Depression, anxiety and cardiometabolic risk in polycystic ovary syndrome

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BACKGROUND: Polycystic ovary syndrome (PCOS) is associated with psychological and metabolic disturbances. The aim of this study was to determine whether depression, anxiety and reduced health-related quality of life (HRQOL) are more common in women with PCOS and associated with metabolic risk.

METHODS: The study included 226 PCOS patients and 85 BMI-matched healthy control women. All participants completed standardized questionnaires assessing depression (Beck Depression Inventory), anxiety (State-Trait Anxiety Inventory) and both depression and anxiety (Hospital Anxiety and Depression Scale and General Health Questionnaire). Patients also completed a PCOS HRQOL questionnaire. Hirsutism scores, serum androgens and lipids were obtained. All subjects underwent a standard oral glucose tolerance test.

RESULTS: 28.6% of PCOS women versus 4.7% of control women had clinical depression scores indicating an 8.1-fold increased risk of depression in PCOS (P < 0.001). Depression and anxiety scores were higher in PCOS women than controls (P < 0.01 for all subscales). Obese PCOS subjects had higher depression scores and rates than non-obese PCOS women (P < 0.05). Depression scores were significantly correlated with insulin resistance and lipid parameters and with the number of components comprising the metabolic syndrome. Menstrual and hirsutism problems were the most serious concerns followed by emotional problems on the HRQOL.

CONCLUSIONS: Depression and anxiety are more common in patients with PCOS compared with healthy women. Depression in PCOS might be associated with obesity and metabolic abnormalities including insulin resistance and dyslipidemia.

Key words: depressive disorder / metabolic syndrome / polycystic ovary / obesity / diabetes

Introduction

Polycystic ovary syndrome (PCOS) is the most common endocrine disorder of reproductive-aged women (Azziz et al., 2009). It is characterized by androgen excess, chronic oligoovulation and polycystic ovaries (PCO) on ultrasound. PCOS may have an adverse impact on the health-related quality of life (HRQOL) and is characterized by an increased risk of psychological disorders. Physical symptoms in PCOS women are suggested to be the likely cause of psychological distress; however, results are still inconclusive (Hahn et al., 2005; Hollinrake et al., 2007; Dokras et al., 2011).

Major depressive disorder (MDD) affects nearly 14.8 million American adults each year and is more prevalent in women (National Mental Health Association, 2006). The prevalence of MDD in women aged 18–44 years ranged from 12 to 14%, with a mean age of onset of 30.4 years (Hasin et al., 2005). Several studies have shown that women with PCOS are more likely to experience depressive symptoms than healthy women without PCOS (Keegan et al., 2003; Ranson et al., 2003; McCook et al., 2005; Mansson et al., 2008; Benson et al., 2009a,b). In the literature, depression rates in women with PCOS are reported to be between 14 and 64% (Adali et al., 2008; Kerchner et al., 2009; Benson et al., 2009a; Dokras et al., 2011). This wide range of prevalence rates might be due to sociocultural characteristics of the study populations, ethnicities or the use of different methodologies to screen for depressive disorder.
Women with PCOS are also vulnerable to psychological symptoms in areas other than depression. Elevations on anxiety subscales and increased rates of binge eating disorders have been reported in several studies (Herrmann, 1997; McCook et al., 2005; Benson et al., 2009a). The link between PCOS and psychiatric syndromes has been confirmed by structured clinical assessments (Mansson et al., 2008).

The prevalence of anxiety in women with PCOS is reported to be higher than in women in the general population (34–57 versus 18%, respectively; ABS, 2007; Benson et al., 2009a,b; Deeks et al., 2010). However, it remains unclear which factors play a role in the development of anxiety in women with PCOS. Some studies have shown that hirsutism (Sonino et al., 1993) and acne (Mallon et al., 1999) are associated with anxiety and psychotic symptoms, whereas others failed to find this association (Kerchner et al., 2009).

Studies have also reported reduced HRQOL in women with PCOS compared with controls (Coffey et al., 2006; Barnard et al., 2007). Obesity appears to be the most important contributor to reduced QOL (Eisenbruch et al., 2003; Guyatt et al., 2004; McCook et al., 2005; Coffey et al., 2006; Ching et al., 2007). Furthermore, menstrual irregularities, hirsutism, acne and subfertility have also been shown to lead to a significant reduction in QOL. The SF-36 psychological dimension has been found to be more strongly affected by PCOS than by asthma, epilepsy, diabetes or back pain (Coffey et al., 2006).

