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The experience of stress in women diagnosed with polycystic ovary syndrome

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Abstract

Polycystic ovary syndrome (PCOS) is a complex endocrine disorder that affects multiple organ systems within the female body, hallmarked by infertility, the possibility of androgen excess, and the possibility of ovulatory dysfunction. Along with a myriad of physiological symptoms, PCOS is also associated with many psychological issues, including an increased incidence of depression, anxiety, and lower reported quality of life among women diagnosed with PCOS. The need for treatment directed to attenuate any psychological implications of the syndrome has become increasingly important are of research. While some researchers have focused on PCOS in a psychosocial perspective, including analysis on depression, anxiety, and quality of life, more research is needed on how women with PCOS experience stress. This study examined how 16 women with PCOS physiologically responded to a brief stressor, the Social Competence Interview (SCI), as compared to a healthy control population (n=64). Saliva samples were collected at 5 time points (S0-S4) before, during, and after the interview to measure cortisol reactivity to the stressor. Further, the participants were asked to fill out questionnaires to gather information about their perceived stress, their psychiatric symptoms, and their physiological health. Results indicated that women with PCOS reported significantly more somatic complaints than healthy controls. Women with PCOS also had a higher baseline cortisol level than healthy controls. Future research should examine other psychological and physiological factors that could contribute to the experience of stress in women with PCOS.

Executive Summary

My capstone project examines how polycystic ovary syndrome (PCOS) affects the health and well-being of women diagnosed with the syndrome. Further, my project examines how women with polycystic ovary syndrome respond to a brief stressor, ultimately aiming to understand how women with PCOS experience stress.

Polycystic ovary syndrome is a complex, female endocrine disorder with multiple reproductive and endocrine symptoms. PCOS is the most common female endocrine disorder worldwide, possibly affecting up to 15% of the reproductive age population. In the United States alone, 5 million women exhibit some form of the syndrome. Along with being an incredibly common disorder, it is also manifests with many problematic symptoms that can negatively impact the quality of life of women diagnosed. A more detailed description is provided in the table below.

Table 1. Clinical features of polycystic ovary syndrome

- Infertility (difficulty or not being able to become pregnant) because of not ovulating.
- Infrequent, absent, and/or irregular menstrual periods
- Androgen excess
- Hirsutism — increased hair growth on the face, chest, stomach, back, thumbs, or toes
- Cysts on the ovaries

- Acne, oily skin, or dandruff
- Weight gain or obesity, usually with extra weight around the waist
- Male-pattern baldness or thinning hair
- Patches of skin on the neck, arms, breasts, or thighs that are thick and dark brown or black
- Skin tags — excess flaps of skin in the armpits or neck area
- Pelvic pain
- Depression and anxiety
- Sleep apnea — when breathing stops for short periods of time while asleep

(Womenshealth.gov, 2013)

PCOS is leading cause of infertility in the United States, accounting for upwards of 75% of anovulatory infertility. Anovulatory infertility is the inability to become pregnant because there is an barrier to typical ovulation. As well as being the leading cause of infertility in the United States, there are other problematic complications associated with PCOS. About 50% of women diagnosed with PCOS can expect to develop prediabetes or type II diabetes in their lifetime, most likely by the age of 40. Moreover, women with PCOS are at a 4 to 7 times greater risk of developing heart disease and having a stroke. With such an array of physiological problematic symptoms, along with the above complications, PCOS can have a huge impact on the daily lives of women diagnosed.

Along with a myriad of physiological symptoms, women with PCOS exhibit psychological symptoms. Women with PCOS not only have a higher prevalence of depressive symptoms, but also are at a greater risk of developing mood regulation disorders and anxiety. Moreover, women with PCOS are often found to have a reduced self-reported quality of life than healthy population that does not have similar issues. Some research has been done on these above constructs in relation to PCOS; however, more research needs to be conducted on other psychological implications of being diagnosed with polycystic ovary syndrome.

While there has been some research done on depression, anxiety, and quality of life related to PCOS, there has been less research completed on other psychosocial experiences in women diagnosed with PCOS, such as how women with PCOS experience stress. It is in this framework that I asked my main research questions for my project. Firstly, do women with polycystic ovary syndrome experience stress differently than a healthy control population? Secondly, how does having PCOS affect the health of women diagnosed? I expected that women with PCOS would experience stress differently than a healthy control population, with greater levels of self-reported perceived stress, as well as having greater physiological reactivity to a brief stressor. Also, I expected that women with PCOS would report more physical symptoms that they found concerning in their daily lives than a healthy control population.

