment for individuals with PCOS have shown a lack of decreased total BF% after an exercise program intervention. Scott et. al. conducted a twelve-week exercise intervention program and found that approximately 66% of participants did not have a decrease in total BF% of five percent or greater (8). The authors also noted that the PCOS participants with higher VO2 peak values had greater gynoid fat losses after the twelve-week exercise program. The current study did not measure aerobic endurance levels prior to the exercise intervention. Most participants both with PCOS and without PCOS reported limited regular aerobic activity prior to participation in the study. The increase in lean body mass observed in the present study among the PCOS participants could potentially lead to an increase in aerobic fitness. Both aerobic and anerobic fitness measures should be included in future studies on the effects of exercise in PCOS patients.

Previous research has also shown that a similar trend in visceral fat was observed. Almenning et. al. found that there were no significant changes in visceral fat after the ten-week HIIT training program. These results correlate with the lack of significant difference in AGR among both individuals with and without PCOS. Almenning et. al. also observed BMI and found that there was no significant change in BMI after the ten-week HIIT training program (1). From the results of the current study, gynoid fat was recruited to a greater extent compared with android fat. This finding could help identify how best to create an exercise program for the PCOS population that will target areas of fat accumulation that directly increase risk of cardiovascular disease. There is no one exercise modality that can directly manipulate fat deposits in a particular area of the body, however Larson-Meyer et al. (2010) found that even though a combination of caloric restriction and exercise elicited a greater total body fat loss, a 25% caloric deficit only over a six-month period had a greater affect on visceral mass decreases (5). Our participants reported moderately low to average daily caloric intake (DCI) values: PCOS = 1, 731, without PCOS = 1,701. One study examining weight loss in a PCOS population compared a 600 DCI for 12 weeks to a population without PCOS and saw significant weight loss in both groups (7). However, the authors did not provide body composition data in order to compare fat loss results.

Further research is needed to investigate the effects of a longer treatment period on body composition in both individuals with and without PCOS. A longer treatment period could produce more significant results compared to a three-week exercise program, which was a limitation of this study. The lack in accountability among the participants was a limitation, as well. To increase accountability, participants should be observed throughout each workout either in-person or virtually through a video submission of the entire workout. Failure to observe participants “in real time” may have led to incorrect completion of the workouts or lack of completion altogether. Increased observation could also guarantee that the participants complete their workouts on the correct days of the week and completion of other necessary information such as 24-hour dietary recall. Further research should implement greater control by enforcing the completion of the workouts at the same time of day and the same days each week. Furthermore, a controlled diet may also promote greater body composition changes in future exercise studies.


