



A Simple Assessing Method for Screening Prevalence of Polycystic Ovary Syndrome (The Thief of Womanhood) and Emotional Distress in Female Students at Northern Border University (NBU) in Arar, Kingdom of Saudi Arabia (KSA)

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ABSTRACT

Background: Polycystic ovary syndrome (PCOS) is an endocrine condition which is caused due to disturbance in hormonal balances. There are more than one influencing factors that can lead to cause of PCOS. Yet, there are few reports that have fully elucidated the connection of conventional factors linked with PCOS so far. **Aim and objectives:** 1. To study the prevalence of risk factors associated with PCOS among female students of NBU, Arar, KSA. 2. To study the correlation between emotional distress and associated risk factors of PCOS among female students of NBU. 3. To create the awareness of PCOS and its associated risk factors among female students of NBU. **Material and methods:** The Northern Border University female students those were willing to participate were selected to enroll in our study. A pre-validated self-structured questionnaire was used as a tool for the collection of the data. Students were grouped into two viz PCOS-group and non-PCOS-group founded on criteria's given by NIH (National Institutes of Health Criteria). As per this criteria diagnosis of PCOS is established founded on incidence of both chronic anovulation (ANOVU) characterized by occurrence of vaginal bleeding for more than 35 days gaps or 8 cycles/year to understand absence of menstruation and clinical hyperandrogenism (CH). CH is defined as the occurrence of acne, androgenic alopecia, acanthosis and hirsutism. **Conclusion:** Students recognized with linked risk factors for PCOS were guided and counseled to have complete investigations done including radiological and hormonal assays for confirming diagnosis and starting treatment.

Keywords: Acanthosis, Hirsutism, Hyperandrogenism, Poly-cystic ovary syndrome, Saudi Arabia

INTRODUCTION

PCOS is an endocrine condition which is common and occur worldwide with a prevalence of 5%-10%. PCOS is found to be a significant basis of chronic anovulation in young females. PCOS is clinically diagnosed by the occurrence of abnormal menstruations, features of acne, infertility, baldness present in the male-pattern and excess body hairs. PCOS is also associated with several long term complications such as diseases of cardiovascular system and metabolic disorders and diabetes mellitus [1,2].

The precise etiology of PCOS is anonymous but it is supposed to be multifactorial. The popular hypothesis is that it may be probably due to hormonal imbalances leading to decrease in follicle stimulating hormone (FSH) and increased luteinizing hormone (LH) causing changed LH/FSH ratio. Hyperinsulinemia and insulin resistance are the associated clinical features related with hyperandrogenism. The factors that may lead to occurrence of PCOS in women are still unknown, few of the cases of PCOS may have genetic link and others like obesity seems to be related with hyperinsulinemia which predisposing persons to develop PCOS [3-5]. National Institutes of Health (NIH) defines PCOS as a disorder having: 1) hyperandrogenemia and/or hyperandrogenism, 2) oligoovulation, and 3) omission of well-known disorders.

Presence of following are also some of the main features of PCOS 1) Essential indicator of PCOS are subcapsular follicular cysts eight or more in number but less than 10 mm in size with expanded ovarian stroma, 2) Chronic anovulation: The ovulation problems can happen in the peripubertal years and worsen with age-related increase in weight resulting in irregular menstrual cycles, chiefly amenorrhea, oligomenorrhea, or dysfunctional uterine bleeding. Majority of the cases of PCOS have persistent amenorrhea, 3) Hirsutism is characterized by presence of undesirable and unnecessary terminal hair production in the body region with a male-like pattern, 4) Infertility, 5) Obesity with apple-shaped body' characterized by increased waist-hip ratio, 6) Acanthosis nigricans, 7) Presence of other symptoms like presence of alopecia and acne in male like pattern especially in temporal region, 8) Elevated LH/FSH hormones.

Causes of PCOS are as following: 1) Hyperinsulinemia with Insulin resistance, 2) Ovarian disorders associated with Primary adrenal androgen excess have also been found to be associated with PCOS, 3) Adrenal enzyme deficiency, 4) Excess production of androgen by ovaries is intently related to PCOS, 5) Gonadotropin releasing hormone (GnRH) pulse frequency and/or amplitude is seen due to variations in the Central Nervous System.