To investigate how women with PCOS experienced stress in their lives, I conducted a psychology study comparing women diagnosed with polycystic ovary syndrome with a healthy control population. I recruited women diagnosed with PCOS from the intro psychology research participation pool, as well as from the Syracuse University and larger campus communities. Participants were invited to the Project Heart Lab space, located at the CNY Medical Building near the Syracuse University campus. Participants were asked to complete a brief series of questionnaires related to their health and well-being, included a Perceived Stress Scale, Symptoms Checklist, and the Center for Epidemiological Studies Depression scale. Also, the participants' basic body measurements taken (height, weight, BMI, waist-to-hip ratio), and they were asked to participate in a brief interview designed to elicit a short term stress response, the Social Competence Interview (SCI). Throughout the study, saliva samples were taken at five time points, to later be analyzed for presence of cortisol and amylase. Both cortisol and amylase are important during the stress response, and from that data, I aimed to evaluate the reactivity of my participants to brief stressor mentioned above, the SCI. I analyzed my results using SPSS statistical software. The saliva samples collected were sent to Brandeis University to be analyzed.

Although we did not find a difference in perceived stress, we did find that women with PCOS reported more somatic complaints and depressive symptoms than healthy controls. Given that PCOS is associated with many problematic physical symptoms, i.e. hirsutism, acne, weight gain, and pelvic pain, it is expected that women diagnosed with PCOS would have more somatic complaints

compared to healthy controls. Further, women with PCOS had a significantly higher levels of baseline cortisol than a healthy, control population.

The findings from this study point to further research on the ties between the experiences of stress and the relation to physical and psychological health in women diagnosed with polycystic ovary syndrome. This study supported that somatic and psychological symptoms associated with PCOS are significantly different than a healthy population. As a result, more research needs to be conducted on how these symptoms could affect the daily lives of women affected.

With such a high prevalence among women, affecting over 5 million women in the United States alone, PCOS is a leading public health concern. As such, it is imperative that there is increased awareness and research in regards to the syndrome. Without both of these factors, it is possible that polycystic ovary syndrome will not receive the attention that it requires for effective treatments to be developed.

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Advice to Future Honors Students

Rome was not built in a day, and neither will your capstone. This is such a wonderful learning experience, and can be even more wonderful if you work at it a little bit every day!

Introduction

Polycystic Ovary Syndrome

Polycystic ovary syndrome (PCOS) is a complex endocrine disorder that affects multiple organ systems within the female body, hallmarked by infertility, the possibility of androgen excess, and the possibility of ovulatory dysfunction (NIH Report, 2012). Ultimately, PCOS is the leading cause of female infertility (Sheehann, 2004), accounting for upwards of 75% of anovulatory infertility (Sheehan, 2004). According to the National Institutes of Health report, 5- 15 % of reproductive-aged women exhibit some phenotype of the syndrome; this accounts for more than 5 million women in the United States alone (NIH Report, 2012). Despite the prevalence of this major public health issue (Sanchez, 2014), a long history of misdiagnosis and non-diagnosis surrounds the syndrome (Colwell et al, 2010). Often, independent symptoms are identified without being attributed to a chronic health issue (Colwell et al, 2010), making it incredibly difficult for women to be diagnosed and treated.

In a recent NIH workshop, the syndrome was described as a "poorly understood condition" for much of the 20th century (NIH Report, 2012). In 1990, the NIH held a conference to create a standard for diagnoses and research in regards to the syndrome, dually hoping to obtain a more accurate understanding of the syndrome and objectives for research (NIH Report, 1990) In a more recent workshop, the NIH identified three different classifications systems (described in Table 1) that have been used to diagnose women with PCOS over the past 20 years (NIH Report, 2012). These multiple classifications systems have lead to an

inevitable miscommunication between practitioner and patient, ultimately serving as an impediment to diagnoses and treatment (NIH Report, 2012).

Table 2. Differing diagnostic criteria for polycystic ovary syndrome

NIH Criteria (1990) Chronic anovulation, clinical and/or biochemical signs of hyperandrogenism (Both criteria needed)
Rotterdam Criteria (2003) Oligo- and/ or anovulation; clinical and/or biochemical signs of hyperandrogenism, polycystic ovaries (Two of three criteria needed)
AE-PCOS Society Criteria Clinical and/or biochemical signs of hyperandrogenism; ovarian dysfunction (oligo-anovulation and/or polycystic ovarian morphology) (Two of three criteria needed)

Polycystic ovary syndrome is associated with a wide variety of physiological and psychological symptoms, some relatively minor, others severe. At its simplest definition, PCOS is a hormonal imbalance that leads to undesirable symptoms such as irregular menstruation, changes in appearance, and infertility (NIH Report, 2012). In actuality, the syndrome is complex and misunderstood, and thus difficult to treat effectively (Colwell et al, 2010). The complexity of this syndrome begins with diagnosis: as there is no one set phenotypic expression of the syndrome, the diagnostic criteria must analyze many aspects of a patient's health. To diagnose PCOS, physicians take an extensive medical history of the

patient, order a series of physiological (physical exam, blood tests, lipid profiling, and ovarian ultrasound) tests, and take into consideration the symptoms listed below.