PCOS is known to be associated with increased insulin resistance and cardiometabolic risk. Women with PCOS are at a substantially higher risk of impaired glucose tolerance and type 2 diabetes with combined prevalence rates of 35–40% for glucose intolerance (Ehrmann et al., 1999). Several studies have shown that women with PCOS have increased cardiovascular disease risk factors, including dyslipidemia, hypertension, endothelial dysfunction, reduced vascular compliance and atherosclerosis (Legro, 2003). The prevalence of metabolic syndrome in women with PCOS has been reported to be increased 2–5-fold (Moran et al., 2010). Little is known about the effect of the phenotypical and biochemical features of PCOS on the development of psychological disorders. The association of metabolic syndrome and depression has been reported in several studies of non-PCOS populations (Skilton et al., 2007; Koponen et al., 2008). However, there is no data about potential relationship between depression and metabolic syndrome in PCOS patients.

The aims of the present study were: (i) to determine whether depression, anxiety and reduced HRQOL are more common in PCOS patients compared with healthy women and (ii) to determine whether cardiometabolic risk markers and mood disorders are associated in PCOS.

Materials and Methods

Subjects

We prospectively studied 226 PCOS patients presenting to the Endocrinology Clinics of Hacettepe University between May 2005 and June 2010. PCOS diagnosis was based on the 2003 Rotterdam criteria (Rotterdam, 2004). All patients had clinical and/or biochemical hyperandrogenism, chronic oligoovulation and/or PCO on ultrasound. Hyperandrogenism and chronic oligoovulation were defined as described previously (Yildiz et al., 2002). PCO was defined as the presence of ≥12 follicles in each ovary each measuring 2–9 mm in diameter and/or increased ovarian volume (>10 ml; Rotterdam, 2004). Cushing’s syndrome, non-classic congenital adrenal hyperplasia, hyperprolactinemia, thyroid dysfunction and androgen secreting tumors were exclusion criteria (Rotterdam, 2004). As controls 85 BMI-matched healthy women from the general population, who had regular menses and no clinical or biochemical hyperandrogenism or PCO were recruited. Subjects were not taking any medication for at least 3 months before the study. The study protocol was approved by Institutional Review Board of Hacettepe University Medical School and informed consent was obtained from all participants.

Measurements

Clinical parameters

Anthropometric measurements, including BMI, waist circumference and waist-to-hip ratio (WHR) were determined in all participants. The amount of excess terminal hair was assessed by using the modified Ferriman–Gallwey (mFG) method and hirsutism was defined by a score ≥7.

Laboratory measures

All sampling procedures were performed in the early follicular phase (Day 2–5). Subjects underwent a standard 2-h 75 g oral glucose tolerance test (OGTT) between 08:00 and 10:00 h after an overnight fast during which fasting plasma glucose (FPG) and 2 h plasma glucose levels were obtained. Laboratory data included fasting and 2 h plasma glucose, fasting insulin, total cholesterol, high-density lipoprotein cholesterol (HDL-C), triglycerides (TG), sex hormone-binding globulin (SHBG) and total testosterone (Tt). Free androgen index (FAI) was calculated from Tt and SHBG levels (Tt * 100/SHBG) as described previously (Yildiz et al., 2010).

Metabolic syndrome was defined using NCEP-ATPIII criteria adopted for PCOS (TG ≥ 150 mg/dl, HDL < 50 mg/dl, waist circumference ≥ 88 cm, FPG = 100–125 mg/dl or 2 h plasma glucose during OGTT ≥ 140–199 mg/dl and blood pressure ≥ 130/85 mmHg; Rotterdam, 2004).

Psychological measurements

All participants completed the Beck Depression Inventory (BDI), Hospital Anxiety and Depression Scale (HADS), General Health Questionnaire 28 (GHQ) and State-Trait Anxiety Inventory 1 and 2 (STAI). PCOS patients also completed the HRQOL questionnaire for women with PCOS. The psychological questionnaires and endocrine/metabolic parameters were measured at the same time in the participants.

