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A Case Study of Polycystic Ovarian Syndrome

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EASTERN KENTUCKY UNIVERSITY

A Study of Polycystic Ovarian Syndrome

Honors Thesis

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In Partial Fulfillment

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Mentor

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A Study of Polycystic Ovarian Syndrome

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Polycystic Ovarian Syndrome (PCOS) is a physiological disorder that causes many negative effects involving a variety of systems in the body, such as the endocrine, metabolic, psychological, and reproductive systems. This paper will explore the complex mechanisms behind the manifestation of PCOS and how these, and other factors, may make diagnosis difficult. In order to thoroughly understand these aspects of PCOS, the causes, symptoms, and treatments were explored. The diversity of causes and symptoms of the disease add to the difficulty in diagnosis and treatment of PCOS. The best treatment option varies among individuals, and the effectiveness of each treatment can vary according to an individual's condition. The research on all of these aspects of PCOS will inform the public about how PCOS can affect them and their loved ones. From this newly gathered knowledge, individuals may be able to protect themselves from some of the negative consequences associated with PCOS.

Keywords and Phrases: Polycystic Ovarian Syndrome (PCOS), hyperandrogenism, insulin resistance, endocrine, Quality of Life (QoL), Psychological aspects of PCOS

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Polycystic Ovarian Syndrome, commonly known as PCOS, is an endocrine disorder seen in women of reproductive age (Scalzo & McKittrick, 2000). The endocrine system involves chemical signaling in the body. Hormones or other chemical signals may be sent out by the endocrine system in response to a certain stimuli, and the release of these chemicals then leads to certain processes being turned on or off in the body. It is a system of control, as it works to keep our body in a steady rhythm of balance. Polycystic Ovarian Syndrome is estimated to affect four to twelve percent of women throughout the world and is most commonly characterized by hyperandrogenism and insulin resistance, each of which affect sixty to eighty percent of PCOS patients and fifty to eighty percent of PCOS women, respectively (Sheehan, 2004; Garad et al., 2011).

PCOS is the most common endocrine disorder among women of reproductive age, with symptoms of PCOS being seen in pre-pubertal girls, in some cases, and post-menopausal women, in many instances (Thomson et al., 2011). One source calculated that, in the U.S. alone, about four million women, ages fifteen to forty-four, are currently affected by PCOS; this source also noted that this was a very conservative estimate due to the low prevalence rate that was used in the source (Azziz, 2007).

The common age of onset for PCOS is adolescence while the common time of diagnosis is during a woman's third or fourth decade of life because the majority of symptoms do not become evident until a woman reaches her twenties or thirties, even though some symptoms may appear starting at menarche (Dunaif, 1997). Although PCOS is an endocrine disease, it affects many systems of the body resulting in reproductive, metabolic, and psychological consequences (Garad et al., 2011).

This endocrine disorder was first identified in 1935 by Stein and Leventhal who noticed a condition in women characterized by irregular menstruation, obesity, and hirsutism, in addition to cysts on the women's ovaries. Before this time, PCOS was present, but people did not realize what they were seeing. These women were considered "freaks" and often known as "the bearded lady," commonly seen in circus acts or portrayed in certain art work (Kitzinger & Willmott, 2002). Today, much more is known about this common condition, and the recently gathered knowledge includes various diagnostic procedures, a lengthened list of signs and symptoms, multiple treatment options, possible causes, and related conditions (Sheehan, 2004). While research has made great discoveries, it is important to remember that this knowledge really needs to be shared, especially with those who may potentially be affected by this syndrome. Research has shown that most of the general public is uninformed about this common disorder, and it has been recognized that very little information is available in sources that are easily accessible to the average citizen (Kitzinger & Willmott, 2002). Many women diagnosed with PCOS complain about receiving inadequate information about the disorder, even after a diagnosis has been made (Ching et al., 2007). If women are to protect themselves against this condition and its negative consequences, information about PCOS must be available to the general public.

Researchers, as well as the general public, lack a lot of the answers to important PCOS questions. Currently, the cause or causes of PCOS remain unknown. There are many theories, with much evidence pointing towards a genetic link because of the appearance of PCOS in clusters of female relatives and the presence of PCOS in certain individuals before their first menstruation (Franks et al., 2006). The hypothesis of a genetic link is also supported by the fact that both obese and lean PCOS women display insulin resistance which shows that there is an intrinsic defect in the action of insulin for PCOS women, although it is more common and more

severe in obese patients (Dunaif, 1997). The exact pathophysiology of PCOS is very complex and remains largely unknown. There are many suggested etiologies for the development of PCOS. While none of the currently proposed hypotheses have full experimental support, what has become clear is that there is an underlying hormonal imbalance that is created by a combination of increased androgens and the effects of insulin resistance. It has also been discovered that there are genetic and environmental factors that contribute to this hormonal imbalance, and these factors contribute to PCOS when combined with ovarian dysfunction, hypothalamic pituitary abnormalities, and obesity (Garad et al., 2011).

The imbalance found in PCOS involves estrogen, progesterone and androgens, such as testosterone ("Polycystic Ovary Syndrome," 2013). Androgens are considered to be the "male hormones" because they are seen in greater quantities in males, although a small amount of these are needed by women in order to carry out certain vital tasks such as building and maintaining bone and muscle mass. Biochemical features of PCOS include elevated androgens, particularly testosterone, luteinizing hormone (LH), estrogen, insulin levels and decreased Sex-hormone binding globulin (SHBG) levels (Tsilchorozidou, 2004). These biochemical levels are extremely important because SHBG normally binds to testosterone to transport it throughout the body, and while some testosterone is needed in women, too much free or unbound testosterone leads to many problems such as the hirsutism, acne, and male-patterned hair loss seen in many PCOS patients. When it is found that the free testosterone levels are increased and the SHBG levels are decreased, a person's hormones must be regulated in order to help the woman manage her excess levels of androgens, and in turn, her PCOS symptoms (Roush, 2010). This excess testosterone is produced primarily in the ovaries and is caused by increased luteinizing hormone (LH) stimulation from the pituitary and the effect of hyperinsulinemia at the ovary (Sheehan, 2004). In

addition, LH and insulin are important hormones due to their involvement in the production of androgens by the ovaries and the necessity of LH in maintaining a woman's normal menstrual cycle (Roush, 2010).

The genetic component of PCOS may involve the development of ovarian structure and function at an early stage of life, possibly in utero, during ovarian development and oogenesis (Franks et al., 2006). Oogenesis is the process of formation of the female gametes, oocytes ("Medical Dictionary," 2013). Evidence supporting a genetic basis for PCOS, and its associated hyperandrogenism and hyperinsulinemia, has been found in a variety of studies. Certain studies observed girls who displayed PCOS symptomology before their first period. Additional supporting research studies found PCOS to occur in clusters of relatives, including siblings (Franks et al., 2006).

