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Factors Influencing Physical Activity in Women with Polycystic Ovary Syndrome in Comparison to Eumenorrheic Non Hirsute Women

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Abstract

Polycystic Ovary Syndrome is the most common endocrinopathy in women of reproductive age. Although physical activity and weight loss has been proposed as the first line management in patients with PCOS, studies on physical activity in patients with PCOS are limited. The aims of this study were to compare levels of physical activity and its related factors between women with polycystic ovary syndrome and eumenorrheic non hirsute women. We compared the physical activity of our study group using the international physical activity questionnaire (IPAQ), using T-test or Mann-Whitney to compare the means of two groups. Step wise multivariate logistic regression was used to determine the relationship between physical activity and body mass index and demographic factors. The results showed that physical activity levels in PCOS women compared to controls were similar; however the time spent sitting in PCOS women was significantly higher than controls; (6.94±2.2 versus 6.09±2.63 hours, $P<0.001$).

Low levels of physical activity were reported by 59.2% of cases and 57.1% of controls. A positive association between physical activity levels and BMI ($P=0.001$) and age ($P=0.03$) was observed in PCOS women. In controls, physical activity levels was found to be associated with BMI ($P=0.01$), education ($P=0.03$) and pregnancy status ($P=0.03$). Considering the results of this study, it was concluded that In PCOS women, the impacts of demographic factors on physical activity may be less important than controls.

Keywords: IPAQ, physical activity, polycystic ovary syndrome

1. Introduction

Polycystic Ovary Syndrome is the most common endocrinopathy in women of reproductive age. According to the World Health Organization (WHO), 116 million women worldwide suffer from PCOS (Vos, Flaxman, Naghavi, Lozano, Michaud, Ezzati, Shibuya, & Salomon, 2010). Depending on its definition and the criteria used for diagnosis of this syndrome, its prevalence ranges between 2.2 to 26% in various countries (Ramezani tehrani, Simbar, Tohodi, Hosseinpanah, & Azizi, 2011; March, Moore, Willson, Phillips, Norman, & Davies, 2010). PCOS has severe consequences including impaired glucose tolerance, type 2 diabetes, insulin resistance, vascular disease, metabolic disorders, anovulation, amenorrehea (Palomba, Santagni, Falbo, & Battista, 2015) and considering the short and long term consequences of this disorder, several medical treatments have been

used. Although physical activity and weight loss has been proposed as the first line management in patients with PCOS, studies on physical activity in patients with PCOS are limited and document inconsistent results. In some studies physical activity levels in PCOS women have been reported to be lower than controls (Eleftheriadou, Michala, Stefanidis, Iliadis, Lykeridou, & Antsaklis, 2012; Wild, Painter, Coulson, Carruth, & Ranney, 1985) whereas in others there was no difference in these levels between women with or without PCOS (Moran et al., 2013; Graff, Mario, Alves, & Spritzer, 2013). Because of the various measurement tools available for evaluating physical activity, comparing physical activity levels of individuals is challenging. Physical inactivity has been suggested as a global concern and is a leading risk for morbidity. WHO's global strategy on diet and physical activity and health recommended that more attention be paid to promoting national and international monitoring and surveillance of physical activity (Haskell et al., 2007). Physical activity has been reported to improve the metabolic and reproductive features of PCOS (Banting, Gibson-Helm, Polman, Teede, & Stepto, 2014).

It is important to determine the baseline physical activity levels in women with PCOS, by using a validated physical activity questionnaire to be able to design the effective life style modifications, furthermore, how patterns of physical activity differ according to anthropometric and socio-demographic characteristics of women with or without PCOS needs to be investigated. So far as we know, few studies have conducted on physical activity levels and the related influencing factors in women with PCOS. The aims of this study were to compare physical activity levels and influencing factors in women with polycystic ovary syndrome, compared to eumenorrheic non hirsute women.

