

Sexual function in women with polycystic ovary syndrome: a systematic review and meta-analysis

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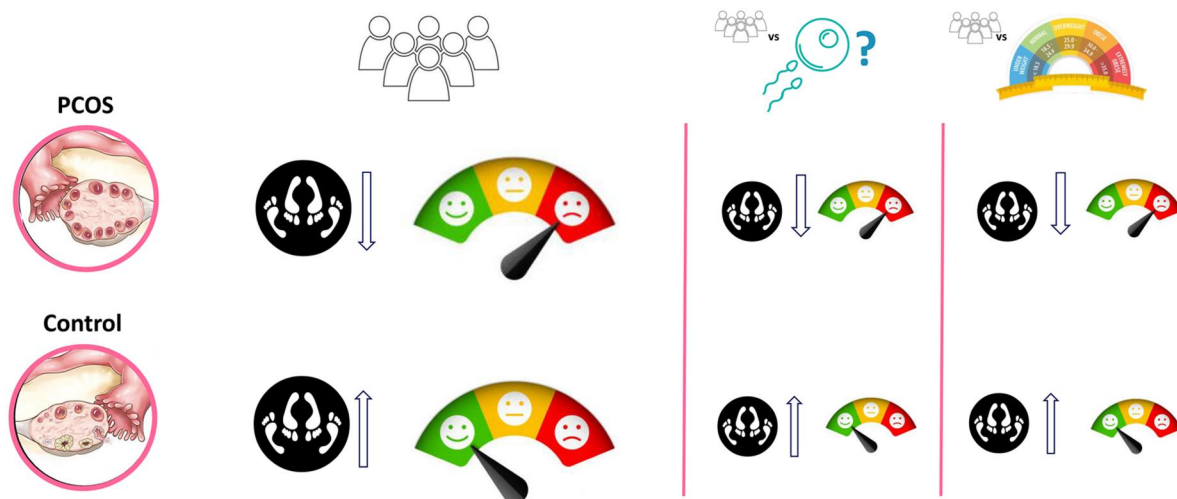
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GRAPHICAL ABSTRACT



Women with PCOS report lower sexual function and lower sexual satisfaction compared to control women, both overall and in subgroups based on fertility status and body mass index.

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ABSTRACT

BACKGROUND: Polycystic ovary syndrome (PCOS) is a common and distressing endocrine disorder associated with lower quality of life, subfertility, diabetes, cardiovascular disease, depression, anxiety, and eating disorders. PCOS characteristics, its comorbidities, and its treatment can potentially influence sexual function. However, studies on sexual function in women with PCOS are limited and contradictory.

OBJECTIVE AND RATIONALE: The aim was to perform a systematic review of the published literature on sexual function in women with PCOS and assess the quality of the research and certainty of outcomes, to inform the 2023 International Guidelines for the Assessment and Management of PCOS.

SEARCH METHODS: Eight electronic databases were searched until 1 June 2023. Studies reporting on sexual function using validated sexuality questionnaires or visual analogue scales (VAS) in PCOS populations were included. Random-effects models were used for meta-analysis comparing PCOS and non-PCOS groups with Hedges' g as the standardized mean difference. Study quality and certainty of outcomes were assessed by risk of bias assessments and the Grading of Recommendations, Assessment, Development and Evaluations (GRADE) method according to Cochrane. Funnel plots were visually inspected for publication bias.

OUTCOMES: There were 32 articles included, of which 28 used validated questionnaires and four used VAS. Pooled Female Sexual Function Index (FSFI) scores in random-effects models showed worse sexual function across most subdomains in women with PCOS, including arousal (Hedges' g [Hg] [95% CI] = -0.35 [-0.53 , -0.17], $I^2 = 82%$, $P < 0.001$), lubrication (Hg [95% CI] = -0.54 [-0.79 , -0.30], $I^2 = 90%$, $P < 0.001$), orgasm (Hg [95% CI] = -0.37 [-0.56 , -0.19], $I^2 = 83%$, $P < 0.001$), and pain (Hg [95% CI] = -0.36 [-0.59 , -0.13], $I^2 = 90%$, $P < 0.001$), as well as total sexual function (Hg [95% CI] = -0.75 [-1.37 , -0.12], $I^2 = 98%$, $P = 0.02$) and sexual satisfaction (Hg [95% CI] = -0.31 [-0.45 , -0.18], $I^2 = 68%$, $P < 0.001$). Sensitivity and subgroup analyses based on fertility status and body mass index (BMI) did not alter the direction or significance of the results. Meta-analysis on the VAS studies demonstrated the negative impact of excess body hair on sexuality, lower sexual attractiveness, and lower sexual satisfaction in women with PCOS compared to controls, with no differences in the perceived importance of a satisfying sex life. No studies assessed sexual distress. GRADE assessments showed low certainty across all outcomes.