Table 2. Clinical features of polycystic ovary syndrome

- Infertility (difficulty or not being able to become pregnant) because of not ovulating.
- Infrequent, absent, and/or irregular menstrual periods
- Androgen excess
- Hirsutism — increased hair growth on the face, chest, stomach, back, thumbs, or toes
- Cysts on the ovaries
- Acne, oily skin, or dandruff
- Weight gain or obesity, usually with extra weight around the waist
- Male-pattern baldness or thinning hair
- Patches of skin on the neck, arms, breasts, or thighs that are thick and dark brown or black
- Skin tags — excess flaps of skin in the armpits or neck area
- Pelvic pain
- Depression and anxiety
- Sleep apnea — when breathing stops for short periods of time while asleep

(Womenshealth.gov, 2013)

Post diagnoses, the diagnosing practitioner will work on a treatment plan for the patient. These treatments generally fall into two categories of intervention, one of which being medication. The goal of treatment with medications is to attenuate the effects of hormonal abnormalities (excess androgens and estrogens) in women with the syndrome. Synthetic hormone treatment, commonly in the form of birth control pills, is provided to dually regulate menstrual cycles and reduce excessive androgens. Also, for concerns surrounding fertility issues, women with PCOS are often provided hormonal treatments that target anovulation. One such example is clomiphene, which has been found to have some efficacy in treating infertility issues in women with PCOS (Palomba et al, 2009).

Further, a practitioner may provide metformin (Glucophage, Glucophage Extended Release (XR), to lower insulin levels, increase insulin sensitivity, and potentially induce ovulation (Mayo Clinic, 2014). Metformin has been found to help those diagnosed manage the overall disorder through increasing insulin sensitivity (Nestler, 2002). In summation, these treatments focus on the biochemical abnormalities that are present in women diagnosed with polycystic ovary syndrome.

Along with medication intervention, another treatment focus is lifestyle intervention. Women diagnosed with PCOS are encouraged to eat a healthy diet, exercise, and if at all possible, lose weight. Women with PCOS often have difficulty losing weight; roughly half of all women diagnosed with PCOS are clinically obese (Hoegar, 2001). Maintaining a healthy lifestyle is crucial for

women diagnosed with polycystic ovary syndrome, as more than half of women diagnosed can expect to develop prediabetes or type II diabetes mellitus prior to the age of 40.

Psychological Implications of PCOS

As demonstrated by the wide variety of intrusive symptoms above, PCOS can exert a strong influence on the lives of those with the syndrome. With such a panoply of physiological symptoms, it is not surprising that negative psychological consequences can co-occur with negative physiological symptoms.

PCOS and Depression

There has been a high prevalence of mood disorders found in women with PCOS, particularly a high prevalence of depressive disorders (Rasgon et al, 2003). Both clinical and biochemical symptom correlates have been found in women diagnosed with PCOS, with depression being associated to greater insulin resistance and higher BMI (Ragson et al, 2003). Thus, there appears to be an association between depression and classic PCOS markers (Ragson et al, 2003).

Stress

Stress is a common and daily occurrence in modern society. Physiologically, stress can be defined as a state in which homeostasis is jeopardized by the action of external (environmental) and internal (physiological and psychological states) stressors (Bozocvic, Racic, Ivkovic, 2013). In particular to psychological state, stress is the experience of a perceived threat, resulting from a series of physiological responses and pathways (Seaward, 2012).

Hypothalamic-Adrenal- Pituitary Axis

One of the main systems that regulate the body's response to stress is the hypothalamic-pituitary-adrenal (HPA) axes. An integral part of the HPA axes, the hypothalamus, is activated in response to a stressor, producing a "fight or flight" response. First proposed by Seyle, this "fight or flight" response is the body's automatic response to stress, preparing the body to either face the stressor or remove itself from the situation. This feedback response is first initiated by the hypothalamus, which in turn activates the sympathetic nervous system, and finally the adrenal-cortical system to eventually release cortisol.

Cortisol

The moments following an initial stressor are critical for the body to physiologically prepare for an appropriate response to the stressor. The first response of the body is by the hypothalamus, which is stimulated to related corticotropin-releasing factor by the stressor. In response to this release of corticotropin-releasing factor, the anterior gland is stimulated to release adrenocorticotropic hormone (ACTH). Finally, the release of ACTH stimulates the release of cortisol by the adrenal glands, which enters the bloodstream to prepare the body to respond to the stressor. Cortisol, also known as hydrocortisone, is a glucocorticoid (steroid hormone), released in response to the HPA axes pathway, which begins after perception of a stressor. Cortisol's primary function is to maintain and increase blood sugar through gluconeogenesis, suppress the immune system, and aid in metabolism. Simply, cortisol prepares the body to respond to a stressor. Therefore, cortisol can be considered a biomarker, or indicator, of HPA axis activity and the larger stress response. Cortisol has been

demonstrated to be a biomarker of psychosocial stress (Selye et al., 1960; Kirschbaum et al., 1995; Eck, 1996; Bozovic, Racic, & Ivkovic, 2013). Typical, daily stressful events have been to induce a rapid increase in cortisol secretion (Eck et al 1996), further demonstrating cortisol's utility as a biomarker for psychosocial stress.

