ORIGINAL ARTICLE: REPRODUCTIVE ENDOCRINOLOGY

Vigorous exercise is associated with superior metabolic profiles in polycystic ovary syndrome independent of total exercise expenditure

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Objective: To characterize metabolic features of women with polycystic ovary syndrome (PCOS) by exercise behavior and determine relative health benefits of different exercise intensities.
Design: Cross-sectional study.
Setting: Tertiary academic institution.
Patient(s): Three hundred and twenty-six women aged 14–52 years-old with PCOS by Rotterdam criteria examined between 2006 and 2013.
Intervention(s): International Physical Activity Questionnaire (IPAQ) administered to classify patients into three groups based on Department of Health and Human Services (DHHS) Guidelines of vigorous, moderate, and inactive, along with physical examination and serum testing.
Main Outcome Measure(s): Blood pressure, body mass index (BMI), waist circumference, fasting lipids, fasting glucose and insulin, 2-hour 75-gram oral glucose tolerance, homeostatic model assessment of insulin resistance (HOMA-IR).
Result(s): The DHHS guidelines for adequate physical activity were met by 182 (56%) women. Compared with moderate exercisers and inactive women, the vigorous exercisers had lower BMI and lower HOMA-IR; higher levels of high-density lipoprotein cholesterol and sex hormone-binding globulin; and a reduced prevalence of the metabolic syndrome. In a multivariate logistic regression analysis controlling for age, BMI, and total energy expenditure, every hour of vigorous exercise reduced a patient's odds of metabolic syndrome by 22% (odds ratio 0.78; 95% confidence interval, 0.62, 0.99).
Conclusion(s): Women with PCOS who met DHHS guidelines for exercise demonstrated superior metabolic health parameters. Vigorous but not moderate activity is associated with reduced odds of the metabolic syndrome, independent of age, BMI, and total energy expenditure. PCOS patients should be encouraged to meet activity guidelines via vigorous physical activity. (Fertil Steril® 2015;■:■–■. ©2015 by American Society for Reproductive Medicine.)
Key Words: Exercise intensity, insulin resistance, metabolic syndrome, polycystic ovary syndrome

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Polycystic ovary syndrome (PCOS) affects between 6% and 12% of reproductive-age women (1–6). The long-term health implications of PCOS include obesity, insulin resistance, dyslipidemia, and hypertension (7–10). To combat increased metabolic risks associated with PCOS, lifestyle interventions including diet and exercise are first-line recommendations (11–13). Significant improvements in body composition, androgen excess, and insulin resistance with a variety of lifestyle interventions targeting diet and exercise have been demonstrated (14–18), but no comparisons of the relative benefits of types of exercise behavior have been reported in women with PCOS.

The risks of physical inactivity in the general population are recognized and are estimated to cause up to 9% of premature deaths worldwide (19). In 2008 the U.S. Department of Health and Human Services (DHHS) published updated guidelines for physical activity for all adult Americans (20). These guidelines were developed by an external scientific advisory committee targeted toward policy makers and health professionals to reduce the burden of chronic disease. Specifically, the DHHS guidelines recommend *either* 150 minutes of moderate intensity exercise per week *or* 75 minutes of vigorous intensity exercise (20). An estimated 50.2% of adult women meet these guidelines for aerobic activity (21). A similar proportion of women with PCOS (59%) have been shown to do so (22). According to these guidelines, vigorous (for 75 minutes) and moderate (for 150 minutes) exercise are treated as interchangeable options to meet aerobic goals. However, data supporting the equivalence of these options for promoting health benefits are lacking.

There has been recent interest in the role of intensity in mediating the favorable health impact of various exercise regimens. Emerging evidence suggests that, in the general population, high-intensity physical activity, rather than moderate, may be associated with improved metabolic outcomes (23). Superior reductions in insulin resistance and cardiac and all-cause mortality have been observed with increased intensity activity (24, 25). However, it is unknown whether exercise regimens of varying intensities afford distinct health benefits in patients with PCOS, and no specific guidelines for physical activity exist for this high-risk group. Such information could be critically useful in counseling the PCOS patient embarking on a lifestyle change. The objectives of our study were to characterize the metabolic features of women with PCOS by exercise behavior and to determine the relative health benefits of vigorous intensity exercise versus moderate intensity exercise or no exercise in this population.

MATERIALS AND METHODS

Selection of Participants

Participants were recruited consecutively over 7 years (2006–2013) from a multidisciplinary PCOS specialty clinic at a tertiary academic institution. Patients signed consent forms if they agreed to participate in a research database and tissue bank study. Approximately 80% of patients evaluated in the clinic consented to participate during the study period. Before we obtained their laboratory tests and before they arrived for their first visit, patients were asked to discontinue oral contraceptives and antiandrogenic medications for at least 1 month. Institutional review board approval was obtained from the University of California at San Francisco (UCSF) Committee on Human Research for this cross-sectional study.

Patients met inclusion for the current study if they fulfilled the revised Rotterdam criteria for diagnosis of PCOS, which require two of the following three features: [1] oligo- or anovulation, [2] clinical and/or biochemical hyperandrogenism, and [3] polycystic ovaries (26). Oligomenorrhea was defined as fewer than eight menstrual cycles per year while not using hormonal contraceptives. Clinical hyperandrogenism was defined as a modified Ferriman-Gallwey score ≥ 8 and/or severe hormone-dependent acne. Biochemical hyperandrogenism was indicated by abnormally elevated levels of total testosterone, free testosterone, androstenedione, or dehydroepiandrosterone sulfate (DHEAS) in serum testing obtained before the clinic visit at local clinical laboratories. Polycystic ovaries were defined as the presence of 12 or more follicles in a single ovary measuring 2–9 mm in diameter, and/or increased ovarian volume greater than 10 cm^3 in a single ovary. Ovarian volume was calculated with the equation for the volume of an ellipse using measurements in transverse, longitudinal, and anteroposterior dimensions. Exclusion of other etiologies was performed by routine screening for thyroid dysfunction via thyroid-stimulating hormone, hyperprolactinemia via prolactin, nonclassic congenital adrenal hyperplasia via 17-hydroxyprogesterone, and hypogonadotropic hypogonadism (premature ovarian insufficiency, functional hypothalamic amenorrhea) via follicle-stimulating hormone and estradiol. If Cushing syndrome was suspected by history and physical examination, cortisol and dexamethasone suppression testing were performed as indicated.

Data Collection

Patients were systematically evaluated over two weekly sessions by a multidisciplinary team that included a reproductive endocrinologist, dermatologist, genetic counselor, registered dietician, and psychologist. Anthropometric data including vital signs, height, weight, and waist circumference were recorded. Endovaginal ultrasound scans were performed by one of two examiners (H.G.H. or M.I.C.) using a Shizmadzu SDU-450XL machine with a variable 4- to 8-mHz vaginal transducer to assess ovarian appearance. Complete skin examinations were performed by a single dermatologist to evaluate cutaneous signs of clinical hyperandrogenism as well as insulin resistance (acanthosis nigricans). A laboratory evaluation of hormonal and metabolic parameters was undertaken using fasting serum samples.

Patients completed a self-administered comprehensive questionnaire before their evaluation in clinic. This intake form addressed the following data: demographics, medical history, menstrual and contraceptive history, family history, dermatologic history, review of systems, and personal health concerns.

Exercise data were ascertained by the International Physical Activity Questionnaire Short Form (IPAQ). The IPAQ is an