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Continuum of Symptoms in Polycystic Ovary Syndrome (PCOS): Links with Sexual Behavior and Unrestricted Sociosexuality

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ABSTRACT

Symptoms of polycystic ovary syndrome (PCOS) exist on a continuum, are associated with hyperandrogenism, and have fertility implications. The present study investigated the relationship between PCOS symptoms and sociosexuality in young women with a continuum of symptoms ranging from none to clinical levels. Given that unrestricted sociosexuality, or one's orientation toward uncommitted sexual activity, is associated with hyperandrogenism, we hypothesized that women experiencing more symptoms of PCOS, and a greater likelihood of androgen excess, would have a more unrestricted sociosexual orientation. Women completed questionnaires about PCOS symptoms, sociosexuality, and sexuality. Unrestricted sociosexuality, unrestricted desire, romantic interest in women, and masturbation frequency were all positively associated with PCOS symptoms (including male pattern hair growth). The sexuality scores were also higher in women who scored above (versus below) the cutoff on a self-report PCOS screening questionnaire. In addition, attraction to women was higher in participants reporting a past diagnosis of PCOS. The findings are in line with theories that androgens play a role in sociosexuality and sexual orientation. Future research should examine sociocultural explanations, and whether the continuum of PCOS symptoms (e.g., hirsutism) is a useful model for studying the effects of androgen exposure, hyperandrogenism, or androgen responsiveness on women's behavior.

Androgens have been associated with sexual functioning and desire in men (e.g., Corona et al., 2014, 2017), but these associations have been less consistent in women (e.g., Cappelletti & Wallen, 2016; Davis, Davison, Donath, & Bell, 2005; Wåhlin-Jacobsen et al., 2015). Some studies have found an association between androgens and unrestricted sociosexuality in both women and men (e.g., Edelstein, Chopik, & Kean, 2011; Shirazi et al., 2019). Clinical range symptoms of hyperandrogenism (i.e., hirsutism, acne, or alopecia) have also been linked with higher sexual desire in women in certain contexts (Rellini et al., 2013). Hyperandrogenism is a primary characteristic of polycystic ovary syndrome (PCOS) (e.g., Azziz et al., 2006), a heterogeneous disorder with symptoms that range on a continuum from low subclinical levels to high levels (Huddleston, 2018). As such, PCOS symptoms may be useful for examining associations between androgens and women's sexuality. Few studies have examined sexuality along the full continuum of PCOS symptoms, and links between unrestricted sociosexuality and PCOS symptoms have not been examined. The primary objective of the present study was to investigate the relationship between the entire continuum of PCOS symptoms and sociosexuality.

Sociosexuality and Androgens in Women

Sociosexuality refers to one's orientation toward uncommitted sexual activity (Gangestad & Simpson, 1990) and is usually measured with the Sociosexual Orientation Inventory – Revised (SOI-R; Penke & Asendorpf, 2008). The SOI-R assesses one's past uncommitted sexual behavior, beliefs, and desire/interest in uncommitted sex. While research on women is limited, some studies suggest that unrestricted sociosexuality may be linked to higher androgen levels (e.g., Edelstein et al., 2011; Shirazi et al., 2019).

The few studies that have examined associations between androgens and sociosexuality in women have had inconsistent findings (Charles & Alexander, 2011; Edelstein et al., 2011; Puts et al., 2015; Shirazi et al., 2019). Two studies found no associations (Charles & Alexander, 2011; Puts et al., 2015), but Puts et al. only included women taking oral contraceptives, and androgen levels are reduced as a result of hormone use (Zimmerman, Eijkemans, Coelingh Bennink, Blankenstein, & Fauser, 2013). Edelstein et al. (2011) reported that unrestricted sociosexual behavior was positively associated with testosterone levels among partnered, but not single, women. In the largest study, Shirazi et al. (2019) found an association between unrestricted sociosexuality and testosterone in women. Links between androgens and sexual relationship status/type may also be relevant. For example, polyamorous women have higher testosterone levels than single and singly partnered women (van Anders, Hamilton, & Watson, 2007), and in nonheterosexual women, testosterone is significantly lower in partnered than single women (van Anders & Watson,

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2006). Further research is needed to better understand associations between androgens, hyperandrogenism, relationship status/type, and women's sociosexuality.

Androgens and PCOS

PCOS is "above all a disorder of androgen excess in women" (Azziz et al., 2006, p. 23). Approximately 60% to 80% of women with PCOS have elevated circulating androgen levels (Azziz et al., 2006), and more than 80% of women with symptoms of androgen excess have PCOS (Azziz et al., 2004). Hirsutism has been associated with higher testosterone levels (Conway, Honour, & Jacobs, 1989) and androgens are credited with changing light vellus hairs into larger terminal pigmented hairs (Randall, 2008). Elevated dehydroepiandrosterone sulfate (DHEAS) levels, an adrenal androgen metabolite often used as a measure of hyperandrogenism in women, are seen in 40% to 65% of women with PCOS (Kumar, Woods, Bartolucci, & Azziz, 2005; Mostafa et al., 2017). Huang, Brennan, and Azziz (2010) reported the following in women with PCOS: a 75.3% prevalence of hyperandrogenemia, 57.6% had supranormal levels of free testosterone, 33% had supranormal levels of serum total testosterone, and 32.7% had elevated levels of DHEAS. Thus, there is heterogeneity between women with PCOS in terms of their hyperandrogenic profile.

Other research has examined if PCOS is associated with high prenatal androgen exposure (e.g., Abbott, Barnett, Bruns, & Dumesic, 2005; Barry et al., 2010; Barry, Qu, & Hardiman, 2018; Cattrall, Vollenhoven, & Weston, 2005; Lujan, Bloski, Chizen, Lehotay, & Pierson, 2010). While prenatal androgen exposure hypotheses are difficult to study, organizational effects of high prenatal or pubertal androgen exposure should be considered along with activational androgen effects as contributing to any symptoms or behavioral effects of PCOS (e.g., sexual effects). Examining organizational effects of androgens might involve measuring physical or behavioral indicators of hormonal exposure or sensitivity, as opposed to hormone levels.

Symptoms of PCOS

Despite the significant heterogeneity in the presenting clinical symptoms of PCOS, some symptoms are common in PCOS. Menstrual irregularities are present in approximately 75% of women with PCOS, with 70% to 75% of these women experiencing oligomenorrhea and 20% experiencing amenorrhea (Azziz et al., 2006). Other common symptoms include: polycystic ovaries (75%), hirsutism (60%), acne (15–30%), spontaneous abortion (43–73%), overweight or obese BMI (61%), infertility (40%), and acanthosis nigricans (53%) (Azziz et al., 2006; de Ávila et al., 2014; Kitzinger & Willmott, 2002; Lim, Davies, Norman, & Moran, 2012; Sirmans & Pate, 2014). While many of the symptoms require medical tests or monitoring to be identified (e.g., polycystic ovaries and infertility), some common clinical symptoms such as hirsutism are easily observed (self- and other-report) and may be useful as vulnerability markers. These clinical symptoms may be particularly important given that some women with PCOS appear to have high androgen sensitivity as opposed to high androgen levels (e.g., Huang et al., 2010). Given the hyperandrogenism inherent in symptoms of PCOS, such symptoms may be worth exploring when examining the hypothesis that high androgens contribute to unrestricted sociosexuality in women.