Salivary Cortisol

In a laboratory setting, salivary cortisol is often collected as an indicator of psychosocial stress. Through the framework described above, salivary cortisol can be utilized as an objective biomarker for psychosocial stress. The present study will analyze salivary cortisol samples for a measurement of psychosocial stress.

Chronic Stress

While the experience of stress is a daily occurrence, not all types of stress are experienced equivalently. Distress, defined as an interpretation that an event will have a negative and/or harmful effect on the interpreter (Ridner, 2004), becomes increasingly problematic when the experience of stress is chronic. Chronic, or prolonged stress, has been shown to have negative implications is regards to psychological health and well-being; stressful events have been shown to be contributing factors to depression (Hammen, 2005; Kendler et al. 1999) and anxiety disorders (Brown et al. 1986).

Further, chronic stress has been demonstrated to be a contributing factor to the development and experience of chronic disease, often accelerating disease processes (Nestler et al., 2002). Implications of chronic stress have been

documented in regards to many major diseases, including heart disease, immune system and hormonal changes such as levels of cortisol (Kirschbaum et al, 1995).

While the effects of stress on physiological functions have been investigated in regards to certain endocrine disorders such as diabetes, there has been less focus on the effects of stress on other chronic, endocrine disorders. In this paper, I will focus on the effects of stress on women with polycystic ovary syndrome.

Polycystic Ovary Syndrome and Stress

The need for treatment directed to attenuate any psychological implications of the syndrome has become increasingly important, particularly how PCOS could affect the experience of stress in women diagnosed. As cited above, women with PCOS may experience

While several researchers have focused on PCOS in a psychosocial perspective, including research on depression, anxiety, and quality of life (Cipkala-Gaffin et al, 2012); (Ferriday et al, 2007), fewer researchers have examined the experiences of stress in women with PCOS, another psychosocial experience that may be altered as a result of having PCOS. One striking example was a study done by Benson et al., who found that women with PCOS had disturbed stress responses, showing an enhanced hypothalamic-pituitary-adrenal (HPA) axis and heart rate reactivity in response to a stress interview task (2008). After the insertion of a catheter to measure serum cortisol, ACTH, and IL-6 levels, participants were asked to complete a public speaking task to elicit an acute psychosocial stress response. It was supported that women with PCOS had

significantly greater increases in HPA-axis mediators (ACTH and cortisol) than a control population (Benson et al., 2008) This seminal work in regards to PCOS and psychosocial stress demonstrates the need for a greater understanding of stress reactivity in women with polycystic ovary syndrome.

Aims of the Present Study

Polycystic Ovary Syndrome and Experience of Stress

The present study aims to explore how polycystic ovary syndrome could affect the health of women with the syndrome, and further, how these effects could alter the experiences of stress in their lives. The study focused on the following primary hypotheses.

Hypotheses

1. Women with polycystic ovary syndrome will report higher levels of perceived stress than healthy age-matched controls
2. Women with polycystic ovary syndrome will report more somatic complaints that are problematic to their daily lives.
3. Women with polycystic ovary syndrome will have a greater baseline cortisol and greater cortisol reactivity over time to the Social Competence Interview (SCI) compared to controls.
4. Somatic complaints will be related to psychosocial variables such as depression, anxiety, perceived stress across all participants.

Methods

Participants

Participants were recruited and screened via advertisements within "SONA", a research participation pool system at Syracuse University, with xx being eligible to participate in the study. Also, participants were recruited and screened via paper and electronic flyers around the Syracuse University campus and surrounding neighborhoods. 78 women, 16 with polycystic ovary syndrome and 62 without polycystic ovary syndrome, were included in data analyses. Exclusion criteria included several lifestyle factors: currently smoking tobacco products, heavy drinking (20 or more drinks per week), age and gender (only women between the ages of 18-35 were eligible). Further, diagnoses of one or more of the following health concerns would result in ineligibility: atopic diseases, allergies requiring regular medications, airway disease (such as asthma), autoimmune diseases, cardiovascular problems, gastrointestinal diseases, diseases of the urinary tract, and any other hormonal disorders that were not polycystic ovary syndrome.

The sample was 100 % female, as this was a study concerning women's health; all of the participants were female. The average age of the participants was 19.05 (SD=2.00) years old. 47% of the participants identified as White, 21% identified as Asian, 15% identified as Black, and 13% were other races, more than one race, or declined to state their race. The average BMI of the entire sample was 23.9 kg/m^2, (SD=4.9) with the average waist-to-hip ratio (WHR) being .83 (SD=. 10).