2. Materials and Methods

2.1 Study Design

In this case control study, the case group (n=142) were recruited from among PCOS women, meeting the criteria according to the Androgen Excess Society (AES) for PCOS (Azziz et al., 2006), who referred to Reproductive Endocrinology Research Center, Shahid Beheshti University of Medical Sciences from January to July 2014. It is a referral endocrinology research center located in Tehran. PCOS was diagnosed using the criteria of Androgen Excess Society (AES) as presence of hyperandrogenism (clinical and/or biochemical) and ovarian dysfunction (oligo-anovulation and/or polycystic ovaries), and the exclusion of related disorders (hyperprolactinemia, thyroid dysfunction, nonclassic 21-hydroxylase deficiency (NCCAH) and Cushing's syndrome) (Azziz et al., 2006). The inclusion criteria for both groups were: 1. Interest to participate 2. Not being pregnant or lactating 3. Age between 18 and 40 years old 4. Absence of any chronic disease (liver disease, hypertension, hypo or hyperthyroidism, hyper prolactinemia, kidney disease, diabetes 5. No special diet or exercise for weight loss 6. Not having any history of malignancy 7. No using antidepressant drugs. Healthy controls were 140 age and BMI matched women who were visited in clinics affiliated to the Shahid Beheshti University of Medical Sciences for annual gynecologic examinations; they fulfilled all the mentioned inclusion criteria and comprised the eumenorrheic without hirsutism group. Sample size was calculated using these assumptions: Type I error=0.5, power=80% and effect size=0.5 using following equation; resulting 140 participants in each group.

$$n = 2\left(Z_{\alpha} + Z_{\beta}\right)^2 \sigma^2 / \left(\mu_1 - \mu_2\right)^2 \quad (1)$$

2.2 Measurement Instrument

A comprehensive questionnaire including socio-demographic questions and reproductive and menstrual history was completed during face to face interviews conducted by the main investigator. Physical activity level was assessed using the International Physical Activity Questionnaire (IPAQ) (International Physical Activity Questionnaire 2005), a questionnaire designed by the WHO, including 7 questions about vigorous, moderate physical activity and walking time during the previous week. It also defines the time spent on sedentary behaviors. To diminish over-reporting, participants were requested to recall the duration, intensity and frequency of their physical activity during the past week. During the interview, responses of subjects were followed by supplementary questions. According to the IPAQ scoring protocol, each participant's physical activity level was calculated and reported in Met minutes per week. A Met is equivalent to resting metabolic rate of approximately 3.5 cc of oxygen per kilogram of body weight per minutes or in other words one Met equals the amount of energy spent per minute for one at rest (Montoye, 2000). According to IPAQ protocol we excluded participants, for whom the total time of walking, moderate and vigorous activity was over 960 minutes (n=10 in PCOS group and n=8 in control). It is supposed that on an average, a person sleeps 8 hours a day. Based on IPAQ protocol, which assigns Met level of 8 for vigorous, 4 for moderate intensity and 3.3 for walking, the level of physical

activity was calculated, and participants were classified into levels of high, moderate and low physical activity. Total physical activity was calculated as follows: Met level×days per week×minutes of activity. Finally the subjects were grouped into active (Met minutes per week above 600) and inactive (Met minutes per week under 600). According to the center of disease control and prevention, physical activity above 600 Met minutes/ week is known to be beneficial to health (U.S. Department of Health and Human Services, 2008). IPAQ is a standard and validated questionnaire, and its validity has been confirmed in previous studies using content validity (Dinger, Behrens, & Han, 2006; Hazavehei, Asadi, Hassanzadeh, & Shekarchizadeh, 2008), also with the accelometer (Aadalh & Jorgenson, 2003). The reliability of questionnaire was reported as 0.87 using correlation coefficient (Kelishadi et al., 2007). Weight was measured to the nearest 100 gram with subjects lightly clothed, without shoes. After each 5 weight measurements, the digital scale (Seca, Hamburg, Germany) was calibrated with standard weight control. Height was measured without shoes using a height gauge where the spine, the buttocks and back of the heels were in contact with the backboard, with an accuracy of 1 cm. BMI was calculated by dividing weight in kilograms by square of height (in meters). Waist and hip circumferences were taken and measured to the nearest 0.1 cm. A non flexible tape measure was used for measuring waist and hip circumferences and all the measurements were taken by the same person.