PCOS and Sexuality

Despite the above-noted positive associations between androgens and sexual desire, women with PCOS report sexual difficulties (Eftekhar et al., 2014; Fliegner, Richter-Appelt, Krupp, & Brunner, 2019). Common difficulties relate to achieving orgasm, frequency of orgasms, and degree of pleasure derived from orgasms (Stovall, Scriver, Clayton, Williams, & Pastore, 2012). They also report lower sexual satisfaction than controls (Hahn et al., 2005; Månsson et al., 2011). Systematic reviews and meta-analyses suggest that women with PCOS have more problems with sexual functioning yet do not have higher rates of sexual dysfunction, compared to control women (Murgel, Simões, Maciel, Soares, & Baracat, 2019; Pastoor et al., 2018). Research has focused on clinical samples, with few studies examining the full continuum of PCOS symptoms. Other factors related to PCOS, such as changes in appearance, menstrual irregularity or absence of menses, and difficulty conceiving may result in psychological distress or affect the feminine identity of patients with PCOS (Barry, Hardiman, Saxby, & Kuczmierczyk, 2011). These factors and some evidence of increased sexual desire (Rellini et al., 2013) may further complicate sexual relationships, sexuality, and sexual functioning in women with PCOS symptoms. The possibility that hyperandrogenism is associated with increased sexual desire and unrestricted sociosexuality in women requires study, particularly given that women with PCOS symptoms report sexual difficulties. Higher desire or unrestricted sociosexuality combined with orgasm difficulties could have negative effects on women's well-being.

Sexuality, Androgen Sensitivity, and PCOS Symptoms

Guided by hypotheses about the importance of androgen sensitivity in sexual desire (Graham, Bancroft, Doll, Greco, & Tanner, 2007), Rellini et al. (2013) examined whether androgen sensitivity (clinical symptoms of PCOS) or androgen levels [i.e., free testosterone dehydroepiandrosterone sulfate (DHEAS), and androstenedione] are associated with sexual desire in women with oligomenorrhea (i.e., <8 menstrual periods per year). Presence of clinical symptoms of hyperandrogenism (i.e., hirsutism, acne, or alopecia) was associated with reports of higher sexual desire from visual/proximity cues. However, Rellini et al. did not find any associations between androgen *levels* and sexual desire. Their findings suggest: (a) androgens may play a role in women's sexual desire but that androgen sensitivity (as measured by clinical symptoms of PCOS), and not plasma androgen levels, predicts sexual desire in women with PCOS symptoms, and (b) PCOS symptoms may be a useful model for examining the role of androgens in women's sexuality by examining clinical symptoms of androgen excess as a measure of androgen sensitivity.

Assessing the Continuum of PCOS Symptoms

The Polycystic Ovarian Syndrome Questionnaire (PCOSQ) (Pedersen, Brar, Faris, & Corenblum, 2007) is the only published screening tool for PCOS. It focuses on symptoms of clinical hyperandrogenism and assesses four common PCOS symptoms: history of long or variable menses, hirsutism (i.e., dark coarse hair growth), history of obesity, and nipple discharge that is exclusive of pregnancy or breastfeeding. The PCOSQ may be useful to researchers examining the full continuum of PCOS symptoms, hyperandrogenism, or subclinical symptoms of PCOS. As noted by Huddleston (2018), PCOS is a heterogenous disorder with a continuum of symptoms, and mild sub-clinical symptoms of PCOS exist in women who do not meet diagnostic criteria. Sjaarda et al. (2018) emphasized the need to examine PCOS symptoms in nonclinical populations and report clinical implications of subclinical symptomatology (i.e., ovulatory insufficiency or lower reproductive function).

Measuring hirsutism (male pattern hair growth) on a continuum may be useful as an endophenotype for PCOS or in predicting behavior or clinical outcomes. Dark coarse hair growth is associated with excess androgen levels (Azziz et al., 2006; Sachdeva, 2010) and androgens play a role in human hair growth (Glaser, Dimitrakakis, & Messenger, 2012; Randall, 2008). Thus, dark coarse hair in women may be a useful indicator of androgen exposure, androgen sensitivity, the activational and organizational effects of androgens on the brain, and might perhaps correlate with behavioral variables linked to androgens (e.g., sexuality or aggression). For example, hirsutism has been linked with reduced fertility and fecundity (Koivunen et al., 2008; West et al., 2014). Male pattern hair growth may prove useful as an indicator of androgen sensitivity and in assessing the continuum of a PCOS symptom.

The Present Study

The present study expanded on Rellini et al.'s (2013) finding of a link between women's sexual desire and clinical symptoms of androgen sensitivity in women with oligomenorrhea. Here we: (a) examined the relationship between sociosexuality and androgen sensitivity using clinical signs and symptoms of androgenism found in PCOS, and (b) looked at this relationship in a general sample of women that included women without any symptoms, with subclinical symptoms, and with a clinical level of symptoms of PCOS (i.e., the full continuum of symptoms). Rellini et al. studied sexual desire in a clinical sample of women with menstrual irregularities, categorically comparing those with and without a clinically significant level of hyperandrogenism symptoms. The present study examined the relationship between women's sexuality and PCOS symptoms in a broader, generally healthy sample of women spanning the entire continuum of PCOS symptoms. Given links between unrestricted sociosexuality and androgens, it was hypothesized that women with more PCOS symptoms would have a more unrestricted sociosexual orientation than women with fewer of such symptoms.

Method

Participants

Participants included 455 female undergraduate students aged 17 to 25 years old (M age = 19.48, SD = 1.85; 88.70% Caucasian/European descent). Mean body mass index (BMI) was 24.02 (SD = 5.39) and 62.40% were taking hormonal contraceptives. Relationship status included: 38.00% single, 49.60% partnered, and 10.8% dating. Also, 18 (4.30% of respondents) reported that they had been diagnosed with, or treated for, PCOS. The following exclusion criteria were applied to the original sample (N = 710): (1) age missing (n = 7) or greater than 25 (n = 137) to maximize sample homogeneity, and (2) missing information on the covariate hormonal contraceptive use (n = 45). The data from 66 of the remaining 521 women were also excluded as one or more data points used to calculate a main variable were missing. This was deemed acceptable as each variable was missing less than 5% of the data points (e.g., Tabachnick & Fidell, 2007).

To further maximize sample homogeneity, a subsample of women who reported being Caucasian or of European descent was also examined (n = 402; mean age = 19.40, SD = 1.77). This group was selected given evidence that hirsutism (Afifi et al., 2017; Engmann et al., 2017), androgen levels (Engmann et al., 2017; Randolph et al., 2003), and androgen receptor gene polymorphisms (Ackerman et al., 2012) differ as a function of ethnicity/race in women. Mean body mass index (BMI) was 23.93 (SD = 5.33) and 63.40% reported taking hormonal contraceptives. Relationship status included: 39.50% single, 48.30% partnered, and 10.9% dating. Also, 15 (4.00% of respondents) reported they had been diagnosed with, or treated for, PCOS. The study was approved by the university's research ethics board and informed consent was obtained from all participants.