Procedures

Participants were invited to meet a member of the research team outside of the CNY Medical Building near Syracuse University, who would guide them to the Project Heart Laboratory. The participant was immediately asked if they had any caffeine yet that day. If so, the participant was invited to reschedule their appointment time, as the presence of caffeine could change the outcome of the results. After ensuring the participant did not have any caffeine, the participant was guided into a comfortable room, and then provided with a consent form to read over on their own. A research assistant then asked the participant if they had any questions on what they read. If there were no questions and the participant felt comfortable with the procedures, the participant was invited to sign the informed consent, which included information on the Social Competence Interview and the methods to collect saliva samples at five repeated measures.

After signing the informed consent, general body measurements and physiological data was collected, including: height (to the nearest quarter inch), weight (in kg), and waist-to-hip ratio (WHR). Later, participant BMI was calculated from the information collected during the study. Following this, the participant was invited to complete the first series of questionnaires. These questionnaires included basic demographic information, Perceived Stress Scale (PSS) that measures perceived stress (Hewitt, Flett, & Mosher 1992), Symptom Checklist (SCL) that collects somatic symptomatic data (Laan et al, 1999), the Center for Epidemiologic Studies Depression (CES-D) Scale that measures self-reported depressive symptoms (Dam & Earlywine, 2011), a scale on body image,

and a polycystic ovary syndrome health questionnaire that collected information on the participant's symptomatic experiences with PCOS.

After 30 minutes of calmly completing questionnaires, the first baseline measurement of saliva (labeled "S0") was taken. Prior to taking the baseline measurement, participants were explained the proper procedure for saliva collection utilizing salivette tubes. Participants were instructed to roll the salivette around their mouth for 60 seconds, trying to reach all parts of their mouth. Participants were instructed to refrain from touching the cotton salivette cylinder with their hands, along with being instructed to refrain from biting the salivette. After 10 minutes of quietly resting, a second baseline measurement (labeled "S1") was taken. At this point, the Social Competence Interview, or SCI, began. A Research Assistant that had been trained on the SCI conducted the interview. Three more saliva samples were taken throughout the study, one in the middle of the Social Competence Interview, or SCI (S2), another at the end of the interview (S3), and a last sample ten minutes following the interview (S4).

Following the SCI, participants were instructed to relax and complete a second set of questionnaires, including two measures on self-reported quality of life. The last saliva sample (S4) was taken 10 minutes after the interview was complete. At this point, the participant continued to fill out and complete any remaining questionnaires in the second questionnaire packet.

When the participants finished their final questionnaires, they were thanked for their time and effort in completing the study, debriefed by one of the Research Assistants, and guided out of the CNY Medical building. The entire

protocol, including entering and exiting the laboratory space, lasted approximately 90 minutes. Participants recruited through the SONA research participation pool were awarded course credit as compensation. Participants recruited through the campus and surrounding communities were awarded $15.00 as compensation for completing the study.

The Social Competence Interview

The SCI (Ewart at al, 2002) is an 8-12 minute interview designed to elicit a short-term stress response. During the interview, participants are asked to describe a recent, stressful situation related to a chronic stressor in their lives. During the first portion of the interview, participants are asked to recall the stressful situation they experienced in as much detail as possible. In the second section of the interview, the participant is directed to describe a potential solution(s) and coping mechanism(s) to the problem they were previously describing. To develop potential solution(s) and coping mechanism(s), the participant is then asked to pretend they are the director of a film. This film is about character similar to themselves, who is experiencing the same chronic stressor and specific stressful experience that the participant had previously described. The participant can direct any ending for their character. Specifically, they are asked to come up with an ideal, realistic ending to the film they described, and are later asked to rate their confidence in achieving that particular ideal ending. Participants were asked for their consent to be audio recorded during their interview.

Measures

Perceived Stress Scale. The Perceived Stress Scale (PSS) is a psychological questionnaire used to measure an individual's perception of stress in their daily lives. Items in the questionnaire are designed to measure how unpredictable, uncontrollable, and overloaded respondents find their lives (Cohen et al, 1998).

Symptom Checklist. The Symptom Checklist-90-R (SCL-90-R) is a self-report questionnaire, designed to evaluate a range of psychological and physiological symptoms. In this study, we used an abbreviated measure, only including a portion of the questionnaire items.

Center for Epidemiologic Studies- Depression Scale (CES-D). The CES-D is a self-report questionnaire, designed to evaluate depression symptoms. In this study, we used this measure to evaluate self-reported symptoms of depression in the study sample.

All measures are presented in Appendix B.

Data Analysis Plan

All data analyses were conducted using IBM SPSS Statistics 21 statistical software package (IBM, Chicago, IL, USA). Using descriptive statistics, I analyzed the demographics of the study sample. I examined group differences using a series of independent samples t-tests.