The normality of data was examined using Kolmogorov-Smirnov test. All statistical analysis was performed using SPSS version 20 software, and P values less than 0.05 were considered as statically significant. The general linear model was used to adjust for factors including education, employment status, marital status and pregnancy status. The independent T test was utilized to compare the means of two groups if the data had normal distribution. Mann-Whitney test was used if the data didn't have normally distributed. Chi square test was used for categorical data. Step wise multivariate logistic regression was used to determine the relationship between physical activity and body mass index and demographic factors. Results were reported as adjusted odds ratio and 95% confidence interval.

2.3 Data Collection and Interventions

The sequential random sampling was utilized to select cases. The cluster random sampling was used to select controls. A list of the health centers affiliated to Shahid Beheshti University of Medical Sciences in Tehran was prepared and in each region (North, South, West and East), two clinics were randomly selected. In each health center, simple random sampling was used. The healthy controls were 140 age and BMI matched women who were visited in clinics affiliated to the Shahid Beheshti University of Medical Sciences for annual gynecologic examinations; they fulfilled all the mentioned inclusion criteria and comprised the eumenorrheic without hirsutism group. This study was approved by ethics committee of Research Institute for Endocrine Sciences and written informed consent was obtained from all study participants.

3. Results

The characteristics and physical activity of study groups are illustrated in Table 1. After adjusting confounding factors (education, employment status, marital status, pregnancy status), there was no significant difference between physical activity in women with or without PCOS. There was a significant difference between time spent sitting between cases and controls, in cases, the time spent sitting was of longer duration than in controls. (6.94±2.2 versus 6.09±2.63 hours, P<0.001). In our study, according to Department of Health and Human Services (DHHS) guidelines (2008), 40.9% (n=58) of women with PCOS and 42.8% (n=60) of controls were active.

Table 1. The characteristics and physical activity of women with polycystic ovary syndrome in compare to eumenorrheic non hirsute women

Factors	Case	Control	Test
Age (years)	28.56±4.86	28.95±5.78	P=0.631*
Weight (kg)	69.37±14.97	67.45±12.92	P=0.048*
BMI (kg/m^2)	26.56±5.67	26.04±4.75	P=0.133*
Waist circumference (cm)	85.26±13.96	85.16±12.89	P=0.893*
Hip circumference (cm)	104.9±10.1	101.5±10.73	P=0.007*
Waist to hip ratio	0.80±0.73	0.83±0.09	P=0.031*
Education			
Less than Diploma/Diploma& higher	14/128	33/107	P=0.002***

Employment status			
Unemployed/ employed	94/48	114/26	P=0.004***
Marital status			
Single/married	32/110	47/93	P=0.039***
Pregnancy status			
Never pregnant/ever pregnant	124/18	72/68	P<0.001***
Physical activity			
Low (<600 MET/min/week)	84(59.2%)	80(57.1%)	
Medium (600-3000 MET/min/week	45(31.7%)	45(32.1%)	P= 0.893***
High (>3000 MET/min/week	13(9.2%)	15(10.7%)	
Levels of physical activity (Met/min/week)	548(189-1044)	539(261.25-1237.5)	P= 0.359**
Time spent sitting (hour)	6.94±2.2	6.09±2.63	P<0.001*

Quantitative variables are presented as mean±SD or median and interquartile range and categorical variables are expressed as percentage.

* T_Tesr** Man-Whitney, *** Chi-square

Table 2 shows the demographic and anthropometric variables according to physical activity in women with PCOS. Among the cases, active women compared to inactive women had significantly lower body mass index (BMI), waist circumference and waist to hip ratio (P<0.05). There was no relationship between levels of physical activity with education, employment and marital or pregnancy status in PCOS women. In a univariate analysis, inactivity was related to overweight and obesity (odds ratio, 5.28; 95% confidence interval, 2.55-10.95; *P*=0.001), higher age (odds ratio, 2.69; 95% confidence interval, 1.33-5.43; *P*=0.006) and larger waist circumference (odds ratio, 3.86; 95% confidence interval, 1.72-8.65; P=0.001). Stepwise multivariate logistic regression analysis demonstrated that compared with normal weight women, overweight or obese PCOS women were more likely to be inactive (odds ratio: 4.65, 95% CI: 2.19-9.89, P<0.001); compared to their younger counterparts, these women aged over 30 years had a 2.3 fold for lower activity levels (odds ratio: 2.3, 95% CI: 1.07-4.96, P=0.032).