While many studies support a genetic link, the mode of inheritance remains unclear, with only projected answers to that question and no agreed upon explanation (Franks et al., 2006). It is most likely that the cause is oligogenic or polygenic, meaning that it is a hereditary characteristic that is produced by one or only a few genes, or by several genes, respectively ("Medical Dictionary," 2013). Multiple genes may be involved, while it is also possible for the cause to be an autosomal dominant mechanism (Franks et al., 2006). An autosomal dominant mechanism of inheritance refers to a trait that is inherited without respect to sex, meaning it does not involve a sex chromosome ("Medical Dictionary," 2013). Genes that are being considered as the source of the defect or defects are genes involved in the androgen biosynthetic pathway, genes that affect the action and/or secretion of insulin, and genes that influence folliculogenesis (Franks et al., 2006).

As the influence of specific genes remains veiled in ambiguity, the importance of Insulin Resistance's (IR) influence on PCOS patients has been recognized (Moran et al., 2003). Many scientists suggest a link between androgen levels and insulin levels (Tsilchorozidou, 2004). Insulin directly stimulates thecal cells to produce androgens, and elevated levels of androgens are related to many of the problems or symptoms seen in PCOS. Insulin also causes a decrease in the production of hepatic Sex Hormone Binding Globulin (SHBG) (Moran et al., 2003). The hyperinsulinemia seen in PCOS most likely results from increased secretion of basal insulin along with decreased hepatic insulin clearance, but why this occurs is not completely understood (Dunaif, 1997). Basal insulin refers to the lowest possible level of insulin ("Medical Dictionary," 2013). Through its effects of increasing androgen production and decreasing hepatic SHBG production, insulin is a major contributor to hyperandrogenism and its associated clinical manifestations. This proposed relationship has been supported by research which found that reduced androgens were seen with improvements in insulin sensitivity, fertility, and menstrual regularity (Moran et al., 2003). In another study, hyperinsulinemia was seen in PCOS women, independent of obesity, and the PCOS women with hyperinsulinemia showed a significant linear correlation between insulin and androgen levels. Additional results from this same study also suggest that hyperinsulinemia has an impact on ovarian morphology and function because a positive correlation was seen between hyperinsulinemia and ovarian stromal hyperthecosis (Dunaif, 1997). Ovarian stromal hyperthecosis involves islands of luteinized theca cells and excessive hyperplasia within the ovarian stroma which means that an excessive transformation of mature ovarian follicles into a corpus luteum and an abnormal increase in the number of normal cells in the typical arrangement of the supporting tissue of the ovaries has taken place (Dunaif, 1997; "Medical Dictionary," 2013).

There may also be a defect in the insulin receptors in which the receptors are unable to adequately carry out phosphorylation of the substrate because the serine phosphorylation of the insulin receptor inhibits the tyrosine kinase activity of the receptor which affects signaling that involves insulin. This defect may be the cause behind the insulin resistance in PCOS women, but why or how this defect occurs remains a mystery (Dunaif, 1997).

The exact etiology of this defect is currently unidentified, but it has been discovered that defects found in the insulin receptors are not related to sex hormone levels, meaning that the irregularities involving insulin are intrinsic. From this same study, it was also gathered that fibroblasts from PCOS women exhibited no change in the binding or receptor affinity of insulin, but there was a decreased insulin receptor autophosphorylation in fifty percent of fibroblasts of the PCOS women (Dunaif, 1997). While some studies point to the insulin receptors, others state that there is a defect in insulin action that does not involve the receptor but rather occurs somewhere along the process in which the role of the receptor has already been carried out. The reason behind this hypothesis is because it coincides with the molecular research results that show no structural abnormalities in the insulin receptors (Tsilchorozidou, 2004). In addition, a pancreatic B-cell secretory dysfunction has been found in PCOS. This dysfunction involves a defect in which Beta cells in the pancreas do not properly and effectively make insulin (“Medical Dictionary, 2013”) The pancreatic B-cell dysfunction that is present leads to insufficient insulin secretion, and even when weight loss occurs, the B-cell dysfunction remains, which suggests that the B-cell abnormality may be the primary irregularity in PCOS (Tsilchorozidou, 2004).

Another important question regarding PCOS and its etiology is how the maternal environment may affect the fetus. It is likely that the development of PCOS is due primarily to a genetic predisposition for the fetal ovary to hypersecrete androgens. While it is possible for the

maternal environment to affect the fetus, it is more likely that the placenta will prevent the maternal androgen excess from directly affecting the fetus; however, maternal metabolic disturbances, such as insulin resistance and glucose intolerance could affect the development of PCOS in the fetus. An example of this would be the effect of gestational diabetes on increased birth weight. Although the degree to which the maternal external environment affects the fetus is still unclear, much evidence has been found for the importance of fetal life as the time of origin for the development of PCOS. Certain studies involving animals, particularly rhesus monkeys, support this proposal because observations of rhesus monkeys suggest that exposure of the fetal hypothalamic-pituitary ovarian axis to excess androgens can lead to a sequence of events which result in both the reproductive and metabolic consequences of PCOS (Franks et al., 2006). The fetal hypothalamic-pituitary ovarian axis refers to the effects of the hypothalamus, pituitary gland, and ovaries on the fetus and how they relate to development and regulation of a number of body systems (“Medical Dictionary,” 2013). Furthermore, exogenous androgens have been shown to affect ovarian follicular development both in the rhesus monkey and in the sheep (Franks et al., 2006). Due to the complexity and heterogeneity of the disease, many professionals hypothesize that there are multiple pathophysiological mechanisms at work in PCOS (Tsilchorozidou, 2004).

As mentioned previously, PCOS affects many different body systems which is seen in the numerous and varied symptoms associated with the disease. An individual may present with a variety of reproductive, metabolic, and psychological problems. Reproductive problems may include infertility and various pregnancy complications and clinical signs of androgen excess. Metabolic problems may include insulin resistance, metabolic syndrome, impaired glucose tolerance (abnormal glucose metabolism), Diabetes Mellitus two, and potentially cardiovascular

disease (Garad et al., 2011). Metabolic syndrome refers to a condition in which an individual has two of the following health problems: increased triglycerides, decreased High Density Lipoprotein (HDL), increased fasting glucose levels, hypertension, and abdominal obesity (“Medical Dictionary,” 2013). Psychological problems may include reduced quality of life, poor self-esteem, depression, anxiety, and possibly eating disorders (Garad et al., 2011).

Hyperandrogenism is a primary hallmark of PCOS, and it shows up clinically as hirsutism, moderate to severe acne in adolescence or development or persistence of acne into adulthood, male pattern alopecia, and skin tags (Sheehan, 2004; Huber-Buchholz et al., 1999). These elevated testosterone levels also lead to menstrual irregularities, recurrent miscarriages, fetal abnormalities, obesity, primarily abdominal, and infertility (Sheehan, 2004; Huber-Buchholz et al., 1999).