To test Hypothesis 1, whether women with polycystic ovary syndrome reported higher levels of perceived stress than healthy age-matched controls, I performed an independent samples t-test.

To test Hypothesis 2, whether women with polycystic ovary syndrome experienced more health concerns, i.e., more somatic complaints and more depressive symptoms than healthy age-matched controls, I performed two more independent samples t-tests.

To test Hypothesis 3, whether the Social Competence Interview (SCI) elicited changes in cortisol and amylase over time in both women with polycystic ovary syndrome and healthy age-matched controls, I performed a repeated measures analysis of variance (ANOVA) comparing differences from Time 1 (baseline sample) to Time 3 (immediately after SCI).

To test Hypothesis 4, whether perceived somatic complaints were related to psychosocial variables such as depression, anxiety, perceived stress, I performed a series of Pearson's correlations.

Results

Means and standard deviations for all study variables of interest are presented in Table 3 (Appendix A). Participants ranged in age from 18 to 29 and had a mean age of 19.18 (SD= 1.79). The sample was comprised of 16 of women with PCOS and 62 healthy controls. The two groups differed significantly in BMI, t (78) = -3.69, $p < .001$. Women with PCOS had a mean BMI of 27.71 (SD=2.08) while the control group had a mean BMI of 22.99 (SD=. 374).

Hypothesis 1

The hypothesis that women with polycystic ovary syndrome would report higher levels of perceived stress than healthy age-matched controls was tested with an independent samples t-test. No significant group differences were found, PCOS (M = 19.60, SD = 6.60) Control (M = 16.85, SD = 6.28), t (n-1) = -1.50 , p > .05.

Hypothesis 2

The hypothesis that women with polycystic ovarian syndrome would report more somatic complaints and depressive symptoms related to their daily lives than healthy age-matched controls was tested with an independent samples t-test. Results revealed significant differences between the groups. Women with PCOS (M = 31.46, SD = 21.48) reported significantly higher levels of perceived somatic complaints than healthy controls (M = 21.16, SD = 11.59),

t(71) = 2.44, p = .02. Women with PCOS (M=43.0, SD = 11.2) also reported more symptoms of depression than healthy controls (M=36.9, SD=8.5), t(64) = 2.05, p=.05

Hypothesis 3

The hypothesis that women with polycystic ovary syndrome would have greater physiological reactivity as measured by cortisol compared to controls was tested with an independent samples t-test. Results revealed a significant difference between the groups, but in the opposite direction than hypothesized. Women with PCOS had a greater decline in cortisol (M= -1.67, SD= 2.93) than healthy controls (M = -.31, SD =1.99), t(65) = 2.11, p= .04.

Further analysis via a repeated measures ANOVA showed that, for all participants, the difference in change in cortisol level between the first baseline time point (M = 9.89, SD = 4.94) and the third time point, immediately after the SCI, (M = 8.39, SD = 4.31) was statistically significant, $F(1,66) = 18.564$, $p < .001$. There was a significant decrement in cortisol from Time 1 to Time 3 across all participants.

Means and standard deviations for cortisol samples for each time, by group, is presented in Table 4 (Appendix A).

Hypothesis 4

The hypothesis that perceived somatic complaints were related to psychosocial variables such as depression, anxiety, perceived stress was tested

with Pearson Correlations were calculated. There was a moderate, statistically significant, positive correlation between somatic complaints and depression; r (63) = .53, $p<0.01$.

There was a moderate, statistically significant, positive correlation between somatic complaints and trait anxiety; r(40) = .49, $p<0.01$.

There was a moderate, statistically significant, positive correlation between somatic complaints and reported perceived stress; r (63) = .55, $p<0.01$.

There was a moderate, statistically significant, positive correlation between somatic complaints and BMI; r (70) = .33, $p<0.01$.

Discussion

The purpose of this study was to explore how polycystic ovary syndrome affects the health of the women diagnosed, and how these effects could alter the experiences of stress in their lives. We found that women with PCOS did not report higher levels of perceived stress than healthy controls (Hypothesis 1). Given that this was a college sample, it is possible that all participants experienced similar levels of stress in their daily lives, independent of any medical condition.

Although we did not find a difference in perceived stress, we did find that women with PCOS reported more somatic complaints and depressive symptoms than healthy controls. Given that PCOS is associated with many problematic physical symptoms, i.e. hirsutism, acne, weight gain, and pelvic pain, it is expected that women diagnosed with PCOS would have more somatic complaints

compared to healthy controls. Along with physical symptoms, women with polycystic ovary syndrome have been found to have high incidences of depressive symptoms, ranging from 28 to 64 % of women diagnosed (Bazarganipour et al, 2013 ; Bhattacharya, 2010; Deeks, Gibson-Helm, Teede, 2010). My results concurred with the previous literature, finding that women diagnosed with PCOS reported more depressive symptoms than healthy controls. Similarly to somatic complaints, the physical symptoms associated with PCOS may contribute to increased depressive symptoms. In line with this, we found a moderate positive correlation between somatic complaints and depressive symptoms across all participants. As reported somatic complaints increased, so did the reported depressive symptoms for all participants.