WIDER IMPLICATIONS: Psychosexual function appears to be impaired in those with PCOS, but there is a lack of evidence on the related distress scores, which are required to meet the criteria for psychosexual dysfunction. Health care professionals should discuss sexual function and distress and be aware of the multifactorial influences on sexual function in PCOS. Future research needs to assess both psychosexual function and distress to aid in understanding the degree of psychosexual dysfunction in PCOS. Finally, more diverse populations (e.g. non-heterosexual and more ethnically diverse groups) should be included in future studies and the efficacy of treatments for sexual dysfunction should also be assessed (e.g. lifestyle and pharmacological interventions).

Keywords: polycystic ovary syndrome / sexuality / female sexual function / sex counselling / sexual satisfaction / sexual arousal

Introduction

With an estimated prevalence of 5–20% worldwide, polycystic ovary syndrome (PCOS) is the most common endocrine disorder in women of reproductive age (Azziz et al., 2016; Teede et al., 2018; Louwers and Laven, 2020; Joham et al., 2022). PCOS in adults is diagnosed when two out of three characteristics are present: oligomenorrhea or amenorrhea, hyperandrogenism (biochemical or clinical), and polycystic ovarian morphology (PCOM) (Rotterdam ESHRE/ASRM-Sponsored PCOS Consensus Workshop Group, 2004). PCOS is a distressing disorder associated with obesity, insulin resistance, dyslipidaemia, and subfertility. Furthermore, there is an increased risk for depression, anxiety, low self-esteem, and a lower quality of life in PCOS compared to non-PCOS populations (Cooney et al., 2017).

Treatment of PCOS is complex and consists of lifestyle modification (e.g. losing weight, exercise, healthy diet) as first-line treatment. For women with subfertility who want to conceive, ovulation induction is often required (Louwers and Laven, 2020; Joham et al., 2022). Women without a desire to conceive are usually prescribed the combined oral contraceptive pill (COCP) (Teede et al., 2018). Both lifestyle changes and COCPs aim to improve endocrine features by either changing androgen levels directly or indirectly through weight change. Androgens play an important role in sexual function in both sexes. It is known that reduced androgen levels in women may affect sexual function (Zimmerman et al., 2014; Davis et al., 2016). However, the effect of supra-physiological androgen levels on sexual function in women is not clearly known.

Sexual function is a complex biopsychosocial phenomenon, as is PCOS, and can be affected by several factors. Androgen levels

can influence sexual function and desire, although psychosocial factors should not be overlooked (Heiman et al., 2011; Maseroli and Vignozzi, 2022). Obesity is associated with lower sexual function and a higher risk of sexual dysfunction in women through direct effects of adipose tissue on sexual response, pathophysiological effects of obesity-related comorbidities, and the impact of psychological factors. Indeed, reducing weight has been shown to improve sexual function (Kolotkin et al., 2012; Rowland et al., 2017; Loh et al., 2022). Similarly, metabolic syndrome can adversely impact sexual function through vascular risk factors, whereas treating metabolic syndrome improves sexual function (Miner et al., 2012; Di Francesco et al., 2019). Infertile women report lower sexual function and satisfaction than fertile women, likely due to contributing factors such as timed intercourse, marital problems, and the psychological burden of infertility (Mendonca et al., 2017; Starc et al., 2019; Okobi, 2021). Mental illnesses such as depression and anxiety influence sexual function negatively as an effect of the disease itself, but also as a side effect of prescribed medication (Brotto et al., 2016; McCabe et al., 2016). Finally, poor body image (Woertman and van den Brink, 2012; van den Brink et al., 2013; Brotto et al., 2016) and low self-esteem (Brotto et al., 2016; Sejourne et al., 2019) impair sexual function through heightened self-consciousness and negative cognitions during sexual activity. These factors are all commonly present in women with PCOS, suggesting that PCOS itself, its comorbidities, and its treatment interventions may potentially influence sexual function.