Polycystic ovary syndrome (PCOS) is a common endocrine disorder with a global prevalence of 5%-10% and is an important cause of chronic anovulation in young women. PCOS is characterized by menstrual irregularity, signs of hyperandrogenism such as acne, excess body hairs, male-pattern baldness and infertility. In addition, PCOS is linked to many long term health problems such as cardiovascular diseases and diabetes [1,2]. Though the exact cause of PCOS is unknown but it is thought to be multifactorial. Mostly due to hormonal imbalances that is increased luteinizing hormone (LH) and normal or suppression of follicle stimulating hormone (FSH) resulting in altered LH/FSH ratio. Also the clinical features of hyperandrogenism are associated with hyperinsulinemia and insulin resistance. Although it is not clear what are the factors that may predispose a women for development of PCOS, however it was observed in some cases that PCOS is genetic in nature and obesity was found to contribute for hyperinsulinemia there by predisposing individuals for PCOS [3-5].

Polycystic ovary syndrome (PCOS) is defined most commonly according to the National Institutes of Health (NIH) as a disorder having: 1) hyperandrogenism and/or hyperandrogenemia, 2) oligoovulation, and 3) exclusion of known disorders.

MATERIAL AND METHODS

With an aim to assess the prevalence of the associated risk factors of PCOS, a cross sectional study was conducted in female students of NBU. Sampling method used was simple random technique. Questionnaire was designed which was self-structured and pre-validated. It was administered to collect the data from 200 NBU female students who volunteered to join in the study. Demographic details and anthropometric measurements details of participating students was also collected. Female students who were found to have related risk factors for PCOS were assessed for presence of Emotional distress symptoms.

Section A: Information Collected about Associated Risk Factors of PCOS among NBU Female Students (Table 1 and Figure 1)

A. General Information: Data collection done related to associated risk factors for PCOS like family history, fatty food intake, exercise etc

B. Weight and height measurement (BMI) were taken

C. Measurement of Waist Circumference (WC) was taken

The students were asked to be in an upright position with arms along the body and feet together and then WC was determined with a metric inelastic tape

D. Based on NIH criteria an assessment of associated risk factors was done for PCOS (Table 2 and Figure 2)

Section B: To Assess The Stress Management Scale Authored by Dr. Vandana Kaushik and Dr. Namrata Arora Charpe Prepared by National Psychological Corporation was Administered (Tables 3-5)

Students who were found to have an associated risk factors for PCOS were advised to get them investigated for serum FSH, serum LH, Serum prolactin, Serum TSH, Lipid profile and blood sugar levels and were advised to undergo lower

abdomen ultrasound for finding status of ovaries. These students who were found to have an associated risk factors for PCOS were further followed-up to analyze for confirmation of PCOS as the final diagnosis.

Section C: Structured Teaching Program was Conducted to Create Awareness of PCOS among NBU Female Students

Structured teaching program: Participants were given pre-validated self-designed questionnaire to assess the level of awareness they had regarding PCOS and its associated risk factors. Participants were then educated about PCOS through structured teaching program. We developed an educational material including power point slides presentation and audio-visual aids about the definition, etiology, pathophysiology, risk factors, and information related to our research questions about PCOS to create awareness among them [6].

Administration of post-education test: After completion of the structured teaching program, post education test was administered to the study participants to assess about the knowledge acquired by them.

Statistical Analysis

A statistical analysis was performed using SPSS 20.0 (SPSS Inc., Chicago, ILL, USA). Descriptive statistics was done and a p-value less than 0.05 was counted as statistically significant.

RESULTS

Majority of the female students were in the age group between 19-22 years. The BMI of these students was found to be between 18.5 kg/m²-24.9 kg/m². Mean age at first menstrual period was found to be 13 years. Thirty students were found to have an associated high risk factors for PCOS. 89% of students who had high associated risk factors of PCOS had menstrual irregularities and positive family history. Also these students had regular intake of fast food and lacked doing physical exercise. 1% of females students had Diabetes Mellitus, 2% of them had hypertension and 2% of them had diagnosed high cholesterol, 19% of the complaint of depression and mood changes. Results of Stress Management Scale authored by Dr. Vandana Kaushik and Dr. Namrata Arora Charpe prepared by National Psychological Corporation showed that 39% of the students were found to be having stress. 60% of these students were able to find their stressor. 73% of students strongly agreed that they try to reduce the intensity of their emotional reaction to the stressor 52% of students agreed that they take regular rest. 60% of students agreed that they do not manage their time properly. 42% of students strongly agreed that they do not schedule time to relax. 23% of students mentioned that they exercise their muscles regularly.