Measures

Demographic Questionnaire

Participants completed a questionnaire which assessed demographic information (e.g., age, ethnicity); general health; sexual history; hormonal contraceptive use (yes/no); previous diagnoses with, and/or treatment for, PCOS; and relationship status.

The Polycystic Ovarian Syndrome Questionnaire (PCOSQ)

The PCOSQ (Pedersen et al., 2007) is a screening tool for PCOS that includes 4 items related to PCOS symptoms (length of the menstrual cycle, areas of dark hair growth, obesity, and nipple discharge). A PCOSQ total score of greater than 2 is consistent with an informal diagnosis of PCOS, while a total score of equal to or less than 2 is inconsistent with an informal diagnosis of PCOS. The PCOSQ has been found to have a sensitivity of 85% for the diagnosis of PCOS and a specificity of 93.4%. Due to multi-dimensionality and heterogeneity of the symptoms, internal consistency measures are not appropriate. Some evidence of construct and divergent validity for PCOSQ total scores is reflected by positive correlations with Hair Severity scores (r_s = .51, p < .001, N = 455)

and Hair Location scores (r_s = .52, p < .001, N = 455). The PCOSQ was used here to create both categorical PCOS screening criteria categorizations (yes/no) and continuous PCOSQ scores (range: −1 to 3) that were used to examine links with sociosexuality and sexuality.

Hirsutism

In order to assess women's dark coarse hair growth (i.e., hirsutism), participants reported if they had "a tendency to grow dark coarse hair" (yes/no) and the amount of coarse dark hair growth "you have had in that area" on each of the eight body parts listed in the PCOSQ (Pedersen et al., 2007). The hair severity item scale ranged from 0 (*no coverage*) to 5 (*complete coverage*). The body parts included the upper lip, chin, breasts, chest between the breasts, back, belly, upper arms, and upper thighs. Three hair variables were created. (1) *Hair Severity* scores (α = .83) were calculated by summing the hair scores across the eight body parts, with possible scores ranging from 0 to 40. (2) *Hair Location* scores (α = .83) reflect the number of body locations in which participants reported having dark coarse hair, with possible scores ranging from 0 (*no hair on any of the eight body parts*) to 8 (*hair on all eight body parts*). (3) Finally, the categorical variable *Any Hair* reflects whether or not participants reported having any hair on any of the eight body parts (*0 = absent; 1 = present*). It was determined using the hair location scores.

The Sociosexual Orientation Inventory Revised (SOI-R)

The SOI-R (Penke & Asendorpf, 2008) is a 9-item questionnaire that assesses sociosexual orientation. The SOI-R scale consists of three facet scales: a behavior subscale (SOI-B; α = .82), which assesses past uncommitted sexual activity (3 items); an attitude subscale (SOI-A; α = .79), which assesses beliefs about uncommitted sexual activity (3 items); and a desire subscale (SOI-D; α = .86), which assesses interest in uncommitted sex (3 items). Items can be summed to form a global sociosexual orientation score (SOI-R), with higher scores indicating a more unrestricted sociosexual orientation (α = .84).

Sex Drive

Three items from the 4-item Sex Drive Questionnaire (Ostovich & Sabini, 2004) were used to assess sex drive. The measure includes questions on sexual desire, frequency of orgasms, frequency of masturbation, and a question requiring one to compare one's own sex drive with that of an average person of the same age and gender. For this sample, it was found that the internal consistency of the scale improved when item 3 (masturbation frequency) was removed (α = .79). Thus, total sex drive was calculated as a sum of items 1, 2, and 4 of the Sex Drive Questionnaire, with higher scores indicating greater sex drive.

Masturbation Frequency

This measure consisted of item 3 from the Sex Drive Questionnaire (Ostovich & Sabini, 2004). Participants were asked to indicate how often they masturbated in an average month, with scores ranging from 1 (*never*) to 6 (*several times a day*).

Sexual Orientation

One item from the demographic questionnaire assessed romantic interest or sexual orientation. Participants indicated the focus of their romantic interest with an 8-point Likert-type scale, with scores ranging from 1 (*only attracted to males*) to 8 (*only attracted to females*). Response options 4 and 5 reflected a more bisexual orientation (i.e., *attracted to males and females*). Higher scores reflect greater romantic attraction to women.

Procedure

Women were recruited from the undergraduate student population at a Canadian University to participate in a study examining hormonal factors in women's health. Interested participants were directed to a website, which indicated the study purpose and procedure. Participants completed the consent form, filled out all questionnaires online, were provided with a debriefing form, and received course credit for participation.

Given that significant correlational effects between .15 and .20 were determined to be of interest, we calculated that a minimum of 346 to 194 participants would be required, respectively, with a two-sided significance of 0.05 and a power of 0.8. All data (except noted exclusions) were included, and all manipulations and measures are reported. Alpha was set at p < .05 for all analyses. A probability level of .05 to .10 was considered a nonsignificant trend.

Hormonal contraceptive use was a covariate in all analyses, given that oral contraceptives decrease androgens (Zimmerman et al., 2013), are often prescribed to regulate cycles or treat hormonal conditions (Dronavalli & Ehrmann, 2007), and use may differ based on sexual behavior and orientation. In the overall sample, hormonal contraceptive users had less male-pattern hair growth in terms of the number of body locations, t(316.05) = 2.00, p = .047, and hair severity scores, t(294.43) = 2.18, p = .03, as well as higher SOI-R behavior scores, t(453) = 3.31, p = .001, SOI-R attitude scores, t(453) = 2.55, p = .011, and sex drive scores, t(294.45) = 4.54, p < .001, compared to non-users. These group differences held when age was statistically controlled (see Supplementary Table 1) and the findings were similar in the more ethnically homogenous sample (Caucasian/European descent).

Scatterplots did not reveal any clear violations of the linearity assumptions. Given that many of the variables were positively skewed (e.g., see frequencies of PCOS symptoms in Supplementary Figure 1), nonparametric Spearman partial correlation analyses were first conducted to examine the relationships between all continuous PCOS symptom variables (Hair Location, Hair Severity, and PCOSQ scores) and sexuality variables (SOI-R and Sex Drive scale scores and the sexual orientation and masturbation frequency scores). Hierarchical regressions were also run to explicitly test for curvilinear relationships.

To further investigate links between male pattern hair growth and sexuality, a 2 group (any dark coarse hair: yes, no) MANCOVA analysis using Pillai's trace and follow-up univariate ANCOVAs were conducted to explore group differences on the four sexuality measures. To rule out potential

issues related to non-normality, ANCOVAs were followed by non-parametric Kruskal-Wallis tests, with group as the independent variable.

In order to examine group differences on the sexuality variables in women with low versus high PCOS symptoms, two sets of groups were created: (a) PCOS screening groups based on meeting the PCOSQ screening tool criteria (yes, no), and (b) history of PCOS diagnosis (yes, no). MANCOVAs were conducted (with follow-up univariate ANCOVAs) to examine group differences on the four above-noted continuous sexuality measures with group as the independent variable. Follow-up Kruskal-Wallis tests were also completed.