Research focusing on psychosocial aspects or sexual function in PCOS is fairly recent. Some studies suggest no differences in sexual function in women with PCOS (Murgel et al., 2019; Zhao et al., 2019), while others report more sexual problems in PCOS

compared to their non-PCOS counterparts (Castelo-Branco and Naumova, 2020; Loh et al., 2020). In 2018, we published the first meta-analysis on sexual function in women with PCOS, which showed lower sexual function and lower sexual satisfaction in women with PCOS compared to control women (Pastoor et al., 2018). Since then, a number of studies on sexual function in PCOS have been published, recognizing the importance of the topic. Although meta-analyses (Murgel et al., 2019; Zhao et al., 2019; Loh et al., 2020) using the Female Sexual Function Index total scores have been conducted, these have included only a few studies (four to six in total); hence, an update of our previous review was deemed timely.

The aim of the current systematic review and meta-analysis is to present a comprehensive synthesis of the published literature on sexual function in women with PCOS and to evaluate the quality of the evidence and certainty of outcomes. Findings from this review and meta-analysis have directly informed the 2023 update of the International Evidence Based Guideline for the Assessment and Management of PCOS, guiding the upcoming recommendations for assessing and managing sexual function in women with PCOS.

Methods

Search strategy

The following electronic databases were searched from inception until 1 June 2023: Embase, Medline (via Ovid), Web-of-Science, Scopus, PsycINFO (via Ovid), Cinahl (via EBSCOhost), Cochrane CENTRAL (via Wiley), and Google Scholar (via Publish or Perish). The search was developed by an experienced biomedical information specialist (W.B.), together with the lead author (H.P.). Various relevant search terms (thesaurus terms and terms in title and/or abstract) concerning PCOS and sexual function were used. The search string did not include restrictions on date, type of publication, or language in order to capture as many publications as possible. To update the previous search from 2018, the Medical Library of Erasmus MC used the following method: first, all results that were obtained in the present search (from inception) were downloaded in Endnote and deduplicated. Second, the previous 2018 Endnote file was completely copied to the new EndNote file and the references were deduplicated again. By removing both duplicates, only the new references were present in the current Endnote file (Bramer and Bain, 2017).

Eligibility criteria using the Population-Intervention-Comparison-Outcome (PICO) framework, as well as the search strategy, are presented in [Supplementary Tables S1 and S2](#).

Inclusion and exclusion criteria

Following the electronic search, the screening and selection of publications were performed by two authors (H.P., H.B.) independently. They considered all studies addressing PCOS and sexual function for inclusion. First, selection on title and abstract and second, selection of full texts on in- and exclusion criteria was done. The following inclusion criteria were used: (i) participants aged 14 years and older; (ii) adequate diagnosis of PCOS (Rotterdam criteria; the former and current National Institutes of Health (NIH) definition; the Androgen Excess (AE) & PCOS Society definition; European Society of Human Reproduction and Embryology PCOS guideline 2018; American Society for Reproductive Medicine; National Institute of Child Health and Human Development); (iii) the use of validated sexuality questionnaires or visual analogue scales (VAS); (iv) inclusion of a control group without PCOS; and (v) adequate definition of sexual function (operationalized as: desire, arousal, lubrication, orgasm,

frequency of intercourse, masturbation frequency, sexual dysfunction, sexual satisfaction, sexual self-image, sexual debut, and sexual distress). To be included, studies had to be original studies and had to be available as full-text in the English language.

Excluded were studies unrelated to PCOS or PCOS induced by valproate use or PCOS in combination with other illnesses or diseases like diabetes and metabolic syndrome. Moreover, studies solely concerning health-related quality of life, quality of life or mental health and studies concerning idiopathic hyperandrogenism or hyperandrogenism caused by diseases other than PCOS were excluded. Finally, review articles, PhD theses, abstracts, and posters were also excluded. All discrepancies in choices were discussed to reach consensus. A complete overview of included and excluded studies can be found in [Supplementary Table S3](#).

Data extraction

The following data were extracted from identified studies: study design, publication date, authors, country, setting, population, period of recruitment, sample size, intervention, outcome measures with corresponding data, and narrative summaries of key findings ([Table 1](#)).