53% of students were found not to indulge in hobbies and 65% of students stated that they do not take proper sleep. The result of pre-validated self-designed questionnaire to assess the level of awareness they had regarding PCOS and its associated risk factors (Table 6) showed that 35% of students were aware that PCOS prevalence is high in women in obesity and overweight category. 15% of these students knew that atherosclerosis, hypertension and diabetes mellitus prevalence is more in women with obesity of android type. 10% of these students were aware that features of hyperandrogenism were common in women with android obesity.

Table 1 Assessing the prevalence of associated risk factors of PCOS among NBU female students

(1) Age in years	<19 years	2%
	19-22 years	91%
	>22 years	7%
(2) Body Mass Index (BMI) in kg/m ² (calculated)	PCOS with BMI (18.5-24.9)	14%
	PCOS (25-29.9) Overweight	7%
	PCOS (equal or more 30) Obese	9%
(3) Age at first menstrual period	Mean age 13 years	78%
(4) Regularity of the menstrual cycle	Regular	70%
	Irregular-Oligomenorrhea	17%
	Polymenorrhea	13%

(5) Pelvic pain during menstruation	Present	39%
(6) Family history of PCOS	Yes	25%
	No	5%
(7) Fast food intake	<3 days/weeks	44%
	>3 days/week	56%
(8) Physical Exercise	<3 days/weeks	59%
	>3 days/week	41%
(9) Waist circumference	<80 cm	70%
	>80 cm	30%
(10) Marital status	Unmarried	98%
	Married	2%
(11) Fertility problems	(11) Fertility problems	Nil
(12) Use of oral contraceptive Pills	(12) Use of oral contraceptive Pills	Nil
(13) Presence of PCOS (diagnosed earlier) If Yes, Answer the following (14) Serum FSH and LH level in (ng/dl) (15) Serum Testosterone level in (ng/dl) (16) Blood pressure in (mmHg)	Nil	Nil
	Mean 120/85 mmg	68%
(17) Other systemic disorders	Diabetes Mellitus	1%
	Hyperthyroidism	Nil
	Hypertension	2%
	High Cholesterol	2%
	Depression and mood change	19%
	Stress	39%
(18) Family History of PCOS	Grandparents/aunt/cousins with PCOS	2%
	Mother with PCOS	3%
(19) Your siblings with PCOS	Siblings with PCOS	2%
(20) Attempt to lose weight Yes/No	Yes	24%
(21) Any medical treatment taken for losing weight (herbal treatment/medicine/surgical treatment)	Herbal treatment	14%
	Medical treatment	9%
	Surgical treatment	1%
(22) Earlier ovarian assessments	(Based on ultrasound findings)	Nil

Table 2 Diagnostic criteria assessment based on NIH for PCOS

Criteria	Percentage of Students(n=30) with Increased Risk Factors for PCOS
Menstrual irregularities	89%
Hirsutism	82%
Alopecia	86%
Acne	77%
Acanthosis	80%

Table 3 Showing percentage of student's responses to important statements included in Stress Management Scale authored by Dr Vandana Kaushik prepared by National Psychological Corporation) were as follows