Results

Correlations: PCOS Symptoms and Sexuality

Spearman partial correlation analyses revealed positive relationships between PCOS symptom scores and sexuality scores (see Table 1). The SOI-R total scale, SOI-R desire scale, masturbation frequency, and sexual orientation scores were all significantly positively associated with the PCOS symptom measures (Hair Location, Hair Severity, and PCOSQ scores). Sex drive also showed a weaker positive association or trend with Hair Location and Hair Severity. The highest partial correlations indicated that women with more severe dark coarse hair growth had more unrestricted sociosexual desire scores (r_s = .20, p < .001, n = 402) and greater romantic attraction to women (r_s = .19, p < .001, n = 402); and that women with dark coarse hair on more body areas also had more unrestricted sociosexual desire (r_s = .20, p < .001, n = 402), more frequent masturbation (r_s = .18, p < .001, n = 402), and greater attraction to women (r_s = .18, p < .001, n = 402). The SOI-R behavior and attitude facet scales were not significantly correlated with any of the PCOS measures.

To better understand the above effect size differences between sociosexual desire and sex drive, Spearman correlation analyses were conducted between PCOS-related measures and individual items of the SOI-R desire facet scale and the Sex Drive scale (see Table 2). All three of the SOI-R desire items reflecting fantasy and arousal in uncommitted situations were significantly positively correlated with all of the PCOS measures in both samples. One item from the sex drive scale (*frequency of sexual desire*) was also significantly positively correlated with all of the PCOS measures. However, the other two sex drive items (i.e., *orgasm frequency and a comparison of one's sex drive to others*) were not significantly correlated with any of the PCOS measures. Thus, PCOS symptoms were positively associated with: (a) general sexual desire, (b) unrestricted sexual desire, and (c) masturbation frequency. However, PCOS symptoms were not associated with orgasm frequency or with unrestricted sexual behavior or attitudes.

We examined whether age or sexual orientation could explain any of the above correlations in Table 1 by re-running the nonparametric partial correlations with age and sexual orientation as additional covariates. Age was examined, given evidence that SOI-R scores increase with age (Gomula, Nowak-Szczepanska, & Danel, 2014) and age was correlated with several sexuality variables in this sample (e.g., age and SOI-R total score, r_s = .20, p < .001, n = 455). Sexual orientation was included to check if associated sociocultural factors might explain the relationships (e.g., lower societal acceptance of same-sex relationships might decrease women's opposite-sex sexual behavior and increase same-sex desire/fantasy). It should be kept in mind that including sexual orientation as a covariate risks removing relevant biological/hormonal variance. Nevertheless, while not shown here, significant findings between the two hair variables and SOI-R, SOI-desire, and masturbation frequency all held, albeit were slightly reduced. This suggests that neither age nor sexual orientation can fully explain the relationships.

We next ran hierarchical regressions to explore the possibility of curvilinear effects (i.e., whether or not a quadratic effect accounted for any variance above and beyond the covariate and any linear effect). For five of the 21 relationships in Table 1 there was evidence of a curvilinear effect with the hierarchical regressions (two of the five were found in both the full sample and the more homogenous sample) but examination of the plots suggested

Table 1. Nonparametric Partial Correlations Between Polycystic Ovary Syndrome (PCOS) Symptoms and Sexuality Variables in all Women (N = 455) [and Women of European Descent/Caucasian (N = 402)] with Hormonal Contraceptive Use as a Covariate.

Variable	Hair Locations	Hair Severity	PCOSQ
1. SOI-R	.12** [.15**]	.13** [.16** [a]]	.11* [.10*]
2. SOI-Behavior	.04 [.07]	.05 [.08]	.01 [.03]
3. SOI-Attitude	.06 [.07]	.07 [.08]	.05 [.05]
4. SOI-Desire	.17*** [.20***]	.18*** [a][.20*** [a]]	.16** [.15**]
5. Sex Drive	.08[t] [.11*]	.07 [.09*]	.07 [.07]
6. Masturbation	.17*** [.18***]	.16** [.16**]	.12** [.12*]
7. Sexual Orientation	.18*** [.18**]	.19*** [a][.19***]	.15** [a] [.12* [a]]

Means (SDs) are for the full sample. Hair Locations = number of body locations women reported dark coarse hair (M = 0.95, SD = 1.66); Hair Severity = sum of hair scores across 8 body parts (M = 1.58, SD = 3.20); PCOSQ = PCOS Questionnaire scores (M = 0.51, SD = 0.77); SOI-R = Sociosexual Orientation Inventory-Revised total scores (M = 27.08, SD = 12.36); SOI-Behavior = SOI-R Behavior scores (M = 6.65, SD = 3.91); SOI-Attitude = SOI-R Attitude scores (M = 11.81, SD = 6.49); SOI-Desire = SOI-R Desire scores (M = 8.63, SD = 5.20); Sex Drive = Sex Drive scale scores (M = 11.14, SD = 3.29); Masturbation = masturbation frequency (M = 1.98, SD = 1.11); Sexual orientation = attraction to women scores (M = 1.52, SD = 1.28).
[t]p < .10. *p < .05. **p < .01. *** p < .001. [a]Hierarchical regression also found a quadratic effect.

Table 2. Nonparametric Partial Correlations Between Polycystic Ovary Syndrome (PCOS) Symptom Score Variables and Sex Drive/Desire Items for all Women (N = 455) [and Women of European Descent/Caucasian (N = 402)] with Hormonal Contraceptive Use as a Covariate.

Variable	Hair Locations	Hair Severity	PCOSQ
SOI-R Desire 1	.14** [.17**]	.15** [.18***]	.13** [.12*]
SOI-R Desire 2	.16** [.17**]	.17*** [.18***]	.15** [.13**]
SOI-R Desire 3	.19*** [.22***]	.18*** [.21***]	.16** [.16**]
Sex Drive 1 (sexual desire frequency)	.14** [.17**]	.14** [.16**]	.10* [.10*]
Sex Drive 2 (orgasm frequency)	.03 [.05]	.02 [.04]	.04 [.02]
Sex Drive 4 (sex drive compared to others)	.02 [.04]	.01 [.03]	.06 [.07]

Hair Locations = number of body locations in which women reported having dark coarse hair; Hair Severity = sum of hair scores across 8 body parts; *PSOSQ* = PCOS Questionnaire scores; SOI-R Desire 1 = Sociosexual Orientation Inventory – Revised desire item 1 (*frequency of fantasies about uncommitted sex*); SOI-R Desire 2 = SOI-R desire item 2 (*frequency of sexual arousal when around someone you are not in a committed relationship with*); SOI-R Desire 3 = SOI-R desire item 3 (*frequency of spontaneous fantasies about sex with a new acquaintance).*
*p < .05. **p < .01. *** p < .001.

that one of these did not involve a curvilinear effect. The variables with potential curvilinear effects are noted in Table 1 with a footnote. Figure 1 illustrates the two relationships with the most obvious curvilinear effects in the larger sample. In both samples, attraction to women showed an exponential increase with PCOSQ scores (see Figure 1a). In both samples, as hair severity increased, women's sociosexual desire increased up to hair severity scores of 14 and then declined (see Figure 1b). The same pattern was found for SOI-R scores in women of European descent/Caucasian. The relationship between attraction to women and hair severity was more difficult to interpret due to small sample sizes in most categories; however, the pattern was somewhat similar to the relationship between sociosexual desire and hair severity scores.