Quality assessment and GRADE assessment

Two reviewers (H.P., H.B.) independently assessed the quality of the included studies using the study characteristics and quality appraisal templates, which were based on an adapted version of the ROBINS-I tool (Sterne et al., 2016), provided by the evidence team of the PCOS guideline update (A.M., C.T.T.). This included assessment of internal validity, based on selection bias (comparability of populations, case definition, control status assessment), performance bias (treatment of groups, validated and standard measurements, blinding, valid and reliable outcome measures, objective assessment of outcome), attrition bias (loss to follow up, exclusion in analysis), report bias (selective outcome reporting), confounding (comparability of cohorts), and other bias (conflicts of interest, power analysis, statistical analysis). Overall risk of bias, judged as low, moderate, or high, was assessed based on these criteria ([Supplementary Table S4](#)).

Visual inspection of funnel plot asymmetry was performed to assess potential publication bias. The certainty of the evidence was independently assessed by two authors (H.P., A.M.) using the Grading of Recommendations, Assessment, Development and Evaluation (GRADE) framework, as per the Cochrane GRADE handbook guidelines (Schunemann et al., 2000). This included outcome-level assessment of risk of bias, inconsistency, indirectness, imprecision, and other biases (e.g. publication bias or observational study design).

Outcome measures

Sexual function was measured using validated questionnaires: Female Sexual Function Index (FSFI) (Rosen et al., 2000); Changes in Sexual Functioning Questionnaire (CSFQ) (Clayton et al., 1997); Sexual Quotient-Female (SQ-F) (Abdo, 2006); McCoy Female Sexuality Questionnaire (MFSQ) (McCoy, 2000); Female Sexual Desire Questionnaire (FSDQ) (Goldhammer and McCabe, 2011); and Multidimensional Sexuality Questionnaire (MSQ) (Snell et al., 1993). Additionally, sexual satisfaction was assessed with several validated questionnaires: Index of Sexual Satisfaction (ISS) (Hudson et al., 1981); Sexual Satisfaction Scales (Davis et al., 2006); and Sexual Satisfaction Questionnaire (SSQ) (Nomejko and Dolińska-Zygmunt, 2014). For details on all questionnaires, see [Supplementary Table S5](#).

Table 1. Study characteristics for the included studies.

Author, year, country	Setting (population) Period of recruitment PCOS diagnostic criteria	Study design	Sample size per group	Outcomes	Summary of findings	Other notes	Risk of bias
Eisenbruch et al., 2003, Germany	Outpatient endocrine clinic, Website clinic (PCOS patients) Health screening program university (age-matched healthy controls, employees) Recruitment period not mentioned NIH criteria	Cross-sectional	PCOS 50 Controls 50	VAS sexual function	PCOS: less satisfied with sexual life, less attractive, sex life is as important as for controls, body hair impacts sexuality negatively	Eisenbruch, Tan, Hahn, and Caruso used the same control group	Moderate
Hahn et al., 2005, Germany	Outpatient endocrine Clinic, Website clinic (PCOS patients) Health screening program university (age-matched healthy controls) Recruitment period not mentioned NIH criteria	Cross-sectional	PCOS 120 Controls 50	VAS sexual function	PCOS: less satisfied with sexual life, less attractive, sex life is as important as for controls, body hair impacts sexuality negatively	Eisenbruch, Tan, Hahn, and Caruso used the same control group	Moderate
Drosdzol et al., 2007, Poland	University Hospital (PCOS patients) Outpatient Gynecological Clinics (controls for routine checkup) Recruitment period not mentioned ESHRE criteria & Polish Endocrine Society	Cross-sectional	PCOS 50 Controls 40	ISS questionnaire sexual function	PCOS lower marital sexual function, more marital sexual dysfunction, hirsutism affects sexual function negatively than controls		Moderate
Tan et al., 2008, Germany	Outpatient endocrine clinic (PCOS patients) Health screening program university (age-matched healthy controls) June 2005 to December 2006 NIH & Rotterdam	Cross-sectional	PCOS 115 Controls 50	VAS sexual function	PCOS reduced sexual satisfaction and sexual self-worth compared to controls	Eisenbruch, Tan, Hahn, and Caruso used the same control group We compared both the PCOS infertile and fertile group separately to the control group.	Moderate
Caruso et al., 2009, Italy	Family planning centre, University of Catania, Italy (PCOS patients) Health screening program university, Germany (age-matched control group, employees) April 2007 to March 2008 Rotterdam criteria	Prospective intervention	PCOS 94 Controls 50	VAS sexual function	Women with PCOS find themselves less sexual attractive. Body hair impacted sexual function and PCOS had an impact on social relations.	Eisenbruch, Tan, Hahn, and Caruso used the same control group Intervention study, we used baseline scores only for this meta-analysis	Moderate
Mansson et al., 2011, Sweden	Linne Infertility Clinic in Uppsala Department of Obstetrics & Gynecology and Medicine at Sahlgrenska University Hospital Gothenburg & support community website (PCOS patients) For each woman with PCOS a woman born on the same day, identified from the population registry served as a control (controls) 2002–2005 Rotterdam criteria	Case control	PCOS 49 Controls 49	McCoy-FSQ	Despite having the same number of partners and about the same frequency of sexual intercourse, women with PCOS were generally less satisfied with their sex lives compared to the population-based controls. PCOS women scored numerically lower than controls on the McCoy total score, but this difference was not statistically significant.	Not included in MA for outliers see Pastoor et al. 2018	NA