The majority of PCOS women have irregular periods with menstruation being very erratic, infrequent, or painful, with an increase in flow and cramping. Chronic anovulation may present as oligomenorrhea, amenorrhea, dysfunctional uterine bleeding, and/or infertility (Sheehan, 2004). Oligomenorrhea refers to infrequent or very light menstruation while amenorrhea refers to the absence of menstrual periods for three or more months in a row (“Medical Dictionary,” 2013). Reproductive symptoms may include anovulation and miscarriages, among other things. One source stated that seventy five percent of anovulatory infertility is due to PCOS, and that PCOS women have a thirty to fifty percent first trimester miscarriage rate (Sheehan, 2004) while another noted that seventy to ninety percent of oligo-ovulatory infertility is caused by PCOS, making PCOS the most common cause of this type of infertility. A certain document went as far as to say that PCOS is the most important single cause

of infertility in women because according to their research, fourteen to thirty two percent of infertile women have PCOS (Azziz, 2007).

A fair amount of PCOS women do have weight problems because of the metabolic abnormalities seen with the disease. Depending on the population looked at, sixteen to eighty percent of PCOS women are obese (Dunaif, 1997). Insulin resistance and metabolic syndrome may be seen in conjunction with high waist circumference, high Body Mass Index (BMI), and abnormal SHBG (Garad et al., 2011). Insulin resistance has also been known to cause acanthosis nigricans which are brown or black velvety patches of skin that appear hyperpigmented and are usually seen on the necks, thighs, and armpits of PCOS patients who have insulin resistance (Dunaif, 1997). Insulin resistance, obesity, and PCOS form a vicious cycle because one can cause the others, be caused by the others, and make the others worse. IR is very common in PCOS; however, a woman can have PCOS without having IR because there are multiple PCOS phenotypes, and just like with any other PCOS symptoms, there are varying degrees of IR (Thomson et al., 2011).

In addition, to the clinical features of PCOS, the biochemical signs and symptoms may include elevated serum testosterone and luteinizing hormone (LH) levels, usually seen with, normal serum Follicle Stimulating Hormone (FSH) concentrations. A situation can also be seen in which some hirsute women with polycystic ovaries have normal serum concentrations of testosterone, but androgen production rates are increased (Franks et al., 2006). PCOS women with insulin-resistance also display increased insulin levels, and possibly elevated LDL and decreased HDL levels (Roush, 2010). With all of these life-changing and potentially distressing symptoms, it seems logical that PCOS would also have a substantial amount of psychological symptoms.

The members of the general public who are aware of Polycystic Ovarian Syndrome are most acquainted with the physiological aspects of the disorder, but what many do not realize is that there is a large portion of PCOS symptoms that are psychological in nature. Various studies have looked at the incidence of depression, anxiety, body image, self-esteem, and eating disorders in patients with PCOS (Garad et al., 2011). Numerous studies have shown a reduced quality of life for PCOS women, and this poor quality of life infiltrates every part of a woman's life. The psychological stress associated with PCOS has been found to cause sexual dissatisfaction, aggression, bodily pain, infertility, weight difficulties, menstrual irregularity, and poorer interpersonal functioning (Barnard et al., 2007; Kitzinger & Willmott, 2002). Hirsutism, menstrual irregularity, and infertility have been found to be the most distressing symptoms for the majority of PCOS women (Barnard et al., 2007; Kitzinger & Willmott, 2002). It has been discovered that PCOS has a more substantial negative impact on psychological quality of life (QoL) than other chronic condition including, but not limited to, asthma, epilepsy, diabetes, cardiac disease, and arthritis (Coffey et al., 2006).

Depression and anxiety are the two most studied psychological problems related to PCOS. These two psychological problems have been examined by looking at quality of life questionnaires administered to women diagnosed with PCOS. Numerous studies have found a greater incidence of depression and anxiety, with greater severity, in PCOS women (Garad et al., 2011). A study conducted by Barnard et al. (2011) found that PCOS patients, including women taking and not taking anti-androgen medications, had lower Quality of Life scores, than women without PCOS, on all seven factors that were looked at using the modified PCOS questionnaire. These seven factors were: emotional disturbance, weight, infertility, acne, menstrual symptoms, menstrual predictability, and hirsutism. The results from this study indicated that weight was the

greatest contributing factor to the lower QoL scores, both in women without PCOS and those with PCOS. This study also compared those taking and not taking anti-androgens and found that the women taking anti-androgens usually had higher QoL scores than women not taking anti-androgens, but, regardless of the circumstances, weight concerns had the greatest impact on QoL in the PCOS population. The proposed explanation for these results is that there are systematic differences between women taking and those choosing not to take anti-androgens. In addition, there are many positive effects that come from the use of anti-androgens, and the combination of these two factors are likely the cause of the better quality of life seen in anti-androgen users. Two-thirds of the women investigated in this study who suffered from PCOS displayed some level of depression, and when depression was found, it was seen to be more severe in PCOS women. This same study actually found a two-fold increase in the prevalence rate of depression seen in women with PCOS versus those without. The overall conclusion from this research was that there is a higher prevalence of depression and poor QoL in PCOS women, and the psychological aspects of PCOS need to be addressed in the diagnosis and treatment of each individual (Barnard et al., 2011).

Anti-androgens seem to have a positive impact on quality of life, and oral contraceptives have also been shown to lead to alleviation of psychological complications involved with PCOS (Barnard et al., 2011). Rasgon et al. (2003) found that PCOS women taking oral contraceptives (OCPs) were significantly less depressed than those not taking oral contraceptives. That same study noted that twenty-nine percent of PCOS patients taking OCPs displayed depression, compared to the sixty-six percent prevalence of depression in untreated PCOS patients (Rasgon, 2003). Another aspect of depression that has been looked at in women is the correlation between testosterone and depression. Weiner et al. (2004) found there to be curvilinear relationship

between testosterone levels and depression in women with and without PCOS. The most severe depression was associated with testosterone levels just outside the normal female range; testosterone levels higher or lower than this were associated with lower levels of depression (Weiner et al., 2004). The reasons behind this finding are not known, but more research is being done to look at the relationship between depression and testosterone levels in women.

Depression has particularly been associated with insulin resistance and Body Mass Index (BMI) in PCOS women (Rasgon, 2003). In the study conducted by Rasgon et al. (2003), the researchers found that ten percent of the general population has depressive symptoms and/or disorders while fifty percent of the PCOS women they sampled had results that indicated the presence of depression. Since insulin resistance usually leads to increased obesity, mood fluctuations, due to the body's sensitivity to changes in blood sugar, and BMI, it is logical to see this association between IR and PCOS markers. Research has indicated that insulin resistance is a cardinal feature in the pathophysiology of PCOS (Franks, 1995). Insulin also affects central serotonin (5-HT) levels; serotonin is an important neurotransmitter involved in depression (Figlewicz, 1999). Central 5-HT system dysregulation, that causes depression, may concurrently affect peripheral insulin sensitivity (Okamura et al., 2000). Peripheral insulin sensitivity refers to the failure of target tissues to increase glucose disposal in response to insulin ("Medical Dictionary," 2013). The mechanism behind this is not understood, but it may possibly occur via some sort of behavioral and/or neuroendocrinologic pathway (Okamura et al., 2000). While these explanations are not complete, experimentation points to the explanation that insulin resistance may be the common pathological link between depression and PCOS, and ongoing research is being conducted to try and determine the exact biochemical mechanism involved (Rasgon, 2003).