Group Comparisons: Male Pattern Hair Growth Groups and Sexuality

All subsequent analyses were completed on the more homogenous sample of European/Caucasian women. This choice was made because findings were similar between the full sample and the more homogenous sample, and due to the above-noted concerns about ethnicity/race differences in hirsutism, androgen levels, and androgen receptor gene polymorphisms.

A MANCOVA was conducted to examine group differences on measures of sexuality for women with and without any male pattern hair growth (see means and SDs on left side of Table 3). The MANCOVA revealed an overall group difference, $F(6, 394) = 4.75$, $p < .001$, partial $\eta^2 = .07$. ANCOVAs revealed that women with any hair scored higher than those without any hair on all of the following measures: SOI-R total, $F(1, 399) = 11.29$, $p = .001$, partial $\eta^2 = .03$; SOI-R behavior, $F(1, 399) = 4.44$, $p = .036$, partial $\eta^2 = .01$; SOI-R desire, $F(1, 399) = 20.53$, $p < .001$, partial $\eta^2 = .05$; masturbation frequency, $F(1, 399) = 8.96$, $p = .003$, partial $\eta^2 = .03$; and sexual attraction to women, $F(1, 399) = 10.43$, $p = .001$, partial $\eta^2 = .03$ (see right side of Figures 2–4). Similar results were found using Kruskal-Wallis tests, except group differences for SOI-R behavior did not hold. When sexual orientation was added as a covariate in the ANCOVAs, all findings held except SOI-R behavior (reduced to a trend).

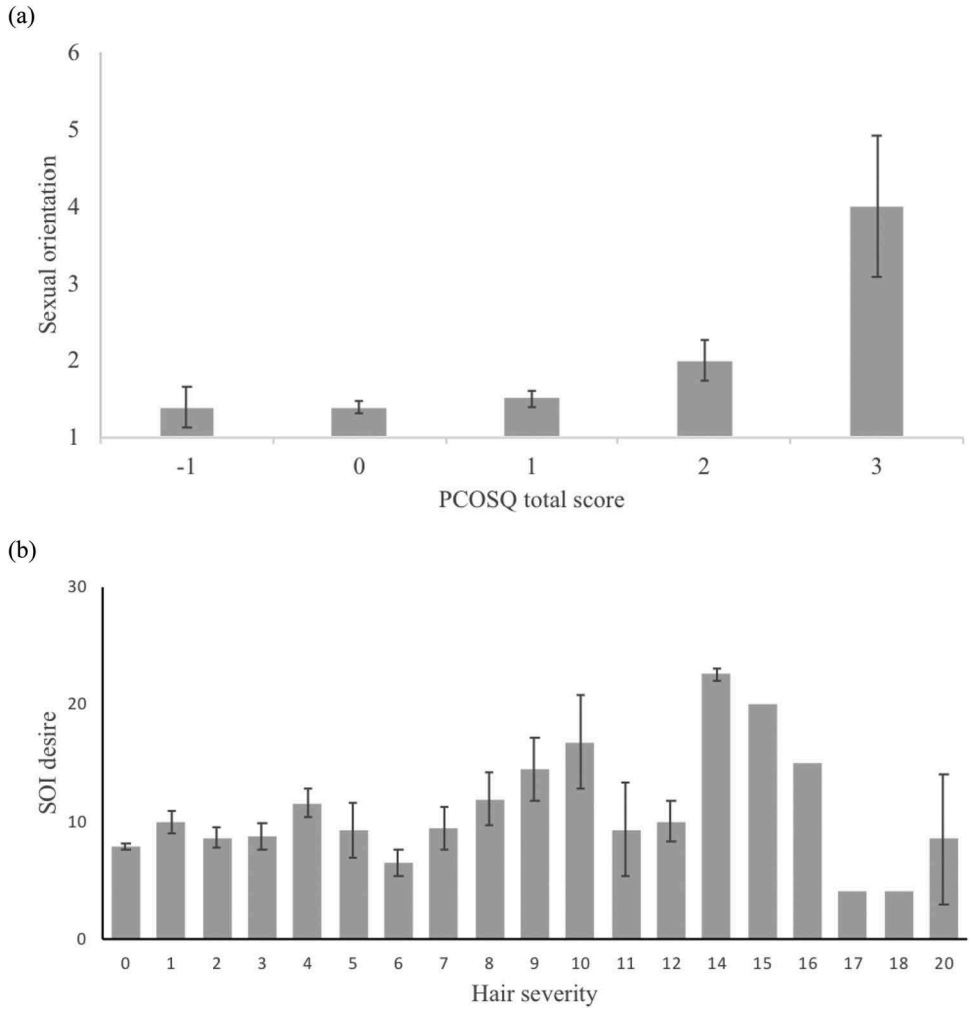

Figure 1. Bar graphs reflect linear and curvilinear relationships between: (a) sexual orientation (attraction to women) as a function of Polycystic Ovarian Syndrome Questionnaire (PCOSQ) total scores, and (b) SOI-R desire scores as a function of the severity or amount of dark coarse hair growth over eight body parts (Hair severity) in the larger sample. Attraction to women is similar at PCOSQ total scores of −1, 0, and 1, after which attraction to women increases exponentially as the PCOSQ score increases. There is a gradual increase in unrestricted desire scores up to a hair severity score of 14, after which sociosexual desire scores decrease as hair severity scores increase. Error bars represent +- 1 SEM.

Table 3. Uncorrected means (SDs) of sexuality scores as a function of dark coarse hair growth (yes/no), meeting the PCOSQ screening Cutoff (yes/no), and history of PCOS diagnosis (yes/no) groups for women of European descent/Caucasian (N = 402).

	Any Dark Coarse Hair		PCOSQ Criteria Met		PCOS Diagnosis History	
Sexuality measures	Yes n = 149	No n = 253	Yes n = 40	No n = 362	Yes n = 15	No n = 357
SOI-R	30.01 (13.34)	26.08 (11.80)**	33.10 (15.85)	26.93 (11.96)**	34.20 (13.82)	27.63 (12.47)^{t}
SOI-R Behavior	7.15 (4.49)	6.47 (3.71)*	8.20 (5.84)	6.56 (3.75)*	7.93 (5.42)	6.70 (3.98)
SOI-R Attitude	12.52 (6.57)	11.73 (6.57)	13.45 (6.82)	11.86 (6.53)	15.13 (5.25)	12.06 (6.64)^{t}
SOI-R Desire	10.34 (5.97)	7.89 (4.50)***	11.45 (5.99)	8.50 (5.06)**	11.13 (6.08)	8.88 (5.22)^{t}
Sex Drive	11.40 (3.51)	11.11 (3.04)	11.42 (3.34)	11.20 (3.21)	11.67 (2.85)	11.25 (3.23)
Masturbation	2.19 (1.12)	1.88 (1.10)**	2.28 (1.13)	1.96 (1.11)^{t}	2.47 (1.19)	1.99 (1.13)
Sexual orientation	1.77 (1.55)	1.34 (1.03)**	2.25 (1.81)	1.42 (1.16)***	2.93 (2.09)	1.46 (1.21)***