(continued)

Table 1. Continued

Author, year, country	Setting (population) / Period of recruitment / PCOS diagnostic criteria	Study design	Sample size per group	Outcomes	Summary of findings	Other notes	Risk of bias
Gateva and Kamenov, 2012, Bulgaria	Hospitalized patients endocrine clinic (PCOS patients, lean, and obese) Other hospital population (controls, obese) Recruitment period not mentioned ESHRE & ASRM Convenient, hospital (PCOS patients) Waiting rooms from three university gynaecological departments and a Family Medicine Clinic (controls) January 2006 to June 2009 NICHD	Cross-sectional	PCOS 57 Controls 22	FSFI	PCOS lower sexual function scores than obese controls. Obese PCOS women score better in FSFI than lean PCOS women.	Intervention study, we used baseline scores only for this meta-analysis We only used data for obese women.	Moderate
Stovall et al., 2012, USA	Convenient, hospital (PCOS patients) Waiting rooms from three university gynaecological departments and a Family Medicine Clinic (controls) January 2006 to June 2009 NICHD	Cross-sectional	PCOS 92 Controls 82	GSFQ	PCOS lower orgasm score than controls, higher BMI related to worse orgasm scores, testosterone >1SD above mean better sexual function		Moderate
Ercan et al., 2013, Turkey	Two university hospital gynaecology departments (PCOS patients) University hospital outpatient unit, routine check-up (controls) Recruitment period not mentioned Rotterdam criteria	Cross-sectional	PCOS 32 Controls 32	FSFI	No differences in sexual function, higher testosterone associated with higher total FSFI score		Low
Ferraresi et al., 2013, Brazil	Consecutive sample, University Hospital Sao Paulo, Gynecologic Endocrinology (PCOS patients) Primary care same hospital, Regular menses (controls) September 2008 to July 2010 Rotterdam criteria	Cross-sectional	PCOS 48 Controls 35 r83/87 total population	FSFI	PCOS 50% below cut off FSFI, no significant differences in FSFI total score between PCOS and control	We used both the lean and obese data.	Moderate
Zueff et al., 2015, Brazil	Outpatient Clinic Human Reproduction Sector, University of Sao Paulo, (PCOS patients and controls) April 2009 to July 2010 Rotterdam criteria	Case control	PCOS 43 Controls 44	SQ-F	No significant differences in total SQ-F scores		Moderate
Benetti-Pinto et al., 2014, Brazil	Gynaecology department university hospital, University of Campinas, Sao Paulo (PCOS patients and controls) Recruitment period not mentioned Rotterdam criteria	Cross-sectional	PCOS 56 Controls 102 r100%	FSFI	PCOS lower score on FSFI scales except for desire and orgasm		Low
Elkhiat et al., 2015, Egypt	Gynecology & Obstetrics Clinic, Kasr El Aini hospital, Cairo University (PCOS patients and controls) Recruitment period not mentioned Rotterdam criteria	Cross-sectional	PCOS 85 Controls 63	FSDQ	PCOS lower scores on FSDQ scales except for solitary desire. Normal testosterone levels in PCOS associated with better sexual function.		Moderate

(continued)