S. No	Questionnaire Statements	Percentage (%)
1	I find my stressor	60%
2	I recognize my reaction to the stressor	58%
3	I do not try to identify reactions I like to change	38%
4	I try to reduce the intensity of my emotional reaction to the stressor	73%
5	I do not control physical reaction to the stressors.	24%
6	I try to keep smiling	27%
7	I take regular rest.	52%
8	I do not manage my time properly.	60%
9	I do my work so that I feel proud of it.	58%
10	I do not take full control of my task performance.	26%
11	I try to be friendly with others.	48%
12	I do not try to create environment which would keep me calm.	24%
13	I try meditation.	30%
14	I do not analyze my deeds	66%
15	I do not schedule time to relax.	42%
16	I do not log my activities.	30%
17	I try to clear out the obligations.	73%
18	I try to meet the deadlines.	57%
19	I do not try to organize my goals	39%
20	I try to delegate work.	25%
21	I do not try to identify my priorities.	48%
22	I use checklists to check the pending work.	34%
23	I do not focus on one goal at a time.	35%
24	I try to be realistic.	23%
25	I do not plan for the unpredictable	62%
26	I try to motivate myself	40%
27	I do not utilize my capabilities.	57%
28	I use my biological rhythm's	73%
29	I do not plan my leisure time	58%
30	I understand my tasks and responsibilities to the fullest	49%
31	I Stay updated for changes in the work environment.	33%
32	I do not go for massages.	78%
33	I exercise my muscles regularly	23%
34	I do not indulge in hobbies.	53%
35	I do not take measures to relieve stress	77%
36	I do not take proper sleep	65%

Table 4 Scoring System of items for stress management scale authored by Dr. Vandana Kaushik: The responses were marked on a five-point scale: Strongly disagree, disagree, neutral, agree, and strongly agree

Type of Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Positive	0	1	2	4	5
Negative	5	4	3	1	0

Table 5 Positively and negatively worded items in stress management scale authored by Dr. Vandana Kaushik

Type of Item	Item No.	Total
Positive	1,2,4,6,7,9,11,13,17,18,20,22,24,26,28,30,31,33	18
Negative	3,5,8,10,12,14,15,16,19,21,23,25,27,29,32	15
Total Number of Items		33

Positively worded items from students indicate higher proficiency in managing stress and negatively worded items from students indicated low proficiency in managing stress.

Table 6 Pre-validated self-designed questionnaire to assess our research questions objectives

1	Do you know that obese and overweight females have increased prevalence of PCOS?	35%
2	Do you know that key contributor to insulin resistance is obesity?	15%
3	Do you know that in PCOS hyperandrogenism and can be led by secondary hyperinsulinism?	5%
4	Do you know that a key role in determination of body composition is played by androgens?	34%
5	Do you know that men have distribution of fat in android pattern and women have fat distribution in gynoid pattern	52%
6	Do you know that the prevalence of metabolic syndrome i.e atherosclerosis, hypertension and diabetes mellitus is higher in women with android obesity?	15%
7	Do you know that after menopause in females the prevalence of android body habitus increases?	34%
8	Do you know that features of hyperandrogenism are common in females with android obesity?	10%
9	Do you know that there is increased risk of cardiovascular disorders in females with android obesity due to less insulin sensitivity?	24%
10	Do you know that women with PCOS independent of BMI have a high prevalence of android obesity?	23%

