

# A study on the relation of attention deficit/hyperactivity disorder symptoms with obesity in women with polycystic ovary syndrome

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## SUMMARY

**Objective:** The goal of this study is to investigate ADHD symptoms and the relation of with obesity in women with PCOS.

**Method:** One hundred twenty five PCOS patients with biochemical hyperandrogenemia were recruited for the study group. For comparison, 125 healthy women were included the study. Current and childhood ADHD symptoms were assessed by using the Adult ADHD Self-Report Scale (ASRS) and Wender-Utah Rating Scale (WURS) and impulsivity was assessed by using the Barrat Impulsivity Scale (BIS).

**Results:** There were no significant difference between the groups in terms of sociodemographic characteristics, but Body Mass Index (BMI) was significantly higher in the PCOS group than the control group. Women with PCOS had significantly higher total current (ASRS) and total childhood (WURS) ADHD scores than controls. Inattention score of ASRS and hyperactivity-impulsivity score of ASRS were higher in PCOS group. Women with PCOS had significantly higher total impulsivity (BIS) scores than controls. Attention impulsivity score of BIS, motor impulsivity score of BIS and Non-planning impulsivity score of BIS were higher in PCOS group. A positive correlation was found between BMI and all scale scores in both PCOS and control groups.

**Discussion:** The results of the study show that women with PCOS have higher current and childhood ADHD symptoms and impulsivity. Also, high serum androgen levels and obesity in the PCOS and control group are associated with both adult ADHD symptoms and impulsivity. Further studies are needed to confirm our findings. We suggest that not only gynecologist but also a multidisciplinary team should examine these patients.

**Key Words:** Attention deficit-hyperactivity disorder, polycystic ovary syndrome, hyperandrogenemia, impulsivity, obesity

## INTRODUCTION

Attention deficit hyperactivity disorder (ADHD) is a major neurodevelopmental psychiatric disorder with childhood onset, manifested by attention deficit, hyperactivity and impulsivity with a prevalence of % 7 in school-aged children (1). ADHD symptoms persist into adulthood in 55-75% of childhood-onset cases and the prevalence of ADHD in adult population is ~2.5% (2,3). Even though the etiology of ADHD is not entirely clear today, it is likely to have multiple genetic, prenatal

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and environmental factors. In recent years, research has focused on the role of androgens in the development of ADHD. Both high androgen levels exposure in the intrauterine period and current high androgen levels exposure have been associated with ADHD. Sexual differentiation of the brain occurs under the control of gonadal hormones, especially androgens, during the prenatal development. In addition boys are two to three times more likely to be diagnosed with ADHD than girls. Studies have found that children with ADHD have higher salivary levels of dehydroepiandrosterone

terone compared to controls. These findings support the idea that high androgen levels may play a role in the etiology of ADHD (4).

Polycystic ovary syndrome (PCOS) is a common endocrine disorder, affecting 10% of women of reproductive age, characterized by clinic or biochemical hyperandrogenemia, irregular menstrual bleeding, and the appearance of polycystic ovaries in ultrasonography (5). In case of the presence of the two above mentioned symptoms, PCOS diagnosis is made (6). Although not part of the diagnostic criteria, obesity also often forms an important component of the clinical presentation of PCOS. Women with PCOS have higher rates of obesity compared to women without PCOS. Nearly 50% of women with PCOS are overweight or obese. It has been reported in studies and meta analyses that there is a significant association between ADHD and overweight/obesity. Studies demonstrate that the prevalence of ADHD in overweight or obese people is higher than in the general population. Also, available evidence suggests that individuals with ADHD have higher rates of overweight/obesity compared with those without ADHD (7-10). In addition, obesity is thought to be a factor that increases the risk of impulsivity (11).

It is claimed that androgens and obesity play a role in the etiology of ADHD. Women with PCOS have high androgen levels and are overweight/obese. In the literature, there is only a study investigating ADHD symptoms in women with PCOS (12). For these reasons, we believe that this issue is worth investigating. In this study, we aimed to research ADHD symptoms in women with PCOS who have high androgen levels and to investigate the effect of obesity in this possible relationship. In the light of this information, our hypotheses are that women with PCOS will have higher total present and total childhood ADHD symptoms than the control group.