Table 1. Continued

Author, year, country	Setting (population) Period of recruitment PCOS diagnostic criteria	Study design	Sample size per group	Outcomes	Summary of findings	Other notes	Risk of bias
Kowalczyk et al., 2015, Poland	University hospital University of Silesia: department of Gynecologic Endocrinology (PCOS patients) Gynaecological outpatient clinics of Women's Health Diagnostic Center, Katowice (controls) March 2009 to September 2009 Rotterdam criteria	Cross-sectional	PCOS 73 Controls 45	MSQ	Both groups find sexuality equally important. PCOS rates themselves negatively as sexual partner.		Low
Lara et al., 2015, Brazil	Endocrine gynaecology outpatient clinic, University of Sao Paulo (PCOS patients and controls) December 2010 to December 2013 Rotterdam criteria	Case control	PCOS 43 Controls 51	FSFI	PCOS more sexual dysfunction at baseline, other scales similar scores between PCOS and controls	Intervention study, we used baseline scores only for this meta-analysis	Moderate
Noroozzadeh et al., 2016, Iran	Stratified-cluster sampling method in four provinces of various geographic regions of Iran (PCOS patients and controls) Recruitment period not mentioned Rotterdam criteria	Cross-sectional population based	PCOS 63 Controls 216	FSFI	No significant differences between controls and PCOS on FSFI scores.		Low
Shafti and Shabbazi, 2016, Iran	Shahid Rajaei Hospital and selected women infertility clinics in Tonekabon, convenient sampling (PCOS patients) Clinics employees and patients companions, convenient sampling (controls) November 2013 to June 2014 Rotterdam criteria	Casual comparative study	PCOS 129 Controls 125	FSFI	No significant differences on FSFI scores between PCOS and controls		Moderate to high
Diamond et al., 2017, USA	Trial PCOS II (PCOS patients) Trial AMIGOS (infertile controls) Women seeking infertility care Recruitment period not mentioned Rotterdam criteria	Cross-sectional secondary data analysis with data from clinical trial	PCOS 733 Controls 865	FSFI	Sexual function scores, as assessed by the Female Sexual Function Inventory, were nearly identical. The Female Sexual Distress Scale total score was higher in women with polycystic ovary syndrome. The mean Female Sexual Function Inventory total score increased slightly as the free androgen index increased, mainly as a result of the desire subscore. This association was more pronounced in the women with unexplained infertility No significant differences on FSFI scores between PCOS and controls	We only used baseline data for this study. Excluded from MA for being an outlier (see Pastoor et al. 2018)	NA
Basirat et al., 2019, Iran	Infertility clinic Fatemeh Azahra Infertility and Reproductive Health Research Center, Babol, Iran (PCOS patients and controls) May 2016 to December 2017 Rotterdam criteria	Case control	PCOS 120 Controls 120	FSFI			Low

(continued)

Table 1. Continued

Author, year, country	Setting (population) Period of recruitment PCOS diagnostic criteria	Study design	Sample size per group	Outcomes	Summary of findings	Other notes	Risk of bias
Glowska <i>et al.</i> , 2020, Poland	Gynecology Clinic at Posnan University Of Medical Sciences (women with PCOS) Internet advertisements (control group) December 2012 to March 2015 Rotterdam criteria	Cross-sectional case control study	PCOS 94 Controls 47	SSS	No significant difference on this scale between PCOS and controls	We only used scores on the Physical satisfaction scale since we thought these were most comparable with FSFI satisfaction	Moderate
Deniz and Kehribar, 2020, Turkey	Private Manavgat Obstetrics and Gynecology Center, Antalya, Turkey (PCOS patients and controls) January 2019 to November 2019 ESHRE & ASRM	Case control	PCOS 50 Controls 50	FSFI	Controls have a significantly higher FSFI total score than women with PCOS	We only used data from PCOS fertile group	Low
Aydogan Kirmiziet al., 2020, Turkey	A tertiary centre (PCOS patients and controls) February 2019 to October 2019 Rotterdam criteria	Case control	PCOS 20 Controls 30	FSFI	FSFI lubrication score was significantly higher in the PCOS group. Other scores were not significantly different.	We only used data from PCOS fertile group	Moderate
Akbari Sene <i>et al.</i> , 2021, Iran	Two infertility centres in Tehran, Iran (PCOS patients and controls) February 2018 to March 2018 ESHRE	Case control	PCOS 116 Controls 93	FSFI	No significant differences were found between PCOS and controls		Low
Mantzou <i>et al.</i> , 2021, Greece	Division of endocrinology of the University Hospital of Patras, Greece (PCOS patients) Two workshops on female sexuality conducted in the Universities of Athens and Patras, Greece (controls) Recruitment period not mentioned AE-PCOS criteria	Case control	PCOS 76 Controls 133	FSFI	Women with PCOS scored significantly lower on FSFI domains arousal, lubrication, orgasm, and satisfaction and on the FSFI total score		Low
Taghavi <i>et al.</i> , 2021, Iran	Infertility clinic in Omelia Hospital in Hormozgan province Iran (PCOS patients) Convenience sampling, patients companions (controls) April 2015 to April 2016 Rotterdam criteria	Case control	PCOS 90 Controls 90	FSFI	Women with PCOS scored significantly lower on all FSFI domains and the FSFI total score		Moderate
Kaluźna <i>et al.</i> , 2021, Poland	Not reported, most likely Poznan University of Medical Sciences (PCOS patients, eumenorrhic healthy women) Recruitment period not mentioned Rotterdam & ESHRE	Case control	PCOS 190 Controls 197	SSQ	No significant difference between the groups in SSQ total score	PCOS infertile, control fertile	Moderate to high
Naumova <i>et al.</i> , 2021, Spain	Reproductive medicine unit of the Hospital Clinic, Barcelona, Spain (PCOS patients and controls) December 2017 to June 2019 Rotterdam criteria Follow up of an RCT (women with obesity and infertility	Case control	PCOS 37 Controls 31 (male factor infertility)	FSFI	Women with PCOS scored significantly lower compared to the MFI control group on all FSFI domains except pain and on the FSFI total score	We only used data from the male factor infertility control group and the PCOS infertile group	Low
		Cross-sectional analysis of	PCOS 64 (orgasm, lubrication, total)	MFSQ			Low