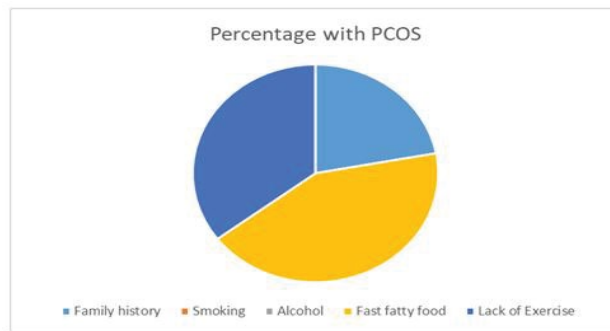


Figure 1 Shows risk factors associated with PCOS among female NBU students

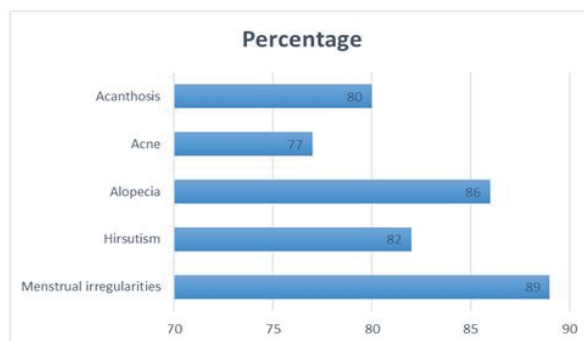


Figure 2 Shows PCOS related clinical features among female NBU students

DISCUSSION

PCOS is a complicated medical condition distressing reproductive-aged females and is upled with metabolic, reproductive, and psychosomatic dysfunctions. The PCOS syndrome is a heterogenous condition characterized by the presence of two out of the following three criteria: (1) anovulation and/or oligo-ovulation, (2) presence of clinical and/or biochemical features of hyperandrogenism, and (3) presence of polycystic ovaries after excluding other causes [6,7]. The causes of PCOS include genetic, dietary and environmental, including behaviour and several unclear causative factors [8]. The clinical features may change with age starting from adolescence to the postmenopausal age [8]. In our study mean age was found to be 13 years. Obesity and metabolic syndrome contestably affect most females with PCOS [9]. In our study, female student who had associated risk factors for PCOS were found to be obese or in overweight category. It highlights that PCOS can cause serious complications related to health problems later. Therefore evaluation of the PCOS is very important. Whereas symptoms related to androgen excess, like menstrual irregularities and infertility are the main complaints of reproductive age group females having PCOS. Our study results were found to be consistent with it and reflect the severity of the manifestations of such PCOS related health problems with proportion of obesity [9]. Earlier studies have shown that affected females are more susceptible to acquire diabetes mellitus type II favoring the development of cardiovascular system [8]. In our study also females who had associated risk factor for PCOS, also had risk factor associated with cardiovascular diseases. PCOS influence life quality and also can worsen stress, panic and despair due to PCOS disease itself or chronic diseases associated with its complication. In our study we tried to analyze the prevalence of stress among female university students and its correlation with risk factors associated with PCOS. Our results showed that females with increased stress also had increased risk factors associated with PCOS. Androgenic and reproductive problems like hirsutism, disturbance in menstruation and infertility have been shown to be the most worrying symptom in adults with PCOS [10]. In adolescents and young females weight difficulties were identified as the most stressful symptom [11]. It has been postulated that there is an increased threat of eating disorder in females with PCOS might have an increased tendency for obesity in them. Central obesity is found to be a common feature of PCOS [12]. Adali, et al. Studies have shown that in females with PCOS, BMI and waist-to-hip ratio (WHR) were significantly greater which was found to be associated with increased emotional distress [13]. Earlier findings support our study which showed that obesity and risk factors associated with PCOS and psychological distress had been found to be associated with each other in students with PCOS [14].

It has been suggested that women with PCOS have a lower self-esteem, due to physical appearance characteristics of hyperandrogenism [15]. Studies results have shown before that PCOS can be caused by increased psychosocial stress [15-17]. Barry et al. showed that females having PCOS had difficulty coping with stress [18]. Lifestyle changes can be the first line intervention in females with PCOS who are overweight. Risk factors associated with PCOS can be managed by diet, exercise and weight control. The females with PCOS there are failure of the follicles to develop so commonly they may have no ovulation. Most cycles are anovulatory and induction of ovulation is essential. It is studied earlier that weight loss can lead to recommencement of ovulation within weeks [19]. Clark and colleagues demonstrated that even a 5% reduction in body mass restores ovulation and fertility [20]. Hence creating awareness regarding associated risk factors for PCOS is very important which one of the aim of our study. The increased risk of PCOS among first-degree relatives and familial clustering reflects presence of a genetic component linked to PCOS [21]. In our study female students with associated risk factors for PCOS had positive family history of PCOS. Frequent consumption of fast food and bad eating habits leads to insulin resistance and increases hormonal imbalance causing risk for development of PCOS. Studies have shown that the person with frequent intake of fast food have 1.7 times greater risk of occurrence of PCOS [22]. Also studies have emphasized that with calorie-restricted diet and attempts to lose weight by physical exercise can help in better control of PCOS [23]. Earlier reports have reflected that participants who are Obese are at greater risk for occurrence of PCOS. Also as obesity enhances the severity of hyperinsulinemia in females therefore physical exercise can be a mainstay in the management of [24]. Excessive consumption of fast food lead to large fluctuations in blood glucose levels causing higher risk for development of PCOS [25]. Many studies including our study have shown that women with PCOS have a lower self-esteem owing to the physical appearance of hyperandrogenism [13,26].