Another correlation was found between body mass index (BMI) and quality of life with increased BMI being associated with poorer quality of life scores in the areas of physical function, role physical, bodily pain, general health, vitality, mental health, and the physical component score of social function, with more difficulties in psychological health for the PCOS women rather than problems pertaining to physical functioning. However, this study did not find a difference between “normal” and PCOS women in quality of life based on socioeconomic status, when comparing age and weight matched women with or without PCOS. It was found that there was a sixty-two point four percent psychological morbidity found in the PCOS women, compared to the twenty-six point four percent found in the group without PCOS (Ching et al., 2007). Psychological morbidity refers to a departure from a state of psychological well being resulting from disease, illness, injury, or sickness (“Medical Dictionary,” 2013). This study used a questionnaire to assess quality of life and the levels of distress caused by particular symptoms seen in PCOS and then compared those results to women surveyed in the general population who do not have PCOS. Overall, the results of this study indicated that the PCOS population has impaired QoL and an increased incidence of psychological morbidity when compared with population norms. This source also noted that the long-term health implications of PCOS can affect an individual’s quality of life. These results were most likely brought about due to poor body image and decreased self-esteem which many PCOS women experience. This explanation is a tentative one, but this source did note that if this explanation is correct, then this needs to be addressed in treatment of PCOS women (Ching et al., 2007).

Strongly associated with BMI is body image distress. It has been discovered that the increased body image distress that is seen in PCOS often leads to increased depression and lower self-esteem which can bring about complications in the realms of symptomology and treatment

(Rosen & Reiter, 1996). One study indicated that the sample of PCOS women presented with a much higher incidence and degree of body image distress than that seen in women with comparable BMI who were also seeking “weight management interventions” (Sarwer, 1998). Rosen and Reiter (1996) reported that seventy-one percent of PCOS women interviewed displayed clinically significant levels of body image distress, and more than half felt a persistent and unrelenting sense of unhappiness about their size, with the mean scores for the entire sample falling on or above the cut-off for clinically significant levels of body image disturbances. These results support the idea that body image distress is a major issue for PCOS women. This key issue is often disregarded, and steps should be taken in treatment to address this psychological problem associated with PCOS.

One reason that PCOS can be very distressing is because diagnosis can be extremely frustrating with some women having to go through a long process of tests and doctors visits before finding out what is wrong with them. Because much is still unknown about PCOS, these women may not get the adequacy of answers that they were looking for. In addition, many PCOS women have stated that they did not receive enough, in-depth education and information about PCOS and all that it entails. A certain study found evidence for the idea that reduced QoL in psychological domains, for PCOS women, is related to the quality of information that the patient had acquired about their disorder. Patients who believed they had received sufficient information, especially in the areas of hirsutism, mental disturbance, and long-term health, had significantly higher QoL scores (Ching et al., 2007). Patients with PCOS also face many distressing symptoms, and while some research points to specific symptoms that lead women to increased depression and anxiety, the fact of the matter is that there are many complex hormonal, metabolic, and reproductive features of PCOS that make determination of the root cause of

depressive and anxious symptoms difficult to identify. Possible symptoms that are being investigated include insulin resistance, androgen levels, acne, hirsutism, obesity, and infertility (Garad et al., 2011).

While psychological distress may not be able to be linked to one particular parameter of PCOS, it is certain that many PCOS symptoms are “painful, uncomfortable, unpredictable, and associated with characteristics that are culturally defined as unfeminine and undesirable” (Barnard et al., 2007, p. 2279). Barnard et al. conducted interviews with PCOS women in which the themes of “freakishness” and a perceived inability to conform to “normal” feminine parameters prevailed revealing that PCOS women have a negative perception of themselves because of certain symptoms experienced (Barnard et al., 2007). It has also been discovered that the patient’s perception of the severity of her symptoms is more important than assessment of the severity of symptoms carried out by a medical professional (Ching et al., 2007). The idea that personal perception is more important than medical assessment can lead to a vicious cycle involving a patient’s perception of symptoms and their psychological distress or morbidity. In addition to the impact that symptoms play on a patient’s psychological well-being, there are biochemical disturbances associated with PCOS that may lead to mood disturbances, although more research is needed in this area (Barnard et al., 2007).

Hirustism in particular has been found to have major implications for an individual’s quality of life and psychosocial wellbeing (Azziz, 2007). Multiple people have studied the psychological repercussions associated with hirsutism in PCOS women. A few of these studies include the research done by Sonino et al. (1993) and Barth et al. (1993). Sonino et al. (1993) identified greater anxiety, psychotic symptoms, and social phobia in hirsute women, while Barth et al. (1993) noted that twenty-seven percent of women undergoing treatment for hirsutism

exhibited psychological morbidity, and sixty-eight percent reported avoiding some social situations because of self-consciousness. It has also been shown that self-reported problems with hirsutism are associated with poorer QoL, particularly social functioning because many PCOS patients are embarrassed about their hirsutism. This embarrassment leads these women to feel uncomfortable in certain situations and possibly even avoid them (Ching et al., 2007).

Menstrual irregularities and unpleasant menstrual symptoms have also been shown to be an area of great concern and distress. In one study, it was discovered that menstrual symptoms were the second biggest area of concern in PCOS women (Barnard et al., 2007).

Anovulation, a type of menstrual irregularity, can lead to many fertility problems, seen especially in PCOS women. Difficulties conceiving, pregnancy complications, and engagement in infertility treatment programs can be very psychologically damaging for many individuals, and unsuccessful fertility treatments lead to increased levels of anxiety and depression in all women, but even more so in women with PCOS. This increased anxiety and depression is very important because it has been discovered that the higher levels of depression and/or anxiety are associated with a lower success rate for *in vitro* fertilization (IVF) and gamete intrafallopian transfer (GIFT) treatment cycles (Galletly et al., 1996).

Many of the problems mentioned above lead to avoidance, whether its avoidance of physical activity, healthy eating habits, social situations or dating and romantic interests. One source mentioned a few studies related to the sexual desire and avoidance of romantic relationships seen in PCOS. Gorzynski and Katz (1977) found that sexual drive was heightened in women with PCOS. From these results, it was proposed that young PCOS women may experience confusion and distress due to the “sense of uncontrollable sexual urge” that is

sometimes experienced by PCOS patients (Gorzynski & Katz, 1977). Further research has linked PCOS with ‘abnormal’ sexuality. One such study was conducted by Meyer and Zerssen (1960) who recognized a “deep rooted insecurity” concerning the sexual role of patients with hirsutism, especially those with PCOS. Another study noted that dating and romantic interests are frequently disrupted due to the psychological problems associated with PCOS and the insecurity and confusion felt by these women (Money & Clopper, 1974). This conclusion was also supported by the research of Michael et al. (1996) which suggested that the physical unattractiveness felt by many PCOS patients affected these women’s ‘abnormal’ sexual desires. The overall theme that keeps appearing is that failure to live up to the expected or ideal views of femininity leads to deviant sexuality in PCOS women (Michael et al., 1996).