It is difficult to interpret the results of Hypothesis 3, that women with PCOS would experience *greater* physiological reactivity to the SCI, because an unexpected decline in salivary cortisol was observed for all participants throughout the study, suggesting there was not an activation of the HPA axes due to the SCI. Possibly, the most physiologically stressful part of the study was meeting an unfamiliar Research Assistant to be brought to the laboratory. At the end of the study, many participants reported feeling that the interview was therapeutic, rather than stressful.

Across all participants, I found that there were moderate to strong correlations between somatic complaints and reported depressive symptoms, anxiety, and perceived stress. The results suggest that in my study sample,

distressing physical symptoms may contribute to higher levels of psychiatric symptoms.

Significance of Study

This study is one of the first to examine the implications of psychosocial stressors in a specific population, women diagnosed with polycystic ovary syndrome. Currently, this population is underserved in terms of psychological and psychosocial research; this study serves to contribute to the deficit in knowledge within the field.

This study is the first to examine indicators of physical health such as BMI and somatic complaints, and indicators of mental health such as depressive symptoms, anxiety, and perceived stress in college-age women diagnosed with polycystic ovary syndrome. The study was also the first to examine changes in cortisol in response to a psychosocial stressor, the Social Competence Interview, in this population.

Strengths of this study include the fact that participants were screened for existing medical conditions; participants with confounding medical conditions (e.g., psychiatric illnesses such as Major Depressive Disorder, ADHD, Generalized Anxiety Disorder, etc.) were not included in the study. Further, the control population was large (N= 62) compared to the experimental group (N=16).

Limitations

Although this study had many areas of strength, there were still some limitations. One key limitation is the sample size in women diagnosed with polycystic ovary syndrome was small relative to the control population. Considering this, it is difficult to draw conclusions that could generalize to a broader population of women with polycystic ovary syndrome. Another key limitation is that the laboratory stressor, the SCI, may not have induced an HPA axes response, making it difficult to examine how this population responded to a stressor. Lastly, my study mostly contained a population of relatively young, college-educated women. Results may not be able to generalizable to a larger population with more diverse backgrounds.

Future Directions

The findings from this study point to further research on the ties between the experiences of stress and the relation to the physical and psychological health in women diagnosed with polycystic ovary syndrome. This study supported that somatic and psychological symptoms associated with PCOS are significantly different than a healthy population. As a result, more research needs to be conducted on how these symptoms could affect the daily lives of women affected.

Like for many who face disorders with difficult and often problematic symptoms, the necessity of medical, psychological, and social support is paramount. Thus, more research needs to be done on the potential benefits of psychological support in women with polycystic ovary syndrome.

Finally, it has only been in recent years that PCOS has garnered attention and credibility, both in the medical field and society. As a result, both women

diagnosed with polycystic ovary syndrome and those hoping to raise awareness for the syndrome may have difficulty finding the language to discuss the syndrome. Therefore, an interesting line of research may include not only more investigation on the psychological impacts of the disorder, but the best methods to increase awareness and communication between health care practitioners, those affected, and their larger communities.

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Appendices

Appendix A

Table 3
Means, Standard Deviations, and Pearson Correlations for Selected Study Variables

	Mean (SD)	*r*			
		1.	2.	3.	4.
1. Symptoms Checklist*	PCOS, 31.46 (21.48); Control, 21.17 (11.60)	1			
2. CES-D*	PCOS, 43.00(11.20); Control, 36.90(8.54)	.528**	1		
3. Self-report Trait Anxiety	PCOS, xx(xx); Control, 43.97(11.29)	.486**	.740**	1	
4. Percieved Stress Scale	PCOS, 19.64 (7.58); Control, 17.23(7.58)	.553**	.710**	.827**	1
5. BMI*	PCOS, 27.71 (8.30); Control, 22.99(2.99)	.331**	.052	-.062	.006

Note. ** indicates correlations significant at $p < .01$.
* indicates significant difference between means and standard deviations of groups.
xx indicated data not included in analysis.

Table 4

Means and Standard Deviations for Cortisol Samples by Group

	Cortisol (nmol/L)	
	PCOS	Controls
Time 1	10.98 (6.44)	8.8 (4.4)
Time 2	10.31(7.04)	8.1 (3.2)
Time 3	9.20(6.50)	7.5 (3.4)
Time 4	8.64(5.99)	7.4 (3.1)
Time 5	7.34(4.84)	6.8 (3.5)

Note. PCOS, N=16, Control N=51

Appendix B

The questions in this scale ask you about your feelings and thoughts **during the last month.** In each case, please indicate with a check how often you felt or thought a certain way.