We have been studied earlier that PCOS is closely associated with psychological distress, therefore the PCOS management should tackle psychological problems as well [27] which may reduce motivation which is the key to agreement with medication and dietary management of PCOS [27].

Our study showed findings consistent with studies done earlier and have helped in improvement of knowledge and its management about associated risk factors with PCOS among participants through structured education program, thus has proved to have an important role in early diagnosis of PCOS and also its prevention. Also, structured education program conducted on strategies for effective management of disease may help in preventing many long term complications such as obesity, diabetes mellitus and cardiovascular diseases in the female students who had associated risk factors of PCOS. In addition recommendation being suggested for introducing PCOS and its management as a topic in the curriculum may help the students to play an important role as health care professionals in combating health issues. The study will also help in creating awareness of PCOS, its health impact and management among adolescents there-by possibly preventing and detecting PCOS at an early stage in the target population.

CONCLUSION

PCOS is very common condition with an importance health impact and has significant and varied clinical implications including reproductive and metabolic and psychological features. The relationships between the related psychological aspects and associated clinical characteristics features of PCOS are not yet clear. Our study results will help to establish psychological stressors among female University students of NBU having linked risk factors of PCOS. After screening of the female NBU students with associated risk factors for PCOS, the students were advised to get themselves investigated for the confirmation of PCOS diagnosis, making it possible to start the treatment for them at the earliest, so that students with PCOS will be able to have improved quality of life and it may also help them to prevent having type 2 diabetes mellitus, infertility, anxiety and depression on diagnosing and treating them on time.

DECLARATIONS

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Conflicts of Interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

REFERENCES

- [1] Mehring P. M. "Disorders of female reproductive system. In: Porth CM, Matfin G, editors. *Pathophysiology: Concepts of Altered Health States. China*". Wolter Kluwer Health, Lippincott Williams and Wilkins, 2009, p. 1144-46.
- [2] Ding, Tao, et al. "The prevalence of polycystic ovary syndrome in reproductive-aged women of different ethnicity: A systematic review and meta-analysis." *Oncotarget*, Vol. 8, No. 56, 2017, p. 96351.
- [3] Asuncion, Miryam, et al. "A prospective study of the prevalence of the polycystic ovary syndrome in unselected Caucasian women from Spain." *The Journal of Clinical Endocrinology and Metabolism*, Vol. 85, No. 7, 2000, pp. 2434-38.
- [4] Azziz, Ricardo, et al. "Criteria for defining polycystic ovary syndrome as a predominantly hyperandrogenic syndrome: An androgen excess society guideline." *The Journal of Clinical Endocrinology and Metabolism*, Vol. 91, No. 11, 2006, pp. 4237-45.
- [5] Barth, Julian H., Ephraim Yasmin, and Adam H. Balen. "The diagnosis of polycystic ovary syndrome: The criteria are insufficiently robust for clinical research." *Clinical Endocrinology*, Vol. 67, No. 6, 2007, pp. 811-15.
- [6] Norman, Robert, Ruijin Wu, and Marcin Stankiewicz. "Polycystic ovary syndrome." *Medical Journal of Australia*, Vol. 180, No. 3, 2004, pp. 132-37.
- [7] Balen, Adam H. "Polycystic ovary syndrome and secondary amenorrhoea." *Dewhurst's Textbook of Obstetrics and Gynaecology*, 2007, pp. 377-98.
- [8] Ehrmann, David A. "Polycystic ovary syndrome." *New England Journal of Medicine*, Vol. 352, No. 12, 2005, pp. 1223-36.
- [9] Rojas, Joselyn, et al. "Polycystic ovary syndrome, insulin resistance, and obesity: Navigating the pathophysiological labyrinth." *International Journal of Reproductive Medicine*, 2014, pp. 1-17.