The chronic, complex, and often frustrating nature of PCOS frequently leads to negative psychological consequences which subsequently lead to decreased motivation and confidence (Garad et al., 2011). This loss of motivation and confidence is very detrimental for PCOS patients because the most important aspect of treatment is lifestyle modification because an individual can make positive changes to aid in the maintenance of PCOS and insulin resistance. If motivation is lacking, it is harder for these women to make the necessary changes in their lives, such as following dietary, pharmaceutical, and physical activity guidelines (Barnard et al., 2007). A vicious cycle has also been noted involving treatment compliance and body image distress. Many PCOS patients, especially those who struggle with weight and appearance traits, such as hirsutism or acne, have been seen to experience more body image distress. This distress has led many women to feel uncomfortable in certain situations, especially exercise participation, this, along with the decreased motivation, perpetuates the negative consequences related to PCOS, obesity, and psychological distress. In fact, Liao et al. (2008) reported that about half of

the PCOS women interviewed stated that they often avoid physical activity because of the way they felt about their size. While some individuals are not aware of the psychological implications of PCOS, it is vital to inform women of these risks, and to incorporate psychological management into the treatment plan because treatment of psychological symptoms, particularly depression, will also have a positive impact on other features of PCOS, including weight management, insulin resistance, and endocrine disturbances. It has also been suggested that treating the depression may help in preventing comorbid conditions from arising or from getting out of control (Barnard et al., 2011).

One source noted the importance psychological symptoms for PCOS women by mentioning that all of the necessary personal changes involved with PCOS cannot be carried out without the desire of the individual. This source suggested that all women should be screened for disordered eating behaviors at time of diagnosis, before referrals or weight-loss treatments are suggested. These recommendations were given because there has been a higher incidence of eating disorders found in PCOS women, with binge eating and fasting being seen most often. Proposed explanations for this trend include the idea that many eating disorders and body image problems arise during adolescence which is also when many of the symptoms of PCOS first become prominent. The added physical and psychological stress of PCOS symptoms during this vulnerable time is believed to be a major contributor to this trend (Scalzo & McKittrick, 2000). Barnard et al. (2007) proposed that because there is a greater risk of obesity in PCOS women, there is also a higher risk of eating disorders. Another reason for disordered eating in PCOS is because a large part of lifestyle modification is diet and nutrition. PCOS women are told that they should follow food guidelines in order to help in alleviation of certain PCOS symptoms. The body image distress that many PCOS women feel eventually leads to loss of control of

healthy eating, and perhaps activity habits, which leads to further weight gain and various eating disorders (Liao et al., 2008). Some women become meticulous about food selection and the intake process to the point that it becomes very unhealthy. While these women may feel that if they severely limit themselves, they will become healthier and will have fewer PCOS symptoms or a lower severity of symptoms, the truth is that the extreme peaks and valleys of energy associated with these extreme eating habits contribute to and worsen insulin resistance. This is the case whether the individual is lean or obese (Scalzo & McKittrick, 2000).

Another source of distress is the treatment process for PCOS because different doctors take diverse approaches, and each treatment option will produce variable outcomes in different patients. With PCOS, women are more likely to develop serious life-long comorbidities, to take larger quantities of medicine, to have higher BMI, and to experience only partial success in alleviating or eliminating PCOS symptoms. Because of these facts, it is logical to note that PCOS women show a higher incidence of psychological morbidity. It has been suggested that psychological treatment should be carried out on a case-to-case basis in order to address the aspects of the disease that are most troubling to each individual (Barnard et al., 2007). Support for this proposal comes from a study in which psychological counseling was shown to improve body image, regardless of weight loss (Rosen, 1996).

With all of these troubling aspects of PCOS, it makes sense, when interviewed, the majority of PCOS women noted pervasive feelings of “freakishness”, “abnormality”, and of not being a “proper” woman. According to the women interviewed, the ideal woman would have regular menstruation, the ability to bear children, and would have smooth, hairless faces; many of these women did not meet their own criteria. Due to the women’s symptoms of hirsutism, menstrual irregularities, and infertility, the women stated that they felt less “feminine” and

“different” from other, “normal”, women. This source suggested that because PCOS has been, and still is, widely unknown by the general public, it remains a “deeply stigmatizing condition”, a “theft of womanhood.” The stigma placed on PCOS has many serious implications for PCOS patients, whether or not they conform to “feminine norms” (Kitzinger & Willmott, 2002).

An added frustration and deterrent of psychological well being is the diagnostic process. Overall, PCOS is diagnosed based on the presence of signs and symptoms of hyperandrogenism when seen in conjunction with menstrual irregularities while excluding other possible causes. Clinical signs of hyperandrogenism include, but are not limited to, acne, hirsutism, and abdominal obesity (Scalzo & McKittrick, 2000). However, diagnosis of PCOS can be very difficult for a variety of reasons. One such reason is that there is no one specific test or one universally accepted criteria that are used to diagnose PCOS, but rather, there are multiple tests and criteria that may be used. To add to the confusion, many of these tests show inconclusive results by themselves and must be used in conjunction with each other in order to come up with a diagnosis (Tsilchorozidou, 2004). The lack of one universally-accepted diagnostic test causes doctors to use a patient's clinical history and a few lab tests in order to make a diagnosis (Sheehan, 2004). While this may be enough to make a diagnosis, it leaves a lot of room for uncertainty and error which helps to explain why PCOS is often misdiagnosed or goes undiagnosed (Scalzo & McKittrick, 2000). Another difficulty with diagnosis is that many symptoms of PCOS are associated with many other diseases; therefore, doctors have to do differential diagnoses in order to rule out other possible causes of the symptoms (Sheehan, 2004). Conditions such as thyroid dysfunction and hyperprolactinaemia must be excluded biochemically while other conditions, including Cushing's syndrome, androgen-producing tumors, and nonclassic congenital adrenal hyperplasia, need to be ruled out clinically. Not every

PCOS woman exhibits the same symptoms or the same degree of symptoms which increases the complicated nature of diagnosis, and different doctors may take different approaches to the diagnostic procedure. Because of this, clinical practice and treatment suggestions are also varied and inconsistent, with certain aspects of the disease often being neglected, such as the psychological issues and the focus on lifestyle modification. In addition, PCOS, although common, is still little known by the general population; therefore, a woman may be having symptoms of PCOS and not recognize the possibility of PCOS. The public is also not well informed about the serious implications that PCOS, and its related insulin resistance, has. This lack of information, could lead to even more serious complications if the correct diagnosis and treatment are not performed. Because of the heterogeneity of this syndrome, PCOS women may present with varied symptoms to many different types of doctors who do not have expertise in PCOS. The variety of medical professionals who treat potential PCOS patients is important because health professionals lack the in-depth knowledge of PCOS that is required to recognize, understand, and diagnose the disease (Garad et al., 2011).