Table 2. Characteristics of women with PCOS based on their physical activity status

Factors	**Active (n=58)**	**Inactive(n=84)**	P Value
BMI(kg/m^2)	24.07±4.37	28.28±5.85	P=0.001*
Age(years)	27.36±4.87	29.39±4.7	P=0.014*
Waist circumference (cm)	79.24±10.27	89.42±14.96	P=0.002*
Waist/hip	0.78±0.05	0.82±0.08	P=0.018*
Education			
Less than Diploma/Diploma& higher	8/50	6/78	P=0.191**
Employment status			
Unemployed/ employed	40/18	54/30	P=0.562**
Marital status			
Single/married	16/42	16/68	P=0.231**
Pregnancy status			
Never pregnant/ever pregnant	54/4	70/14	P=0.085**

* T_Test ,** Chi-square

Table 3 illustrates the characteristics of eumenorrheic non hirsute women according to their physical activity status. In controls, active women compared with inactive women had significantly lower BMI and waist circumference (P<0.05). There was a relationship between the levels of physical activity and age, education, marital status and pregnancy status (P<0.05). Stepwise multivariate logistic regression analysis demonstrated that in controls, overweight or obese women compared with normal weight women were more likely to be

inactive (odds ratio: 2.58, 95% CI: 1.18-5.62, P=0.01). In comparison with nuliparous, parous women had more chances for inactivity (odds ratio: 2.36, 95% CI: 1.08-5.17, P=0.03). Women with higher education compared with less educated women, had less chances for inactivity (odds ratio: 0.3, 95% CI: 0.1-0.9, P=0.03).

Table 3. Characteristics of eumenorrheic non hirsute women according to their physical activity status

Factors	**Active (n=60)**	**Inactive(n=80)**	Level of significancy
BMI(kg/m^2)	23.57±4.34	26.84±4.58	P<0.001*
Age(years)	27.12±5.48	30.23±5.65	P<0.001*
Waist circumference (cm)	79.3±12.2	89.56±11.65	P=0.003*
Waist/hip	0.81±0.07	0.84±0.12	P=0.140*
Education			
Less than Diploma/Diploma& higher	5/55	28/52	P<0.001**
Employment status			
Unemployed/ employed	48/12	66/14	P=0.707**
Marital status			
Single/ married	27/33	20/60	P=0.011**
Pregnancy status			
Never pregnant/ever pregnant	42/18	30/50	P<0.001**

* T_Test ,** Chi-square

4. Discussion

The results of this study demonstrated that there was no significant difference between the physical activity levels of women with or without PCOS, even after adjusting for confounding factors and over half of the women of both groups were inactive. In PCOS women the time spent sitting (sedentary behavior) was 56 minutes more than controls.

Our results are consistent with those of Wright et al. (2004) who reported no difference in the time spent in various activities (low-medium -high) in women with or without PCOS. Our data are also in line with those of Moran et al. (2013) who reported women with PCOS and their controls had similar physical activity levels. Our results however contrary to those of Eleftheriadou et al.(2012) who reported that the frequency and intensity of physical activity levels in adolescent girls with PCOS are lower than in controls, an inconsistency which may be due to differences in the study population and the tool for evaluating physical activity, their study population included adolescent girls with normal BMI. Mean and standard deviation of age in our study was 28.75±5.32 years, they also used a researcher made questionnaire for evaluating physical activity. Our results are also in line with those of Álvarez, Luque-Ramirez, & Escobar-Morreale (2011) Ahmadi et al. (2013) and Graff et al. (2013) who showed no difference in physical activity among women, with or without PCOS.

Among controls, our results are in line with previous studies which reported physical activity had an inverse relation with BMI, education, and pregnancy status (Damirchi, Mehrabani, Mousavi, & Baghrabad, 2014; Raine, 2004; Hajian & Heidari, 2007). The association between excess body weight and inactivity may be explained by various psychological factors like fear of being ridiculed or harassed, fear of others negative judgments (Stankov, Olds, & Cargo, 2012). Educated women have more knowledge about physical health and how to take care of their appearance, all of them contributed to the decision to participate in physical activity (Zarotis, Katsagolis, & Mitrotasios, 2007). Furthermore, women's commitments and responsibilities have been increased with having children (Baxter, Hewitt, & Haynes, 2008).