## METHOD

The study was approved by the Ethical Committee of University Hospital, and written informed consent was obtained from all the participants.

## Participants

Between 1 July 2018 and 1 April 2019, 157 patients between the aged of 18-40 who admitted to Obstetrics and Gynecology outpatient clinic with complaints such as infertility, irregular menstruation, hirsutism, acne, those detected hyperandrogenemia in hormone tests and diagnosed with PCOS according to the Rotterdam Diagnostic Criteria (6) were included in the study. Exclusion criteria of the study: Use of hormone therapy to cure the symptoms of PCOS within three months before admission, current psychiatric illness, current use of psychotropic drugs, current malignancy, current endocrine disease such as diabetes mellitus, hypothyroidism, hyperthyroidism, congenital adrenal hyperplasia and pathology detected in routine biochemical tests. All patients were examined by the same psychiatrist. As a result of the psychiatric examination, 12 patients with psychiatric illness (7 patients with depression, 4 patients with anxiety disorder and 1 patient with bipolar disorder) and 8 patients for not accepting psychiatric examination were excluded from the study. According to the examination of the hospital records and the statements of the patients, 6 patients with diabetes, 2 patients with hypothyroidism excluded from the study. Moreover, 4 patients who did not complete the scales completely were excluded from the study. The healthy control group was selected among healthy hospital staff between the aged of 18-40, who had regular menstruation. A total of 125 women with PCOS and 125 healthy women subjects were included in the study.

## Data Collection

Wender-Utah Rating Scale (WURS), Adult ADHD Self-Report Scale (ASRS) and Barratt Impulsiveness Scale (BIS-11) were administered to the all participants. These scales were used and scored by the same psychiatrist. Height and weight of all participants were measured and Body Mass Index (BMI) was calculated. Sociodemographic characteristics of the patients were recorded.

The duration of data collection process was nine months.

## Data Collection Instruments

*Socio-demographic Data form:* This form, which includes questions about the participants' age, marital status and education level (the number of years in full-time education), was developed by the researchers in order to collect data on the demographic characteristics of the participants.

*Wender-Utah Rating Scale (WURS):* It is a 25-item self-report scale used to measure childhood symptoms severity of ADHD retrospectively (13). These 25 items are rated from 0= not at all or slightly to 4= very much. Total score of the WURS ranges from 0 to 100 and the scale's cut-off point was found as 36. Validity and reliability tests of the Turkish version were performed by Öncü et al (14).

*Adult ADHD Self-Report Scale (ASRS):* ASRS is a self-rating scale with 18 items used to measure current ADHD symptoms. It composed of two subscales, each consisting of nine items: inattention and hyperactivity-impulsivity. It is a five-points Likert-type scale rated from 0 to 4 (0=never/seldom and 4 =very often). The scale was developed by Kessler et al. (15), and validity and reliability tests of the Turkish form were performed by Doğan et al (16).

*Barratt Impulsiveness Scale (BIS-11):* It is one of the most widely used scales to assess impulsivity. It is a self-rated scale composed of 30 items and was designed by Barrat (17). It is a four-point Likert scale from Rarely/Never=1 to Almost Always/Always=4. It consisted of three subscales: non-planning, attention impulsivity and motor impulsivity. The total score ranges between 30 and 120 and is the result of the sum of three different subscales. Higher scale scores indicate higher severity of impulsivity. Validity and reliability tests of the Turkish version were performed by Güleç et al (18).

## Statistical analyses

The sample diameter analysis was performed for Wender-Utah Rating Scale (WURS) consisting of PCOS and control groups. It was assumed that the

strength of the test was 0.80 and the type 1 error was 0.05. The sample diameter determination process was performed for dual comparison (comparison of PCOS and Control group averages). Reference values (sample mean and standard deviations) were obtained from the study "Symptoms of attention deficit-hyperactivity disorder in women with polycystic ovary syndrome" (12) in determining the sample diameter. Taking all these into account, the sample diameter required for this comparison was calculated as 61 for each group. The calculations were made with the G-Power 3.1.7 package program.