As mentioned previously, different women have different PCOS symptoms and to different degrees; along with this, there is the matter of certain test results being skewed or inconclusive. For example, PCOS causes increased androgens; therefore, women's blood tests should indicate increased testosterone, but testosterone may appear normal in these blood tests because birth control lowers total testosterone. This fact can make interpretation of test results difficult and diagnosis challenging. In fact, birth control can affect many biochemical or hormonal levels which may prevent certain PCOS symptoms from appearing on tests. Women may also develop symptoms at different times of their lives with some women developing

symptoms at menarche and others developing symptoms later in life, sometimes after gaining a certain amount of weight (Sheehan, 2004).

Another type of test whose results can be confusing is the pelvic ultrasound. The approach to ultrasound and lab evaluation is widely varied without any consensus as to which method is the best, even among experts (Sheehan, 2004). Much confusion is due to the fact that many women have polycystic ovaries but do not have polycystic ovarian syndrome.

Approximately twenty-five percent of women have polycystic ovaries on ultrasounds, but only four to twelve percent of women have PCOS, and some PCOS women may not have cysts on their ovaries (Tsilchorozidou, 2004). Therefore, an ultrasound showing ovarian cysts is not needed to diagnosis PCOS, which can be very confusing for consumers and patients who are not familiar with PCOS (Scalzo & McKittrick, 2000). Another complication is that ten cysts measuring greater than or equal to two to eight mm around a dense core of stroma or scattered within an increased amount of stroma must be present in order to diagnose PCOS (Tsilchorozidou, 2004). The difficulty of using this criterion can be seen in the following example. If a woman has eight cysts with some being four mm in diameter and some being one mm in diameter, is it truly correct to say that this woman does not have PCOS? This example serves to show that, while these criteria are helpful in theory, they can be difficult to use in practice as lines are blurred between what is and what is not PCOS. In addition, new information about PCOS is continuing to be found, thus causing changes in criteria and leading to increased diagnostic complications in determining a set criteria.

One of the major signs or symptoms of PCOS is irregular menstruation; however, not all PCOS patients exhibit this ovulatory dysfunction. In fact, up to forty percent of women with oligo-ovulation secondary to PCOS can exhibit a history of "normal menstruation." This

complicates matters because periodic vaginal bleeding cannot be assumed to involve ovulation if the woman is suspected of having PCOS (Azziz, 2007).

Various combinations of tests and diagnostic methods may be utilized, and results can be difficult to interpret especially when using tests to assess insulin resistance. None of the tests used to for insulin resistance are very specific or sensitive, and some professionals even argue that the only assessments needed are fasting lipids and glucose (Sheehan, 2004). Another difficulty to diagnosing insulin resistance is that twenty-five percent of normal subjects have insulin action values that overlap with those from insulin resistant individuals because there is a wide range of insulin sensitivities that are seen in "normal" individuals, individuals not diagnosed with IR (Dunaif, 1997). New strides are being made, and it is now recognized that a two hour glucose tolerance test may be a better predictor of insulin resistance (IR) than fasting glucose. However, this better diagnostic practice is still not universally used, but it may cause the betterment of therapeutic decisions, as its use becomes more widespread because this test is extremely useful in determining an individual's risk for type two diabetes (Sheehan, 2004). The betterment of diagnostic testing is extremely important in relation to PCOS because early diagnosis can lead to prevention and better management of the possible risks associated with Polycystic Ovarian Syndrome.

PCOS is a complicated and distressing disorder on its own, but what many people do not realize is that PCOS can increase a woman's risk for many other serious health problems. The greatest concerns are cancer, cardiovascular disease, and insulin resistance, which can lead to type two and gestational diabetes. PCOS can potentially increase a woman's risk for endometrial carcinoma by three-fold, due to infrequent periods which cause endometrial buildup and possibly endometrial cancer (Sheehan, 2004). However, how common these endometrial abnormalities

are remains to be seen, and more research is needed, on a larger-scale, in order to make more accurate assertions (Azziz, 2007).

Cardiovascular Disease is another area of concern in which more research is necessary to truly determine its association with PCOS. Research has shown that, due to the many strains that insulin resistance and obesity put on the body, a PCOS patient exhibiting these two conditions has an increased risk of coronary artery disease, dyslipidemia, and hypertension (Sheehan, 2004; Dunaif, 1997). In particular, the hyperinsulinemia associated with PCOS can cause abnormal lipid metabolism, leading to elevated LDL and triglyceride levels and decreased HDL levels (Scalzo & McKittrick, 2000). This abnormal lipid metabolism causes the body to enter a state in which there is an irregular or elevated level of lipids or lipoproteins in the blood, known as dyslipidemia (“Medical Dictionary,” 2013). All of these factors contribute to the fact that, as much as, a seven-fold increased risk of myocardial infarction and a six-fold increased risk of coronary artery calcification have been found in PCOS women (Sheehan, 2004). Myocardial infarction refers to an episode in which some of the heart's blood supply is severely cut off or restricted, causing the heart muscle to suffer and die from lack of oxygen (“Medical Dictionary,” 2013). Increased insulin can also lead to abnormal clotting factors, which also increases an individual's risk for developing heart disease (Scalzo & McKittrick, 2004). Currently, adequate evidence for an increased incidence of cardiovascular disease and events in PCOS is still lacking, but it is certain that these women are at a higher risk for developing cardiovascular problems and/or complications (Azziz, 2007). These increased risks for developing CVD are extremely important and must be monitored because CVD disease is currently the number one killer of women in the United States, with more than one in three adult females in the U.S. having some form of CVD (Gillespie et al., 2013).

Another cause of many deaths for women in the U.S. is diabetes. Currently, 12.6 million, or 10.8 percent of, women in the U.S., over the age of twenty, have diabetes, and diabetes is the seventh leading cause of death as of 2011 (Centers for Disease Control and Prevention, 2011). One source stated that thirty-one percent of PCOS women have impaired glucose tolerance and seven and a half to sixteen percent have type two diabetes with PCOS women being three to seven times more likely to develop type two diabetes than weight matched controls (Sheehan, 2004; Scalzo & McKittrick, 2000). Even at seven and a half percent incidence, these women display a four-fold increase in prevalence of type two diabetes when compared to women of similar age in the general population. This increased prevalence of type two diabetes is correlated with the insulin resistance and obesity seen in PCOS patients (Azziz, 2007). Increased insulin resistance and obesity also put PCOS women at a ten-fold increased risk for gestational diabetes mellitus (Sheehan, 2004).