	Never	Almost never	Sometimes	Fairly often	Very often
1. In the last month, how often have you been upset because of something that happened unexpectedly?	0	1	2	3	4
2. In the last month, how often have you felt that you were unable to control the important things in your life?	0	1	2	3	4
3. In the last month, how often have you felt nervous and "stressed"?	0	1	2	3	4
4. In the last month, how often have you felt confident about your ability to handle your personal problems?	0	1	2	3	4
5. In the last month, how often have you felt that things were going your way?	0	1	2	3	4
6. In the last month, how often have you found that you could not cope with all the things that you had to do?	0	1	2	3	4
7. In the last month, how often have you been able to control irritations in your life?	0	1	2	3	4
8. In the last month, how often have you felt that you were on top of things?	0	1	2	3	4

9. In the last month, how often have you been angered because of things that were outside of your control?	0	1	2	3	4
10. In the last month, how often have you felt difficulties were piling up so high that you could not overcome them?	0	1	2	3	4

CESD

Below is a list of the ways you might have felt or behaved. Please tell me how often you have felt this way **during the past week**.

1 = Rarely or None of the Time (Less than 1 Day)

2 = Some or a Little of the Time (1-2 Days)

3 = Occasionally or a Moderate Amount of Time (3-4 Days)

4 = Most or All of the Time (5-7 Days)

During the past week:	Rarely or None of the Time (Less than 1 Day)	Some or a Little of the Time (1-2 Days)	Occasionally or a Moderate Amount of Time (3-4 Days)	Most or All of the Time (5-7 Days)
1. I was bothered by things that usually don't bother me.	1	2	3	4
2. I did not feel like eating; my appetite was poor.	1	2	3	4
3. I felt that I could not shake off the blues even with help from my family or friends.	1	2	3	4
4. I felt that I was just as good as other people.	1	2	3	4
5. I had trouble keeping my mind on what I was doing.	1	2	3	4
6. I felt depressed.	1	2	3	4
7. I felt that everything I did was an effort.	1	2	3	4
8. I felt hopeful about the future.	1	2	3	4
9. I thought my life had been a failure.	1	2	3	4
10. I felt fearful.	1	2	3	4
11. My sleep was restless.	1	2	3	4
12. I was happy.	1	2	3	4
13. I talked less than usual.	1	2	3	4
14. I felt lonely.	1	2	3	4
15. People were unfriendly.	1	2	3	4
16. I enjoyed life.	1	2	3	4
17. I had crying spells.	1	2	3	4

18. I felt sad.	1	2	3	4
19. I felt that people dislike me.	1	2	3	4
20. I could not get “going”.	1	2	3	4

SCL

Below is a list of symptoms that young adults sometimes have. Circle a number telling how much you were bothered by each symptom **during the past two weeks.**

In the last two weeks, how much were you bothered by each symptom?

	Never	Almost never	Sometimes	Fairly often	Very often
1. Headaches	0	1	2	3	4
2. Faintness or dizziness	0	1	2	3	4
3. Pain in your heart or chest	0	1	2	3	4
4. Feeling low in energy or slowed down	0	1	2	3	4
5. Pains in your lower back	0	1	2	3	4
6. Sore muscles	0	1	2	3	4
7. Trouble caution your breath (when you're not exercising)	0	1	2	3	4
8. Hot or cold spells (suddenly feeling hot or cold)	0	1	2	3	4
9. Numbness or tingling in parts of your body	0	1	2	3	4
10. A lump in your throat	0	1	2	3	4

11. Weakness (feeling weak) in parts of your body	0	1	2	3	4
12. Heavy feelings in your arms or legs	0	1	2	3	4
13. Nausea or upset stomach	0	1	2	3	4
14. Constipation	0	1	2	3	4
15. Loose (runny) bowel movements or diarrhea	0	1	2	3	4
16. Pain in your stomach or abdomen	0	1	2	3	4
17. Your heart beating too fast	0	1	2	3	4
18. Difficulty swallowing	0	1	2	3	4
19. Losing your voice	0	1	2	3	4
20. Deafness	0	1	2	3	4
21. Double vision	0	1	2	3	4
22. Blurred vision	0	1	2	3	4
23. Blindness	0	1	2	3	4
24. Fainting or passing out	0	1	2	3	4

25. Memory loss or amnesia	0	1	2	3	4
26. Seizures or convulsions	0	1	2	3	4
27. Trouble walking	0	1	2	3	4
28. Paralysis or muscle weakness	0	1	2	3	4
29. Difficulty urinating	0	1	2	3	4
30. Vomiting	0	1	2	3	4
31. Feeling bloated or gassy	0	1	2	3	4
32. Food making you sick	0	1	2	3	4
33. Pain in your knees, elbows or other joints	0	1	2	3	4
34. Pain in your arms or legs	0	1	2	3	4
35. Pain when you urinate	0	1	2	3	4

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