Results from a national survey, conducted by WHO in Iran, reported about 76.3% of women to be inactive in urban and rural areas (Hazavehei et al., 2008). In women with PCOS, the mean spent sitting time is higher than controls (P<0.001), results are in line with those of Moran et al. (2013) who reported this sedentary time was more than in controls. Increment in sitting time leads to accumulation of adipose tissue and increase the risk of metabolic disease (Owen, Healy, Matthews, Charles, & Dunstan, 2013). Each 2 hour increase in watching TV is related to 23% increment in obesity and a 14% increase in diabetes risk (Hu, Li, Colditz, Willett, & Manson, 2003). In Iran, times spent in sedentary behaviors (in the car, office work, leisure time activity which have an energy consumption of 1 to 1.5 Mets) have not been investigated. Our results reveal that in women, sedentary behaviors constitute approximately of half of their waking hours. According to ACSM and American Heart

Association (AHA), in addition to daily activities, all individuals should be engaged in at least 30 minutes of moderate to vigorous physical activity, 5 days a week or 20 minutes vigorous physical activity 3 days a week (Haskell et al., 2007). These recommendations would definitely reduce the time spent sitting (Owen et al., 2013). On the other hand, there is evidence that different types of sedentary behavior predict insulin sensitivity (Helmerhorst, Wijndaele, Brage, Wareham, & Ekelund, 2009), type 2 diabetes (Hu et al., 2003), cancer (Howrard, Freedman, Park, Hollenbeck, Schatzkin, & Leitzmann, 2008) and cardio vascular disease (Dunstan, Barr, Healy, Salmon, Shaw, & Balkau 2010). Time spent sitting has been reported to be related to the incidence of diabetes after adjusting for total physical activity (Hu et al., 2003). The results of cross sectional studies indicate that sitting time is associated with overweight and obesity (Shields & Tremblay, 2008). Although this is not a casual association, overweight individuals may tend to have sedentary behaviors that lead to obesity. Sedentary behavior leads to changes in vascular dysfunction and decreased blood flow and glucose uptake by insulin; these mechanisms explain the role of inactivity in insulin resistance (Houmard, Tanner, Slentz, Duscha, McCartney, & Kraus, 2004). These behaviors also reduce contractile motion and cause decreased triglyceride uptake and high-density lipoprotein (HDL-C). Sedentary behavior has a direct effect on venous thrombosis and poor metabolism of lipids (Hamilton, Hamilton, & Zderic, 2007). In our study, according to the American Guidelines for physical activity, 59.2% (n=84) of PCOS women and 57.1% (n=80) of controls were found to be inactive. Our results in relation to BMI and waist circumference were consistent with those of Lamb et al. (2011) who showed that inactive PCOS women, compared to active ones, had higher BMI (33.7±9.3 versus 29.9±7.8 Kg/m²) and larger waist circumference (98±24.4 versus 89.9±18.5, $P<0.05$). In cases, results of logistic regression showed that inactivity is related to BMI and age, whereas in controls, inactivity is related to BMI, pregnancy status and education. It can be concluded that factors influencing physical activity in women with or without PCOS aren't exactly the same. The main strength of our study is its design that removed all the biases that may be resulted from differences in age and BMI. Using a standard tool for assessment of physical activity and conducting all assessment by a single person (main investigator) improved the reliability of our study. The main limitation of our study was the recall bias related to the self reported physical activity questionnaire, which may have been partly decreased by conducting face to face interview, compared to self reported questionnaires. Also, we did not measure other sensitive adiposity markers, besides anthropometric parameters.

5. Conclusion

Results of the study showed no difference between levels of physical activities in women with or without PCOS, despite a significant difference in time spent sitting between the two groups. It can be concluded that women with PCOS are not fully aware of the necessity and significance of physical activity to manage PCOS symptoms and decrease long term consequences. Health care providers should encourage PCOS women to increase their physical activity to prevent long term adverse consequences of their physical inactivity on insulin resistance.

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Conflict of Interest

The authors declare that there is no conflict of interests regarding the publication of this paper.

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