PCOSQ Screening Groups were created based on cutoffs on the Polycystic Ovarian Syndrome Questionnaire (PCOSQ). SOI-R = Sociosexual Orientation Inventory-Revised total score; SOI-R Behavior = SOI-R behavior facet score; SOI-R Attitude = SOI-R attitude facet score; SOI-R Desire = SOI-R desire facet score; Sex Drive = Sex Drive scale; Masturbation = masturbation frequency; Sexual orientation = attraction to women. Asterisks reflect the results of follow-up univariate ANCOVAs with hormonal contraceptive use as the covariate (yes/no).
$^{t}p < .10$. *p < .05. **p < .01. ***$p < .001$

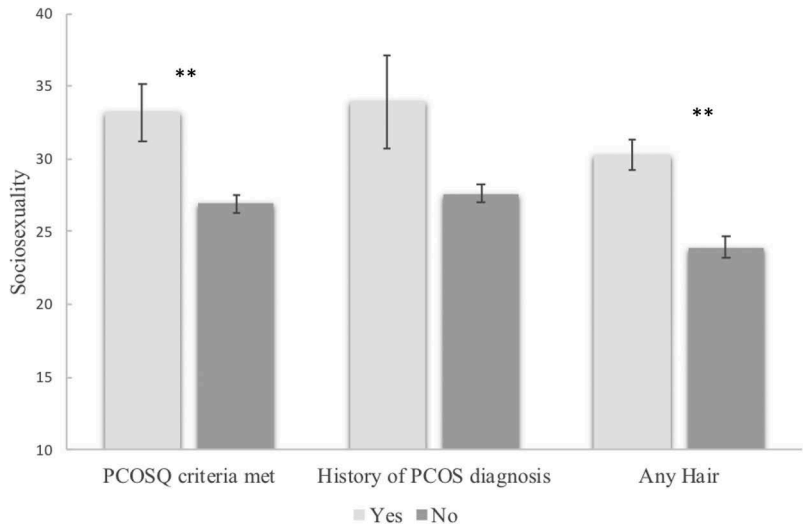

Figure 2. Group differences in overall sociosexuality scores as a function of scoring above the Polycystic Ovarian Syndrome Questionnaire (PCOSQ) screening cutoff, history of a PCOS diagnosis, and the presence of any dark coarse hair (with hormonal contraceptive use as a covariate) in women who reported being Caucasian or of European descent. A more unrestricted sociosexuality score was found in: (a) women who met (versus did not meet) the PCOSQ cutoff, $F(1, 399) = 9.25$, $p = .003$; and (b) women with (versus without) any coarse dark hair growth, $F(1, 399) = 11.29$, $p = .001$. Error bars represent +- 1 SEM. **p < .01. ***$p < .001$.

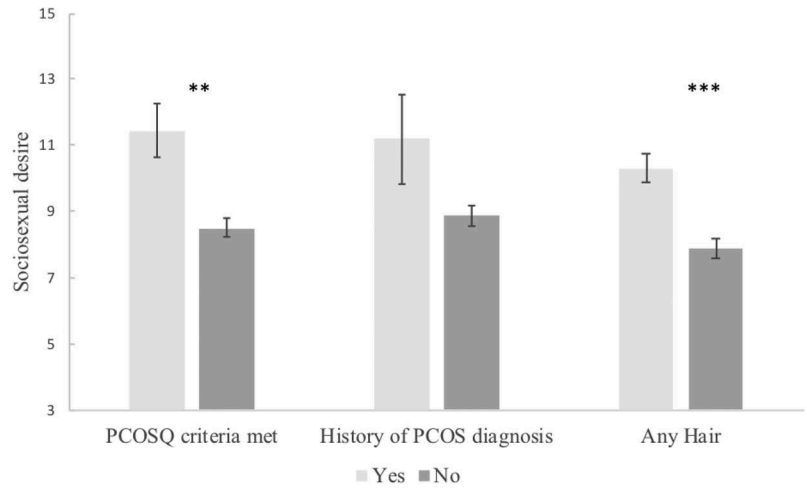

Figure 3. Group differences in sociosexual desire as a function of scoring above the Polycystic Ovarian Syndrome Questionnaire (PCOSQ) screening cutoff, history of a PCOS diagnosis, and the presence of any dark coarse hair (with hormonal contraceptive use as a covariate) in women who reported being Caucasian or of European descent. A more unrestricted sociosexual desire score was found in: (a) women who met (versus did not meet) the PCOSQ cutoff, $F(1, 399) = 11.60$, $p = .001$; and (b) women with (versus without) any coarse dark hair growth, $F(1, 399) = 20.53$, $p < .001$. Error bars represent +- 1 SEM. **p < .01. ***$p < .001$.

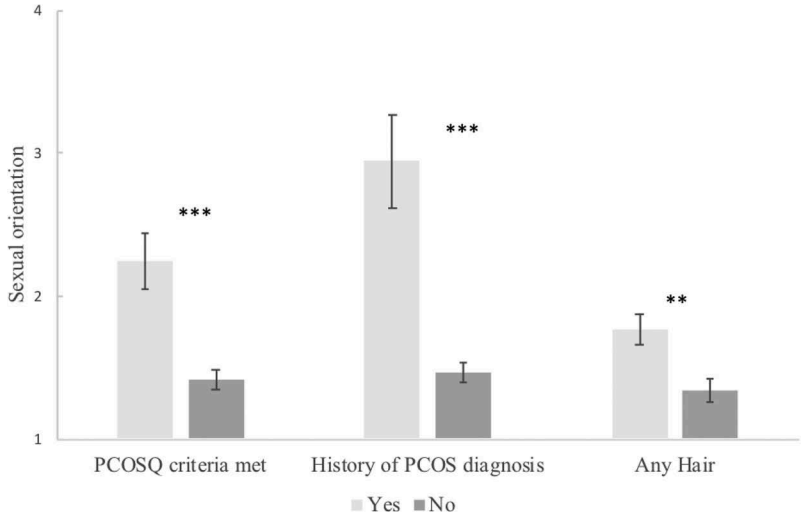

Figure 4. Group differences in sexual orientation as a function of scoring above the Polycystic Ovarian Syndrome Questionnaire (PCOSQ) screening cutoff, history of a PCOS diagnosis, and the presence of any dark coarse hair (with hormonal contraceptive use as a covariate) in women who reported being Caucasian or of European descent. Greater attraction to women was found in: (a) women who met (versus did not meet) the PCOSQ cutoff, $F(1, 399) = 16.12$, $p < .001$; (b) women with (versus without) a history of a PCOS diagnosis, $F(1, 369) = 19.83$, $p < .001$; and (c) women with (versus without) any coarse dark hair growth, $F(1, 399) = 10.43$, $p = .001$. Error bars represent +- 1 SEM. **p < .01. *** $p < .001$.

Group Comparisons: PCOS Groups and Sexuality

A preliminary examination of group equivalency for age between the women who met, versus those who did not meet, the PCOSQ screening criteria did not reveal a group difference ($p > .05$).