SPSS 23.0 package program was used for statistical analysis of the data. The suitability of the variables to normal distribution was examined using the Shapiro-Wilk Tests. Numbers and percentages were used in summarizing the categorical measurements, continuous measurements as mean, deviation, and 25th–75th percentiles. The comparison of the categorical variables was made by Chi-square test. In the comparison of continuous measurements between groups, by controlling the distributions, Mann Whitney u test was preferred for the parameters which display normal distribution and Kruskal Wallis tests were used for the parameters which do not present normal distribution. Spearman correlation test was performed to reveal the relationship between scale scores. Statistically significance probability values was taken as  $P < 0.05$ .

## RESULTS

There were no significant difference between the groups in terms of age, education and marital status. The BMI was significantly higher in the PCOS group. The socio-demographic characteristics of the groups are reported in Table 1.

Inattention score of ASRS, hyperactivity-Impulsivity score of ASRS, total ASRS score and total WURS score were significantly higher in PCOS group ( $p < 0,001$ ). Non-planning impulsivity, attention impulsivity and motor impulsivity score of BIS and total BIS score were significantly higher in PCOS group ( $p < 0,001$ ) (Table 2).

**Table 1.** Sociodemographic characteristics of the groups.

	Control n=125	PCOS n=125	<i>p</i>
Age (years)	28 (CI: 26,01-30)	27 (CI: 26-29)	0,724 <sup>a</sup>
Education (years)	12 (CI: 11-13)	12 (CI: 11-13)	0,656 <sup>a</sup>
Married	46 (36,8)	50 (40)	
Single	68 (54,4)	65 (52)	0,866 <sup>b</sup>
Divorced	11 (8,8)	10 (8)	
BMI (kg/m <sup>2</sup> )	23,4–2,6	25,7–2,9	<0,001 <sup>c</sup>

Values are expressed as (%), mean – SD or median (25th -75th percentiles).

<sup>a</sup>Mann-Whitney *U* test, <sup>b</sup>Chi-Square test, <sup>c</sup>Independent t test.

Spearman correlation analysis presented that ASRS, WURS and BIS scores and age, education and marital status were not correlated with each other (Table 3).

The BMI and the inattention score of ASRS, Hyperactivity-Impulsivity score of ASRS, total ASRS score, total WURS score, non-planning impulsivity, attention impulsivity and motor impulsivity score of BIS, total BIS score in the PCOS group were positively correlated with each other (Table 3).

BMI and all scale scores in the control group were positively correlated with each other (Table 3).

## DISCUSSION

In this study, we investigated current ADHD and childhood ADHD symptoms and impulsivity in women with PCOS. Results of the study showed that women with PCOS had more current and childhood ADHD symptoms than women in the control group. Moreover, women with PCOS exhibited more impulsivity than women in the control group.

We think that one of the most important reasons

for this is due to the high androgen levels in women with PCOS. The dopamine system plays an essential role in the neurobiology of ADHD (19). Dopaminergic activity in the mesolimbic system and prefrontal cortex is affected by high serum androgen levels (20,21). It was reported that rats' being exposed to high androgen levels in the early stages of their development results in reduced dopamine innervation in the frontal cortex and ADHD-like behaviours (22). These results indicate that being exposed to high androgen levels might be effective on the hyperactive and impulsiveness of women with PCOS. Another reason may be that women with PCOS have a genetic predisposition to ADHD because genetics plays an important role in the etiology of both ADHD and PCOS.

When the literature is examined, the relationship between maternal polycystic ovary syndrome and attention deficit/hyperactivity disorder has been investigated in almost all of the studies. Currently according to our knowledge, there is only one publications in the literature on the prevalence of adult attention deficit hyperactivity disorder in women with polycystic ovary syndrome. In this study conducted with 40 women with PCOS and 40 healthy controls, significantly higher current ADHD and childhood ADHD symptoms were reported in women with PCOS (12). These findings are similar to the results of our study. The superiority and dif-