(continued)

Table 1. Continued

Author, year, country	Setting (population) Period of recruitment PCOS diagnostic criteria	Study design	Sample size per group	Outcomes	Summary of findings	Other notes	Risk of bias
Karsten et al., 2021, The Netherlands	randomized to lifestyle intervention followed by infertility treatment or to prompt infertility clinics (PCOS patients and controls) June 2009 to June 2012 Rotterdam criteria	data from a follow up study after a multicentre RCT	PCOS 73 (sexual interest) PCOS 70 (sexual satisfaction) Controls 79 (orgasm, lubrication, total) Controls 100 (sexual interest) Controls 97 (sexual satisfaction)		No significant differences between PCOS and controls were found on MFSQ scores.		
Ashrafi et al., 2022, Iran	Royal Institute and health care centres in Tehran, Iran (PCOS patients and controls) May 2016 to June 2017 Rotterdam criteria	Cross-sectional	PCOS 80 Controls 80 (male factor infertility)	FSFI	Infertile women with PCOS showed lower scores on all FSFI domains and the FSFI total score compared to women with male factor infertility.	We only used data from the male factor infertility control group	Moderate
Aba and Aytok Şik, 2022, Turkey	Sisli Kolan Hospital Reproductive Health and Family Planning Center in Istanbul, Turkey (POCS patients and controls) January 2019 to June 2019. Rotterdam criteria	Case control	PCOS 97 Controls 95	FSFI	Sex drive, arousal, lubrication, orgasm, and averages of pain subscales and female sexual function index total score were significantly lower in the PCOS group than in the control group.		Moderate
Çetinkaya Altuntaş et al., 2022, Turkey	Recep Tayyip Erdogan University endocrinology outpatient clinic, Turkey 2020–2021 Rotterdam criteria	Cross-sectional	PCOS 167 Controls 73	FSFI	No significant differences on the FSFI were found between the PCOS group and the control group.	We only used data from the complete PCOS group. PCOS group overweight, control group normal BMI.	Low
Daneshfar et al., 2022, Iran	Arash hospital clinic at Tehran in Iran October 2018 to December 2019 Rotterdam criteria	Cross-sectional	PCOS 210 Controls 210	FSFI	Women with PCOS reported a significantly lower total FSFI mean score than control women.	We only used data from the PCOS group and the control group. PCOS group infertile, control group fertile. Both groups overweight.	High
Mojahed et al., 2023, Iran	Arash hospital clinic at Tehran in Iran October 2018 to December 2019 PCOS criteria used: not reported	Cross-sectional	PCOS 106 Controls 106	FSFI	PCOS Group scored significantly lower on all FSFI subdomains (except arousal) and the FSFI total score compared to the control group.		High
Yıldız et al., 2017, Turkey	Sisli Etfal Research Hospital and Van Ercis State Hospital January 2013 to December 2013 Rotterdam criteria	Cross-sectional	PCOS 90 (27 with normal BMI) Controls 80	FSFI	In the normal BMI groups, the PCOS group scored significantly lower on all FSFI domains (except desire) and FSFI total score compared to the control group.	We only used the scores of the PCOS group with a normal BMI.	High