Beck Depression Inventory. The BDI (BDI-II), created by Dr Aaron T. Beck, is a 21 question multiple choice self-report inventory for measuring the severity of depression. The most current version of the questionnaire is composed of items relating to depression symptoms such as hopelessness and irritability, cognitions such as guilt or feelings of being punished, as well as physical symptoms such as fatigue, weight loss and lack of interest in sex. Scores ≥17 indicate severe depression that needs to be treated (Joe et al., 2008).

General Health Questionnaire. The GHQ is a measure of current mental health. GHQ-28 is a measure of psychological function or disturbance comprising a global score and four scales for somatic symptoms, anxiety, insomnia, social dysfunction and severe depression. Psychological morbidity was identified by a standard score of >5 and chronic disease was identified at ≥13 (Goldberg and Hillier, 1979).

Hospital Anxiety and Depression Scale. The HADS was constructed to allow a rapid and separate measure of depression and generalized anxiety in hospital, outpatient and community settings (Herrmann, 1997). Its aim is to assess the presence and severity of anxious and depressive symptoms rather than to distinguish between different types
of anxiety or depression. A subscale score of 11 or higher indicates probable presence of the mood disorder.

State-Trait Anxiety Inventory. We measured the generic level of anxiety among patients using the state anxiety scale from the Dutch version of the STAI (Spielberger et al., 1983). The STAI is composed of two separate self-report scales, the STAI-1 and -2. Each of them consists of 20 statements that address the individual’s situational anxiety. Participants are to indicate the degree to which each statement reflects their current feelings on a four-point scale. The responses add up to a score between 20 and 80, with higher scores indicating higher levels of state and trait anxiety, respectively.

PCOS health-related quality of life. PCOS HRQOL questionnaire is a multi-dimensional construct encompassing physical, emotional and social consequences of a disease. Factor analyses helped the researchers identify five domains believed to be of foremost importance to women with PCOS: emotions, body hair, weight problems, menstrual problems and infertility (Cronin et al., 1998). Each item is associated with a seven-point scale, in which a score of 7 denotes no problems or difficulties and a 1 indicates maximum HRQOL impairment on that item. The mean score of all items in a domain shows the domain score. In the questionnaire, lower maximum HRQOL impairment on that item. The mean score of all items in a domain shows the domain score. In the questionnaire, lower scores indicate a lower HRQOL and a higher concern.

Assays

Plasma glucose was measured by the glucose oxidase technique (Roche Molecular Biochemicals, Mannheim, Germany). tT levels were measured by chemiluminescent enzyme immunoassay (Immulite 2000; Diagnostic Products Corporation, Los Angeles, CA, USA), with intra- and inter-assay coefficient of variations (CVs) of 6 and 7%, respectively. SHBG was measured by immunoradiometric assay (Diagnostic Systems Laboratories, Inc., Webster, TX, USA) with intra- and inter-assay CVs of 3.7 and 9.4%, respectively. Insulin was measured by chemiluminiscent immunoassay kits (Roche Diagnostics GmbH, Mannheim, Germany) with intra- and inter-assay CVs of ≤4.3 and ≤3.4%, respectively. Plasma total cholesterol, HDL-C and TG levels were determined by enzymatic colorimetric method (Roche Molecular Biochemicals, Mannheim, Germany). The average intra- and inter-assay CVs were 1.4 and 2.2%, respectively.

Statistical analysis

All data were analyzed using SPSS version 11.0. Continuous variables were analyzed using a two-tailed Student’s t-test or Wilcoxon rank sum test. A $\chi^2$ or Fisher exact test was used to evaluate categorical variables. Pearson/ Spearman correlation was used to examine the relationship between BDI, HADS, GHQ, STAI, HRQOL scores and other hormonal, metabolic variables and mFG scores. To adjust for covariate effects and to identify independent relationships, multivariate regression analysis was performed. Results were reported as mean ± SD. Statistical significance was defined as $P < 0.05$.

Results

Participants

A total of 226 women with PCOS and 85 controls participated in this study and completed the required questionnaires. The prevalence rates for oligoamenorrhea (O), hyperandrogenism (H) and PCO (P), in the patient group were 78.6, 71.9 and 73.8%, respectively.

Clinical, biochemical and hormonal characteristics of women with PCOS and controls are summarized in Table I.