**Table 2.** Total ASRS, WURS and BIS scales and subscale scores of the groups.

	Control n=125	PCOS n=125	<i>p</i>
ASRS: Inattention	14 (CI: 13-14)	18,5 (CI: 17-20)	<0,001 <sup>a</sup>
ASRS: Hyperactivity-Impulsivity	14 (CI: 13-15)	20,5 (CI: 20-22)	<0,001 <sup>a</sup>
ASRS: Total	27 (CI: 26-29)	40 (CI: 37-43)	<0,001 <sup>a</sup>
WURS: Total	24 (CI: 21-27)	40 (CI: 38-43)	<0,001 <sup>a</sup>
BIS: Attention impulsivity	13 (CI: 12-14)	16 (CI: 15-17)	<0,001 <sup>a</sup>
BIS: Motor impulsivity	14 (CI: 13-14)	20 (CI: 19-23)	<0,001 <sup>a</sup>
BIS: Non-planning impulsivity	14 (CI: 14-15)	21 (CI: 20-24)	<0,001 <sup>a</sup>
BIS: Total	41 (CI: 40-42,98)	57 (CI: 53-63)	<0,001 <sup>a</sup>

Values are expressed as median (25th -75th percentiles).

ASRS: Adult ADHD Self-Report Scale; WURS: Wender-Utah Rating Scale; BIS: Barratt Impulsivite Scale.

<sup>a</sup>Mann-Whitney *U* test.

**Table 3.** Correlation between ASRS, WURS, BIS scales and subscale scores and age, education, BMI.

	Control		PCOS	
	r	p	r	p
Age	0,056	0,538	0,115	0,205
Education	-0,014	0,874	-0,079	0,384
ASRS: Inattention	0,205	0,022*	0,562	<0,001**
ASRS: Hyperactivity-Impulsivity	0,224	0,012*	0,438	<0,001**
ASRS: Total	0,239	0,007**	0,524	<0,001**
WURS: Total	0,282	0,002**	0,510	<0,001**
BIS: Attention impulsivity	0,282	0,001**	0,614	<0,001**
BIS: Motor impulsivity	0,261	0,003**	0,656	<0,001**
BIS: Non-planning impulsivity	0,284	0,001**	0,596	<0,001**
BIS: Total	0,326	<0,001**	0,668	<0,001**

ASRS: Adult ADHD Self-Report Scale; WURS: Wender-Utah Rating Scale; BIS: Barratt Impulsivity Scale.

\* p<0,05, \*\* p<0,001, Spearman correlation test, r= Correlation coefficient value

ference of our study from other studies is that it is the second study in the literature that investigates current and childhood ADHD symptoms and impulsivity in women with PCOS.

In our study, it was concluded that women with PCOS exhibited more impulsivity than women in the control group and overweight/obesity was associated with ADHD symptoms and impulsivity. The first study focusing on the prevalence of ADHD in obese individuals was conducted by Altfas et al. (23). In this study, the prevalence of ADHD in obese adults was found to be 27.4%. Also, the BMI of ADHD patients was significantly higher than that of non-ADHD. In later studies, it has also been reported that obesity is associated with ADHD (24-26). When the literature is examined, there are studies reporting that obesity increases impulsivity (27-30). Based on the results of our study, we think that obesity increases both ADHD and impulsivity.

This study has some limitations. The most important limitation was subjects in the control group recruited according to their self-reports for PCOS rather than a clinical examination. Another limitation was all measures were based purely on self-report. Furthermore, the use of WURS for childhood ADHD symptoms might lead to inaccurate recall. The ASRS and WURS are useful tools for

screening but do not have the ability to make a clinical diagnosis. One other limitation is that our sample is relatively small and does not represent all patients diagnosed with PCOS in the community.

In conclusion, the findings of the study show that adult ADHD and impulsivity are common in patients followed up with a diagnosis of PCOS; high serum androgen levels and obesity are associated with both adult ADHD and impulsivity. PCOS is a highly heterogeneous disease. Some patients are overweight or obese, while others are normal weight. Lots of women with PCOS experience problems such as hirsutism acne due to hyperandrogenemia but there are women with PCOS who have normal androgen levels. For these reasons further studies that take into account the clinical characteristics of patients in larger sample groups are needed to support our findings. Since psychiatric disorders are more common in PCOS, we recommend that a multidisciplinary team, not just gynecologist, should examine these patients.

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