The overall MANCOVA comparing women who met and did not meet the PCOSQ screening cutoff indicated that the two groups differed on measures of sexuality, $F(6, 394) = 4.50$, $p < .001$, partial $\eta^2 = .06$ (see middle panel of Table 3 for group means and SDs). Follow-up univariate ANCOVAs revealed that the women who met the PCOSQ cutoff reported significantly higher and more unrestricted sociosexuality scores than the women below the cutoff on the following scales: SOI-R total, $F(1, 399) = 9.25$, $p = .003$, partial $\eta^2 = .02$; SOI-R behavior, $F(1, 399) = 6.56$, $p = .011$, partial $\eta^2 = .01$; and SOI-R desire, $F(1, 399) = 11.60$, $p = .001$, partial $\eta^2 = .03$. Univariate ANCOVAs also revealed a significant group difference in sexual orientation, $F(1, 399) = 16.12$, $p < .001$, partial $\eta^2 = .04$, with the high PCOSQ score group indicating greater romantic attraction to women. Some of these group differences are illustrated on the left side of Figures 2–4. Finally, a nonsignificant trend was found for masturbation frequency, $F(1, 399) = 3.05$, $p = .082$, partial $\eta^2 = .01$, suggesting that women meeting the PCOSQ cutoff showed a nonsignificant trend to masturbate more frequently than women whose scores fell below the PCOSQ cutoff. Group differences were not found for SOI-R attitude scores or the sex drive scores. Similar results were found using Kruskal-Wallis tests, although group differences for SOI-R behavior did not hold. When sexual orientation was added as a covariate in the ANCOVAs, all significant findings held.

Women with ($n = 15$) and without ($n = 357$) a self-reported history of a PCOS diagnosis were also compared on the sexuality variables (see right side of Table 3 for means and SDs). The MANCOVA revealed an overall group difference for the seven sexuality variables, $F(6, 364) = 3.64$, $p = .002$, partial $\eta^2 = .06$. Follow-up univariate ANCOVAs demonstrated a similar pattern; however, only one group difference was significant (see middle bars of Figures 2–4). Women with a history of diagnosed PCOS were more attracted to women than those without a history of a PCOS diagnosis, $F(1, 369) = 19.83$, $p < .001$, partial $\eta^2 = .05$ (see middle section of Figure 4). There were also trends for women with a history of PCOS diagnosis to have higher scores on the following: SOI-R total, $F(1, 369) = 3.66$, $p = .056$, partial $\eta^2 = .01$; SOI-R attitude, $F(1, 369) = 2.79$, $p = .096$, partial $\eta^2 = .01$; and SOI-R desire, $F(1, 369) = 2.80$, $p = .095$, partial $\eta^2 = .01$. Given that the prevalence of PCOS diagnosis in this sample (i.e., 3.73%, $n = 15$ of 402) is lower than PCOS population prevalence estimates (15 to 20%; Sirmans & Pate, 2014) and lower than the percentage of women who met the PCOSQ cutoff here (9.95%), it is likely that additional women in this sample had undiagnosed PCOS and that the findings with our PCOS diagnosis groups may underestimate the true relationship between PCOS and the sexuality variables examined. Similar results were found using Kruskal-Wallis tests. When sexual orientation was added as a covariate in the ANCOVAs, the findings were similar.

Discussion

To our knowledge, this is the first study to investigate unrestricted sociosexuality as a function of PCOS or PCOS symptoms. Women with high PCOS symptoms (based on the PCOSQ scores and groups based on cutoff scores) had a more unrestricted sociosexuality, greater sociosexual desire, greater masturbation frequency, and greater romantic attraction to women. When grouped based on the presence/absence of male-pattern dark coarse hair on any of eight body parts, women with such hair reported a more unrestricted sociosexuality, more unrestricted sociosexual desire and behavior, greater masturbation frequency, and greater sexual interest in women. Women with a history of PCOS diagnosis also reported greater attraction to women. The results suggest

that there is value in further examining whether self-reported PCOS symptoms, and hirsutism specifically, may be useful measures/paradigms for researchers studying the effects of androgens or androgen sensitivity on women's behavior.

Unrestricted Sociosexuality, Frequent Masturbation, and Attraction to Women

The findings support the hypothesis that women with more PCOS symptoms (i.e., more male-pattern hair growth on more bodily locations and higher PCOSQ scores) have a more unrestricted sociosexuality. Given the higher androgen levels and androgenic traits in PCOS, the findings fit with the possibility that a higher androgen exposure history may play a causal role in unrestricted sociosexuality in such women, but sociocultural explanations are also possible.

Our positive association between PCOS symptoms and unrestricted sociosexual desire is consistent with a few studies suggesting that women's sexual desire is associated with higher androgen levels (Wåhlin-Jacobsen et al., 2015) and symptoms of hyperandrogenism (Rellini et al., 2013). However, links between androgens and sexual desire have been inconsistent in past research (e.g., Cappelletti & Wallen, 2016). While we found effects for unrestricted sexual desire, not all facet scales of the SOI-R were associated with PCOS symptoms, as we did not find a relationship for sociosexual attitudes. Along similar lines, previous research has not found a consistent relationship between sexual attitudes and testosterone (Bancroft, Sherwin, Alexander, Davidson, & Walker, 1991; Penke & Asendorpf, 2008), and Shirazi et al. (2019) found stronger hormonal relationships with unrestricted desire than with attitudes or behavior in women. As one may expect sociocultural factors to have a larger effect on attitudes and beliefs than desire, the pattern of our findings may fit better with biological/hormonal explanations of the findings.

Our findings fit with those of Rellini et al. (2013) who demonstrated that higher physical indicators of androgen sensitivity (i.e., clinical symptoms of hyperandrogenism) are associated with higher sexual desire after visual proximal cues but not emotional/bonding cues. These authors used the visual proximal cue subscale from the Cues of Sexual Desire Scale (McCall & Meston, 2006) which examined sexual desire in situations where one sees or is in close proximity to someone powerful or attractive. While Rellini et al. did not specifically look at the role of androgens in unrestricted sociosexuality, visual proximal sexual cues are likely the type of cues that promote desire in unrestricted sociosexuality. Taken together, the findings suggest that androgens (or another factor associated with PCOS symptoms) may play a role in activating women's sexual interest/desire in short-term sexual relationships and that androgens (or a third factor) may facilitate this by enhancing the ability of visual proximal sexual cues to promote women's sexual desire. While not examined here, the findings raise the question of whether PCOS symptoms would also be associated with higher in-pair desire.

The correlational analyses found that PCOS symptoms were positively related to unrestricted sociosexual desire and also weakly associated with sex drive. The measure of sex drive used in the present study may not be an ideal measure. While the sexual desire frequency item was positively correlated with all three PCOS symptom measures, an orgasm frequency item was not. The latter finding was not consistent with research indicating orgasm difficulties in women with PCOS (Eftekhar et al., 2014). The current findings suggest that further examination of sex drive or sexual desire is warranted in relation to PCOS symptoms, and that it may be important to examine sex drive in the context of both short-term (unrestricted or extra-pair) and long-term (restricted or in-pair) contexts.