<table>
<thead>
<tr>
<th></th>
<th>PCOS</th>
<th>Control</th>
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<tr>
<td></td>
<td>(n = 226)</td>
<td>(n = 85)</td>
</tr>
<tr>
<td>BMI (kg/m²)</td>
<td>24.7 ± 5.7</td>
<td>23.4 ± 5.4</td>
</tr>
<tr>
<td>Age (years)</td>
<td>23.2 ± 5.2</td>
<td>24.4 ± 4.0</td>
</tr>
<tr>
<td>WHR</td>
<td>0.78 ± 0.08</td>
<td>0.76 ± 0.07</td>
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<tr>
<td>FAI</td>
<td>10.2 ± 9.3</td>
<td>3.4 ± 2.9</td>
</tr>
<tr>
<td>FPG (mg/dl)</td>
<td>80.9 ± 12.0</td>
<td>81.1 ± 10.4</td>
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<tr>
<td>Two hours plasma glucose (mg/dl)</td>
<td>92.5 ± 26.3</td>
<td>84.4 ± 21.0</td>
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<tr>
<td>Total cholesterol (mg/dl)</td>
<td>169.3 ± 33.8</td>
<td>167.1 ± 25.2</td>
</tr>
<tr>
<td>HDL-C (mg/dl)</td>
<td>58.9 ± 14.8</td>
<td>62.9 ± 14.1</td>
</tr>
<tr>
<td>Triglycerides (mg/dl)</td>
<td>95.2 ± 66.3</td>
<td>74.1 ± 33.7</td>
</tr>
<tr>
<td>Fasting insulin (µU/ml)</td>
<td>13.8 ± 9.4</td>
<td>9.3 ± 4.4</td>
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<tr>
<td>HOMA-IR</td>
<td>3.05 ± 3.4</td>
<td>1.9 ± 0.8</td>
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</table>

Psychological disturbances in women with PCOS compared with controls

There were 64 PCOS patients (28.6%) and 4 control women (4.7%) who had scores $\geq 17$ on the BDI ($P < 0.01$) indicating clinically significant depression that needs to be treated (odds ratio 8.1, 95% CI 2.85–23.03, $P < 0.001$). BDI, HADS, GHQ, STAI-1 and -2 scores were all higher in PCOS women compared with controls ($P < 0.01$ for all comparisons, Fig. I). Furthermore, BDI scores correlated with HADS ($r = 0.720$, $P < 0.01$), GHQ ($r = 0.752$, $P < 0.01$), STAI1 ($r = 0.545$, $P < 0.01$) and STAI2 ($r = 0.619$, $P < 0.01$) scores. Mean HADS subscale scores of the patients for anxiety and depression were 9.3 ± 4.3 and 6.4 ± 4.1, respectively. Of the patients, 42.3% showed elevated HADS anxiety scores (i.e. HADS anxiety subscale $\geq 11$) and 17.3% of the patients showed elevated
HADS depression scores (i.e., HADS depression subscale ≥11), while 15.4% of the patients scored above the cutoff values for both subscales indicating comorbid anxiety and depression.

The PCOS HRQOL questionnaire results showed that the menstrual and hirsutism problems were the most serious concerns followed by emotional problems in women with PCOS whereas weight and infertility were the least (Table II). Scores were also significantly lower in depressive PCOS subjects (Table II).

### Association of psychological measures with cardiovascular and metabolic risk factors

There were significant correlations between depression, anxiety and HRQOL scores and metabolic and androgen excess parameters as shown in Table III.

Obese subjects (BMI ≥ 30 kg/m²) with PCOS had significantly higher BDI, GHQ and HADS scores and lower scores in emotion and weight domains of HRQOL than non-obese patients (P < 0.05, Table IV). In addition, obese PCOS subjects had higher depression rates (48.8%) than non-obese PCOS women (23.5%; P < 0.05). In the obese group (BMI ≥ 30 kg/m², n = 50), PCOS women (n = 41) had a higher risk of depressive disorders (n = 21, 51.2%) than did control subjects (n = 0 among 9 obese controls, 0%; P < 0.05).

BDI scores correlated with the number of metabolic syndrome components (r = 0.187, P < 0.01). Subjects having metabolic syndrome had significantly higher HADS but non-significantly higher BDI and GHQ scores than the others (20.9 ± 9.8 versus 15.1 ± 8.0, P < 0.05 for HADS; 9.8 ± 4.8 versus 5.8 ± 4.0, P < 0.01 for HADS depression score; 12.2 ± 4.9 versus 8.6 ± 4.6, P < 0.05 for HADS anxiety score; 33.7 ± 16.9 versus 28.0 ± 14.5, P > 0.05 for GHQ and 16.7 ± 11.5 versus 12.1 ± 8.5, P > 0.05 for BDI). Moreover,
pared with 4.7% in the control group and PCOS patients had an

higher prevalence of depression and anxiety in PCOS patients with and without depression. Overall, our data suggest that PCOS appears to be a risk factor for depression independent of obesity and depressed PCOS patients are more likely to be obese.