- [10] Kitzinger, Celia, and Jo Willmott. "The thief of womanhood': Women's experience of polycystic ovarian syndrome." *Social Science and Medicine*, Vol. 54, No. 3, 2002, pp. 349-61.
- [11] Trent, Maria, et al. "Overweight status of adolescent girls with polycystic ovary syndrome: Body mass index as mediator of quality of life." *Ambulatory Pediatrics*, Vol. 5, No. 2, 2005, pp. 107-11.
- [12] Gambineri, A., et al. "Obesity and the polycystic ovary syndrome." *International Journal of Obesity*, Vol. 26, No. 7, 2002, pp. 883-96.
- [13] Adali, E., et al. "The relationship between clinico-biochemical characteristics and psychiatric distress in young women with polycystic ovary syndrome." *Journal of International Medical Research*, Vol. 36, No. 6, 2008, pp. 1188-96.
- [14] Elsenbruch, Sigrid, et al. "Determinants of emotional distress in women with polycystic ovary syndrome." *Human Reproduction*, Vol. 21, No. 4, 2006, pp. 1092-99.
- [15] Eggers, S., and S. Kirchengast. "The polycystic ovary syndrome-a medical condition but also an important psychosocial problem." *Collegium Antropologicum*, Vol. 25, No. 2, 2001, pp. 673-85.
- [16] Barry, John A., et al. "Testosterone and mood dysfunction in women with polycystic ovarian syndrome compared to subfertile controls." *Journal of Psychosomatic Obstetrics and Gynecology*, Vol. 32, No. 2, 2011, pp. 104-11.
- [17] Norman, Robert J., et al. "The role of lifestyle modification in polycystic ovary syndrome." *Trends in Endocrinology and Metabolism*, Vol. 13, No. 6, 2002, pp. 251-57.
- [18] Pasquali, Renato, et al. "Clinical and hormonal characteristics of obese amenorrheic hyperandrogenic women before and after weight loss." *The Journal of Clinical Endocrinology and Metabolism*, Vol. 68, No. 1, 1989, pp. 173-79.
- [19] Clark, A. M., et al. "Weight loss in obese infertile women results in improvement in reproductive outcome for all forms of fertility treatment." *Human Reproduction (Oxford, England)*, Vol. 13, No. 6, 1998, pp. 1502-05.
- [20] Latendresse, G. A., McCance K. L., and Morgan K. "Alterations of the reproductive systems. In: McCance KL, Huether SE, Brashers VL, Rote NS, editors. *Pathophysiology: The biologic basics for disease in adults and children*." USA. Mosby Elsevier; 2010, pp. 824-26.
- [21] Legro, Richard S., et al. "Prevalence and predictors of risk for type 2 diabetes mellitus and impaired glucose tolerance in polycystic ovary syndrome: A prospective, controlled study in 254 affected women." *The Journal of Clinical Endocrinology and Metabolism*, Vol. 84, No. 1, 1999, pp. 165-69.
- [22] Diamanti-Kandarakis, Evanthia, et al. "A survey of the polycystic ovary syndrome in the Greek island of Lesbos: Hormonal and metabolic profile." *The Journal of Clinical Endocrinology and Metabolism*, Vol. 84, No. 11, 1999, pp. 4006-11.
- [23] Legro, Richard S., et al. "Diagnosis and treatment of polycystic ovary syndrome: An endocrine society clinical practice guideline." *The Journal of Clinical Endocrinology and Metabolism*, Vol. 98, No. 12, 2013, pp. 4565-92.
- [24] Alvarez-Blasco, Francisco, et al. "Prevalence and characteristics of the polycystic ovary syndrome in overweight and obese women." *Archives of Internal Medicine*, Vol. 166, No. 19, 2006, pp. 2081-86.
- [25] Weber, Bettina, et al. "Testosterone, androstenedione and dihydrotestosterone concentrations are elevated in female patients with major depression." *Psychoneuroendocrinology*, Vol. 25, No. 8, 2000, pp. 765-71.
- [26] Weiner, Cindy L., Margaret Primeau, and David A. Ehrmann. "Androgens and mood dysfunction in women: Comparison of women with polycystic ovarian syndrome to healthy controls." *Psychosomatic Medicine*, Vol. 66, No. 3, 2004, pp. 356-62.
- [27] Barnard, L., et al. "Quality of life and psychological well-being in polycystic ovary syndrome." *Human Reproduction*, Vol. 22, No. 8, 2007, pp. 2279-86.