Because there are many secondary disorders, the exact etiology of PCOS is still widely unknown, women exhibit different symptoms to varying degrees, and there is not one set protocol for diagnosing PCOS, treatment options are diverse, and response to the treatment option chosen is variable. Not all patients will respond to treatment, and when a patient does respond to treatment, the responses are often incomplete with no alleviation of some symptoms and marginal mitigation of others. Another difficulty in the management process is that a six to twelve month period of time is needed before a professional can determine the effectiveness of a treatment option (Sheehan, 2004). The complexity of treatment and the complexity of diagnostic process are similar in that there is no universally accepted method or recommendations. Therefore, various treatments will be prescribed and suggested treatment will be based on each individual case.

The main goal of treatment is to manage or alleviate a patient's symptoms. Different treatment options may be suggested according to which symptoms are most prevalent or depressing for a particular PCOS patient. According to one document, the focus of management should be on education and support with a strong emphasis on healthy lifestyle in order to manage and prevent major negative consequences of PCOS. This same source also stated that appropriate medical therapies should be implemented when needed (Sheehan, 2004). One such medical therapy often used in treatment is Metformin. Metformin is an oral anti-diabetic drug, often prescribed for type two diabetes, that suppresses glucose production by the liver, lowering plasma glucose levels (Dunaif, 1997). This insulin sensitizing drug has been shown to lead to amelioration of many of the symptoms seen with PCOS including weight gain, fatigue, headaches, hirsutism, and menstrual abnormalities. While the benefits of Metformin are more pronounced when accompanied by weight loss, this drug has been shown to decrease hyperandrogenism and hyperinsulinemia regardless of weight loss (Scalzo & McKittrick, 2000). Metformin, along with other insulin sensitizers, can potentially prevent or delay the development of type two diabetes in PCOS patients. There is also evidence that Metformin, when used throughout pregnancy, decreases the rate of gestational diabetes mellitus from about three to thirty percent (Sheehan, 2004). Certain studies have shown Metformin's effectiveness of safely decreasing the amount of first-trimester miscarriages seen in PCOS women. In addition, there are currently no known adverse fetal outcomes amounting from the use of Metformin during pregnancy (Tsilchorozidou, 2004). Metformin and lifestyle modification increases SHBG which correlates with improved insulin sensitivity resulting in a decrease of free testosterone available and a decline in testosterone action (Sheehan, 2004).

Another common medical treatment for PCOS is the use of oral contraceptives (OCP). Oral contraceptives can be used to help with menstrual irregularity, endometrial buildup, and hyperandrogenism due to ovarian androgen production (Dunaif, 1997). Oral contraceptives have been shown to decrease SHBG and gonadotropin production which, in turn, decreases the bioavailable testosterone by forty to sixty percent (Sheehan, 2004). Gonadotropin is a hormone that stimulates the growth and activity of the gonads (“Medical Dictionary,” 2013). This is extremely important for PCOS women because many of the distressing symptoms are caused by an increase in a woman's testosterone levels. Birth control has also been shown to have some affect on amelioration of depression associated with PCOS. In one study, the rate of depression in untreated patients was sixty-six percent while the rate of depression in patients taking birth control was twenty-nine percent (Rasgon, 2003).

While oral contraceptives are often used with a significant amount of success, a number of PCOS patients may be advised against taking birth control because OCPs can worsen hypertriglyceridemia which is already a problem for insulin resistant individuals (Roush, 2010). Most OCPs have also been shown to produce IR in normal women, especially oral contraceptives that contain triphasic progestin (Dunaif, 1997). Hypertriglyceridemia causes elevated triglycerides or fat levels often leading to obesity and other related health consequences which simply perpetuate the vicious cycle involving PCOS, obesity, and insulin resistance (Sheehan, 2004).

One source focused on the treatment of the physical and psychological aspects of PCOS and suggested that an individual should consider getting counseling after diagnosis (Sheehan, 2004). Multiple sources also stated that much of the psychological distress associated with PCOS could be ameliorated with improved communication of information between doctors and

patients, including an accurate online source of information which could improve the quality of life and self-management of many PCOS women. Currently, many patients say that the amount and quality of information they received about PCOS and specific aspects of the disease were sub-par and wished that they had been given better information in order to be able to use it in their management techniques (Ching et al., 2007).

There are four issues related to PCOS that are targeted in treatment. These four issues are: controlling hirsutism, regulating menses, managing IR and its associated risks, and dealing with fertility issues. There are numerous techniques in existence that are designed to help with each specific symptom of concern. Various sources give different suggestions on how the treatment of PCOS should be handled or which method of treatment is best, but overall the most important aspect of treatment is that it must be tailored to the specific patient. Individualization of care is extremely important in PCOS because of the extreme heterogeneity of the disease. Care should focus on symptoms and the short and long term metabolic, reproductive, and psychological features of the disorder (Sheehan, 2004).

While treatment may vary from person to person, depending on her symptoms, one suggested treatment is always the same, lifestyle modification. There is no medical option that fully reverses the underlying hormonal disturbances and treats all of the features of PCOS, but lifestyle modification can drastically improve the majority, if not all, of the aspects of PCOS and its associated symptoms and conditions (Garad et al., 2011).

It is well known that exercise and healthy eating habits are important to an individual's overall health, what some people may not realize is how important each of these things is in relation to Polycystic Ovarian Syndrome. Lifestyle modification is the first line of treatment for

PCOS patients because weight loss, and the prevention of weight gain, are vital to the improvement of PCOS symptoms, and a better quality of life (Garad et al., 2011). Lifestyle modification should take precedence regardless of whether a patient is lean, obese, taking medications, or not.

According to certain sources, increased physical activity and change in diet is the best combination for improvements in the many realms of health, with better results being seen with this combination than with exercise or diet alone. The addition of an exercise regiment has been shown to result in better long-term weight management (Garad et al., 2011; Thomson et al., 2011). When advising a patient about a lifestyle treatment plan, the doctor must create an individualized system for each patient due to the very personal nature of the disease. An enjoyable exercise program should be chosen for the patient, goals should be realistic, and changes must be able to be sustained (Scalzo & McKittrick, 2000; Galletly et al., 1996). While the exact lifestyle plan for each woman may differ, certain suggested lifestyle changes will benefit most patients. For example, each patient should modify her diet by decreasing her total energy intake, reducing her stress, considering group support, meeting with a dietetics professional, and increasing her physical activity level (Sheehan, 2004; Scalzo & McKittrick, 2000). Lifestyle modification is also "the least expensive, least invasive, and safest way to control weight and insulin levels" (Scalzo & McKittrick, 2000, p.958). Diet and exercise have also been shown to be a very effective form of treatment, with even just a five to ten percent reduction in weight, creating positive changes in the realms of metabolic, reproductive, and psychological symptoms (Garad et al., 2011).

There are numerous benefits related to lifestyle modification, and improvements can be seen in regards to many of the distressing symptoms seen in PCOS. By increasing one's level of

physical activity and changing her diet, she can lose weight and decrease her risk of developing cardiovascular disease (Sheehan, 2004). Simply by doing moderate physical activity, including at least thirty minutes of structured exercise a day, weight loss and weight maintenance is likely to occur along with improvements in clinical outcomes (Garad et al., 2011). Research has found that lifestyle modification can lead to better health through reduction in central fat and improvement in insulin resistance even without weight loss; however, better results are seen when weight loss occurs (Garad et al., 2011; Huber-Buchholz et al., 1999). Improvement in nutrition and physical activity often result in weight loss, and reduction in abdominal fat leads to restoration of ovulation in many women (Huber-Buchholz et al., 1999; Moran et al., 2003).