### Discussion

We report here a high prevalence of depression and anxiety in PCOS patients. The depression rate was 28.6% in women with PCOS compared with 4.7% in the control group and PCOS patients had an 8.1-fold increased risk of depression compared with controls. BDI and anxiety scores were significantly higher in PCOS subjects and strongly correlated with each other indicating a potential interaction between these psychological abnormalities. In a recently reported meta-analysis including 10 cross-sectional studies, the OR for abnormal depression scores was found to be 4.03 (95% CI 2.96–5.55, \(P < 0.01\)) in women with PCOS (\(n = 522\)) compared with those in the control group (\(n = 475\); Dokras et al., 2011). Increased propensity to anxiety in PCOS has also been reported previously (Benson et al., 2009a).

HRQOL questionnaire results in PCOS women showed that the menstrual and hirsutism problems were the most serious concern followed by emotional problems. Since most patients suffered from oligomenorrhea and hirsutism, this was not unexpected. However, the majority of studies applying HRQOL reported that the most adversely affected domain was weight. The domains of body hair and emotions were frequently identified as the areas least affected by PCOS (Guyatt et al., 2004; Jones et al., 2004). Barnard et al. (2007) found that emotional disturbance and hirsutism were the areas of least concern in women with PCOS. On the other hand, unlike Austrian comparison samples, Brazilian women expressed more concerns about hirsutism, infertility and menstrual irregularities (Hashimoto et al., 2003). Overall these data suggest that the rate of obesity, cultural variables as well as the background population appear to mediate PCOS women’s responses to the different symptom dimensions.

The skin manifestations of hyperandrogenism especially hirsutism and acne are strongly associated with body dissatisfaction. Hyperandrogenism causes lower self-esteem and a more negative self-image in women with PCOS. A few studies have shown that hirsutism (Sonino et al., 1993) and acne (Mallon et al., 1999) are associated with anxiety and greater psychotic symptoms; but others have failed to demonstrate a significant correlation between depression and androgen levels or hirsutism scores in women with PCOS (Keegan et al., 2003; Rason et al., 2003; Ching et al., 2007; Hollinrake et al., 2007). In our study, there was no correlation between FAI and BDI, GHQ, and HRQOL scores, however, there was a significant correlation between FAI and HADS and STAI scores and between mFG scores and depressive disorders. Moreover, the mFG score was found to be independently associated with having depression in a multivariate linear regression analysis. In our population, the body hair part of the HRQOL questionnaire was the most serious concern. Taken together, these data suggest that body perception might show variation in different populations depending on sexual factors.

Depressive symptoms and mood disorders are common in obese people (Roberts et al., 2000). Community-based studies suggest a positive association between depression and obesity (Carpenter et al., 2000; McElroy et al., 2004). In our study, the risk of depression was higher in obese PCOS patients (48.8 versus 23.5%, \(P < 0.05\)). BDI was also correlated with weight scores of HRQOL questionnaire. In addition, considering obese patients, the weight domain of HRQOL was the area of most concern. Among obese subjects, PCOS patients had higher depression rates compared with non-PCOS women. Finally, depressed PCOS patients had higher BMI and WHR than non-depressed PCOS patients. Overall, our data suggest that PCOS appears to be a risk factor for depression independent of obesity and depressed PCOS patients are more likely to be obese.