The finding of a consistent relationship between PCOS symptoms and the desire facet of sociosexuality, but not the behavior facet, fits with research showing that sociosexual behavior and desire are less closely linked in women than in men, perhaps because women may not often act on their sexual desires (Baumeister, 2000). Research also shows that PCOS is related to greater masculinization in appearance, such as hirsutism and acne (Azziz et al., 2006). Taking this into account, two speculative possibilities may explain the fact that PCOS symptoms are linked with sociosexual desire but not sociosexual behavior. First, symptomatic changes in physical appearance in PCOS may affect women's self-esteem and beliefs about whether they can or should act on their sexual desire. Research shows that hirsutism is associated with a decreased quality of life and lower self-esteem (Drosdzol, Skrzypulec, & Plinta, 2010). Thus, women with PCOS may feel less attractive and have lower self-esteem, which may prevent them from engaging in sexual activities, or even putting themselves in situations that might offer opportunities for such behavior, even though they have the desire to do so. Second, changes in physical appearance, including masculinization symptoms, may directly constrain the number of opportunities that women with PCOS or high PCOS symptoms have to engage in sociosexual activities. That is, mating opportunities may be limited by acne, weight gain, and hirsutism if such women are perceived as less attractive by potential mates. This is consistent with research showing that women with acne (Fink, Grammar, & Thornhill, 2001) and who are overweight (Brierley, Brooks, Mond, Stevenson, & Stephen, 2016) tend to be rated as less attractive. This second possibility suggests that women with PCOS may have the desire to engage in unrestricted sociosexual activities, but they lack opportunities to do so. The findings require replication and these speculative explanations should be examined in future research.

Masturbation frequency was also higher in women with more PCOS symptoms (i.e., greater hair severity, hair in more locations, and greater PCOSQ scores). This is consistent with Silva et al.'s (2010) findings that the absence of menstruation in PCOS was associated with greater frequency of masturbation, and is consistent with other studies reporting associations between masturbation and androgens (Goldey, Conley, & van Anders, 2018; van Anders, 2012). However, it is also possible that higher sexual desire combined with lower self-esteem or sexual opportunities might lead to higher frequency of masturbation. Further research is needed to examine these possibilities, to explore the role of hyperandrogenism in

female masturbation, and to determine how more frequent masturbation affects sexual functioning and well-being of women with higher PCOS symptoms.

Finally, the three PCOS symptomatology measures were associated with greater attraction to women. Also, greater interest in women was found for women with (versus without): (a) symptoms that exceeded the PCOSQ cutoff, (b) a self-reported diagnosis of PCOS, and (c) any dark coarse hair. To the extent that PCOS symptoms reflect high androgen exposure, our finding is somewhat consistent with research and theories linking hormone exposure with sexual orientation in women (Balthazart, 2011; Breedlove, 2017; Gartrell, Loriaux, & Chase, 1977; Rahman, 2005). The finding also fits with Agrawal et al.'s (2004) report that homosexual women had a higher prevalence of polycystic ovaries and PCOS compared to heterosexual women. Taken together, these studies suggest the possibility of greater hyperandrogenism in women attracted to women (WAW) or in homosexual versus heterosexual women.

The relative stability of the findings when age and sexual orientation were statistically controlled reduces the likelihood of a sociocultural explanation. These analyses reduce the possibility that the findings can be explained by: (a) age, (b) a stigma effect whereby lower societal acceptance of same-sex relationships inhibits the sociosexual behavior of women with PCOS symptoms while amplifying both their sociosexual desire and tendency to masturbate, or (c) an empowerment social/cultural explanation where the variables examined represent a cluster of factors associated with sexual empowerment or a rejection of heteronormativity [e.g., a greater sense of entitlement to masturbation (Horne & Zimmer-Gembeck, 2006), less of an effect of body dissatisfaction on sexual satisfaction (Moreno-Domínguez, Raposo, & Elipe, 2019), and greater acceptance of body hair (Fahs, 2011) in sexual minority or lesbian women].

The sexual orientation findings require replication and more research is needed on the relationships between androgen exposure (i.e., both organizational and activational effects), PCOS symptoms, and sexual orientation. Such studies must also examine all alternative social/cultural explanations. While examining hormonal correlates of sexual orientation can be controversial, there is value in this line of research beyond a theoretical understanding of potential hormonal mechanisms involved in romantic partner preferences (Bailey et al., 2016). As noted by Agrawal et al. (2004), the long-term health implications of PCOS and related symptomatology suggest that such research may have high practical value for lesbian women's health care risks and needs.

Strengths, Limitations, and Future Directions

The results of the present study must be considered in light of its strengths and limitations. Some strengths include the large sample size which improves the generalizability of the findings, controls for use of hormonal contraceptives, and the consideration of both the continuum of PCOS symptoms as well as a diagnostic history categorization.

In terms of limitations, the findings should be replicated using: (a) women whose formal PCOS diagnoses, or lack thereof, are confirmed by an expert; (b) comprehensive validated self-report measures of PCOS symptoms, sexual orientation, masturbation, and sexual desire [e.g., the Sexual Desire Inventory (Spector, Carey, & Steinberg, 1996)]; (c) direct measures of both activational and organizational androgen exposure (keeping in mind that these may not capture hormonal sensitivity), (d) women of all ages, (e) different racial/ethnic groups, (f) explicit questions about hair growth "prior to any hair removal", and (g) samples with little missing data. While we sought to measure symptoms of PCOS, some symptoms may be due to conditions hormonally distinct from PCOS, such as hypothalamic amenorrhea. Also, given that PCOS symptoms affect physical appearance (i.e., hirsutism) and are associated with women's sexuality, social/cultural effects of this experience require further study. Finally, future researchers should examine if higher PCOS symptoms are associated with higher in-pair sexual desire, in addition to our finding of an association with higher unrestricted sexual desire.

Conclusion

This study suggests that women with higher PCOS symptoms have a more unrestricted sociosexual orientation (largely due to higher sociosexual desire), greater romantic attraction to women, and greater masturbation frequency. Thus, clinical features of PCOS that likely reflect hyperandrogenization, and that can be both self-reported or observed (e.g., hirsutism), are associated with women's sexuality. The findings suggest that androgens (i.e., high levels or high responsivity to androgens) as well as sociocultural factors may play a role in women's sociosexuality, sexual behavior, and sexual orientation. The associations between symptoms of PCOS and sexuality are of relevance to researchers who study PCOS, sexual desire, masturbation, sociosexuality, sexual orientation, and sexual relationships broadly. The findings may also be useful to women with PCOS symptoms and their treating clinicians.

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Disclosure statement

The authors do not have any potential conflicts of interest to report.

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Data Availability Statement

The data that support the findings of this study are available on request from the corresponding author. Due to the sensitive nature of the questions asked in this study (e.g., medical diagnoses and sexual

behavior), participants were not asked to provide consent to share the data publicly. However, access to the data that support the findings of this study are available from the corresponding author upon reasonable request, and will be deposited and available upon approved request in Scholars Portal Dataverse (https://doi.org/10.5683/SP2/SCWCSO) upon acceptance of this manuscript.

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