One important aspect of lifestyle modification is a woman's diet, and through this literature review, it was gathered that no single diet has been proven to be best for PCOS patients. Moran et al. (2003) compared various diets and found a reduction in abdominal fat, independent of diet composition. Usually an individual experiences an reduction in hyperlipidemia, IR, miscarriages, and hyperglycemia, an increase in frequency of ovulation, and possibly restoration of fertility with weight loss, even if the weight loss is less than ten percent of the individual's initial weight (Dunaif, 1997; Thomson et al., 2011). Decreased levels of one's free androgen index (FAI) and testosterone along with increased SHBG have also been seen in conjunction with weight loss (Thomson et al., 2011). Huber- Buchholz et al. (1999) also noted that marginal weight loss improves menstrual function, hopefully leading to long term restoration of reproductive potential and improved likelihood of pregnancy. It has been found that the restored fertility, and other reproductive benefits, seen with weight loss are due to the decrease in circulating insulin levels. Improvements in various reproductive parameters have also been seen when other methods are used to decrease insulin levels, suggesting that agents that

lowering one's insulin levels, through the improvement of insulin sensitivity, may provide a new therapeutic modality for PCOS (Dunaif, 1997).

Not only does lifestyle modification affect a woman physically, but it also influences her mentally. Various lifestyle modifications have been found to create positive changes in regards to the many psychological aspects including mood and psychological well-being. Studies have shown that lifestyle modification leads to decreased levels of depression and anxiety and increased self-esteem and Health Related Quality of Life (HRQOL) scores for women with PCOS (Thomson et al., 2011). One program, that involved a brisk-walking regimen, found that women who completed the program had reduced body image distress, despite changes in BMI (Liao et al., 2008). Another program used exercise, healthy diet information, and group discussion sessions, and found that after the completion of the twenty-four week program there was significant improvement in the women's self-esteem, self-image, and depression. This study also did a two year follow-up in which improvements were found to be maintained and further weight loss was seen in many of the patients (Galletly et al., 1996). This successful maintenance, seen in the study of Galletly et al.(1996), supports the suggestion that this combination of treatment options should be used for all PCOS women, due to its great success and fairly easy process. The results of this research also supported the idea that with an increase in information, PCOS women may experience improved quality of life and self management (Ching et al., 2007; Galletly et al., 1996).

Interestingly, it has been found that moderate exercise is as effective as vigorous exercise at improving some of the PCOS symptoms, and it is possible to see an improvement simply by incorporating moderate-intensity lifestyle activity, without the necessity of structured aerobic exercise. Because of these results, researchers suggest that doctors should use a three point

approach to increasing physical activity. According to this source, a physician should stress the importance of decreasing sedentary behaviors, increasing lifestyle activity, and initiating moderate exercise (Sheehan, 2004). It is also vital that an individual maintain her weight loss, and because of this, self-monitoring is an important part of the lifestyle aspect of treatment because more intense action must be taken if weight increases, even if it just by a small amount (Garad et al., 2011).

The diet portion of treatment is equally important, and the most important aspect of diet seems to be caloric restriction. By reducing a person's intake by 500-1000 calories per day, a seven to ten percent reduction in weight was seen, over a six to twelve month time period in a study done by Garad et al. (2011). Ongoing research is being conducted to determine which type of diet is best for a PCOS patient, but no conclusive results have been found. Different projects have looked at, or are currently comparing, diets such as low glycaemic index (GI) diets, high protein diets, and low protein diets. While each type of diet has its benefits, there have been no significant results found to favor any one diet plan over the other. In fact, in one study, equal improvements were seen in both groups of women, those with high protein intake and low protein intake. There was no difference in the changes seen in weight or abdominal fat loss, lipid and glucose metabolism, total fat mass, total lean mass, testosterone, SHBG or fasting insulin (Moran et al., 2003). Overall, a PCOS patient should eat multiple, small, balanced meals a day with the inclusion of high fiber foods, whole grains, healthy fats, lean protein, fruits, and vegetables, while limiting the amount of sugar intake (Scalzo & McKittrick, 2000). Meals should be balanced in order for your body to carry out the optimum insulin secretion and metabolism by eating foods that will cause a slower rise in blood sugar levels, and prevent large peaks and

valleys in insulin and glucose levels. These results point to the conclusion that energy restriction is what really matters in relation to diets for PCOS patients.

These improvements associated with lifestyle modification help to protect against the development of CVD and diabetes, limit morbidity, and reduce mortality.

The importance of PCOS education cannot be stressed enough. With early diagnosis and adequate information, individuals can prevent serious complications and minimize the distressing symptoms that accompany PCOS. With the great prevalence of PCOS, and the lack of knowledge in the population, many women are set up to struggle with this mysterious disease while feeling completely alone. Women with PCOS have also complained that they have received "less than optimal" information about the syndrome, including its short and long-term implications. Because of these facts and other research, it had been suggested that information programs for PCOS would be very beneficial, especially in the relation to Quality of Life (Ching et al., 2007). Ching et al. (2007) also noted that these types of programs may promote "proactive self-management" of women's PCOS symptoms. While many strides still need to be made in this area, the creation of online support groups that provide a plethora of accurate information are a step in the right direction.

Along with increased information, an increase in screening could prove to be a cost-effective manner by which to prevent and manage PCOS. If testing for PCOS became a routine process as part of a woman's yearly exam, cases would be able to be diagnosed earlier, leading to earlier treatment, and hopefully amelioration and prevention of negative consequences associated with PCOS. Azziz's (2007) study showed just how cost-effective increased diagnostic evaluation can be. The study used a 6.6% incidence rate to look at the annual cost of PCOS in

reproductively-aged women in the U.S. This study found that about 4.37 billion dollars are spent annually to evaluate and provide care to PCOS patients in the U.S. Not all possible aspects of PCOS were looked at, but the cost of many were estimated. The estimations showed that 40.4% of this cost was due to type two diabetes treatment, and only 2.3% of the expense was due to diagnostic measures (Azziz, 2007). These results are very significant because they show that the overall cost of PCOS could be greatly decreased by finding and using early and accurate diagnostic techniques. If these measures are carried out, the number of PCOS women with type two diabetes would be likely to decrease, easing the economic burden of PCOS.

As mentioned previously, there are still many questions about PCOS that remain unanswered. However, certain studies are looking into many aspects of PCOS. Some researchers are proposing possible causes; others are trying to determine which diet and exercise regiment is best; while others are exploring the avenues of education, prevention, and associated disorders. Regardless of the current state of information, it can be said that there will be a brighter future for patients with PCOS.

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