### Table V Metabolic parameters of PCOS patients with and without depression.

<table>
<thead>
<tr>
<th></th>
<th>PCOS with depression ((n = 64))</th>
<th>PCOS without depression ((n = 162))</th>
<th>(P)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>24.2 ± 6.2</td>
<td>22.9 ± 4.7</td>
<td>NS</td>
</tr>
<tr>
<td>BMI</td>
<td>26.4 ± 7.3</td>
<td>24.1 ± 4.8</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>Obesity (%)</td>
<td>21 (33.3%)</td>
<td>22 (13.8%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>WHR</td>
<td>0.80 ± 0.09</td>
<td>0.78 ± 0.07</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td>mFG score</td>
<td>11.8 ± 6.8</td>
<td>10.0 ± 5.9</td>
<td>NS</td>
</tr>
<tr>
<td>Glucose intolerance</td>
<td>3 IFG (4.8%)</td>
<td>2 IFG (1.4%)</td>
<td>NS</td>
</tr>
<tr>
<td>(IFG, IGT)</td>
<td>2 IG T (3.2%)</td>
<td>7 IG T (4.7%)</td>
<td></td>
</tr>
<tr>
<td>FAI</td>
<td>9.5 ± 8.3</td>
<td>10.6 ± 9.7</td>
<td>NS</td>
</tr>
<tr>
<td>FPG (mg/dl)</td>
<td>81.5 ± 11.2</td>
<td>79.6 ± 12.2</td>
<td></td>
</tr>
<tr>
<td>Two hours plasma glucose (mg/dl)*</td>
<td>92.7 ± 20.9</td>
<td>87.0 ± 19.7</td>
<td>NS</td>
</tr>
<tr>
<td>Fasting insulin ((\mu U/ml))*</td>
<td>15.3 ± 10.8</td>
<td>12.7 ± 7.3</td>
<td>NS</td>
</tr>
<tr>
<td>HOMA-IR*</td>
<td>3.4 ± 3.1</td>
<td>2.5 ± 1.5</td>
<td>NS</td>
</tr>
<tr>
<td>HDL-C</td>
<td>57.3 ± 12.4</td>
<td>59.6 ± 15.7</td>
<td>NS</td>
</tr>
<tr>
<td>TG</td>
<td>106.6 ± 78.9</td>
<td>90.8 ± 60.2</td>
<td>NS</td>
</tr>
<tr>
<td>Total cholesterol</td>
<td>168.1 ± 33.2</td>
<td>169.9 ± 34.2</td>
<td>NS</td>
</tr>
<tr>
<td>Metabolic Syndrome (%)</td>
<td>6 (10.5%)</td>
<td>6 (4.3%)</td>
<td>NS</td>
</tr>
</tbody>
</table>

*Calculated after exclusion of IGT patients.
There is limited and conflicting information on the association between depression and cardiometabolic risk factors in PCOS. Rasgon et al. (2003) found that higher levels of insulin resistance and higher body mass indices were associated with depression in women with PCOS. We found that there were significant correlations between depression scores and postload glucose, insulin resistance and lipids. BDI scores were significantly correlated with the number of components comprising the metabolic syndrome. PCOS subjects having metabolic syndrome had significantly higher HADS but non-significantly higher BDI and GHQ scores than others. Moreover, patients with metabolic syndrome had significantly lower scores in emotion and weight domains of HRQOL than patients without metabolic syndrome. Metabolic syndrome is shown to be associated with both depression (Heiskanen et al., 2006; Skilton et al., 2007; Koponen et al., 2008) and PCOS (Apridonidze et al., 2005). Our results suggest that depression and metabolic syndrome are associated in PCOS women.

Our data do not support any effect of PCO on ultrasound on prevalence or severity of depression in PCOS. Also, the rates of depression are similar among different subphenotypes of PCOS (POH, OH, PH, PO).

One of the limitations of the present study was its cross-sectional design which limits the ability to evaluate the possible effects of PCOS on the future risk of depression. Moreover, we reported the risk depending on the abnormal screening for depression and confirmation of depression by clinical assessment was not included in the study design. Lack of data related to family history of mood disorders and possible confounding factors such as diet and physical activity were other shortcomings.

In conclusion, our results suggest an increased prevalence of the symptoms of depression and anxiety and a significantly impaired quality of life in women with PCOS. These disorders appear to be associated with obesity and cardiometabolic risk. We propose that potential adverse psychological implications of PCOS along with cardiometabolic risk should be explored in routine clinical evaluation of women with PCOS at regular intervals, and patients with abnormal screening results should be followed up with a mental health professional.

Authors’ roles

B.O.Y. was the principal investigator and formulated the research question. N.C., M.C.K., A.H., D.Y.A. and G.B. contributed to acquisition and analysis of the data. N.C., D.Y.A., B.D. and B.O.Y. contributed to interpretation of the data. N.C. and D.Y.A. drafted the article. All authors contributed to the critical revision of intellectual content and approved the final version of the paper.

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