BMI, body mass index; CSFQ, Changes in Sexual Function Questionnaire; FSFI, Female Sexual Function Index; FSDQ, Female Sexual Desire Questionnaire; FSDQ, Female Sexual Desire Questionnaire; ISS, Index of Sexual Satisfaction; McCoy-FSQ, McCoy Female Sexuality Questionnaire; MSQ, Multidimensional Sexuality Questionnaire; PCOS, polycystic ovary syndrome; SSS, Sexual Satisfaction Scales; SSQ, Sexual Satisfaction Questionnaire; SQ-F, Sexual Quotient-Female; VAS, visual analogue scale.

Seven questions scored with VAS were available for analysis: (i) How important is a satisfying sex life for you?; (ii) How many sexual thoughts and fantasies did you have in the past 4 weeks?; (iii) Do you find yourself sexually attractive?; (iv) How much does excessive body hair impact your sexuality?; (v) Does your appearance make it difficult to engage in social contact?; (vi) How often did you experience pain during intercourse in the past 4 weeks?; (vii) How satisfied were you with your sex life in the past 4 weeks? (Elsenbruch *et al.*, 2003; Hahn *et al.*, 2005; Tan *et al.*, 2008; Caruso *et al.*, 2009).

Statistical methods and meta-analysis

Meta-analyses were performed in SPSS v28.0.1.0 (142) using random-effects models. Differences between PCOS and control women are expressed in Hedges' g (Hg) with corresponding 95% CIs and presented in forest plots. Where intervention studies were included, only the baseline scores were used in the meta-analyses.

To perform the meta-analyses, we grouped the multiple scales and subscales into total sexual function, sexual desire, sexual arousal, lubrication, orgasm, pain, and sexual satisfaction. Scores for ISS were reversed by subtracting the mean score from the total score, before entering them in the analysis.

Meta-analyses for all questionnaires combined were performed, as well as the sensitivity analyses for FSFI only studies. Analyses were performed for the following subscales: total sexual function, sexual desire, sexual arousal, lubrication, orgasm, pain, and sexual satisfaction. To assess the influence of fertility status and BMI on the relationship between PCOS and sexual function, subgroup analysis for fertility status (as reported in the included studies) and BMI status (mean BMI as reported in the included studies) was performed and presented in forest plots.

Since no new studies used VAS, no additional studies with VAS were included and no new meta-analyses were performed. Results of meta-analyses for the VAS studies are shown in [Supplementary Fig. S1](#) and can also be found in [Pastoor *et al.* \(2018\)](#).

Registration

This systematic review and meta-analysis were not previously registered. It was commissioned by the Centre for Research Excellence in Women's Health in Reproductive Life (CRE-WHiRL), Monash University, Melbourne, Australia, to update the 2023 International Evidence Based Guideline for the Assessment and Management of PCOS ([Mousa *et al.*, 2023](#)).

Results

Search results

In [Fig. 1](#), the results of the systematic literature search are presented. After screening, 34 articles were eligible. Two studies were then excluded because of outliers: the first for being an outlier on total sexual function, as well as for arousal and lubrication, most likely due to having a highly motivated participant group repeatedly instructed to have sexual intercourse at least twice a week ([Diamond *et al.*, 2017](#)); the other for being an outlier for orgasm probably due to assessing orgasm differently than other scales did ([Mansson *et al.*, 2011](#)). This resulted in a total of 32 included studies, of which 16 were newly added compared with our previous review ([Pastoor *et al.*, 2018](#)).

Twenty studies used the FSFI ([Gateva and Kamenov, 2012](#); [Ercan *et al.*, 2013](#); [Ferraresi *et al.*, 2013](#); [Benetti-Pinto *et al.*, 2014](#); [Lara *et al.*, 2015](#); [Noroozadeh *et al.*, 2016](#); [Shafti and Shahbazi, 2016](#); [Yildiz *et al.*, 2017](#); [Basirat *et al.*, 2019](#); [Aydogan Kirmizi *et al.*,](#)

[2020](#); [Deniz and Kehribar, 2020](#); [Akbari Sene *et al.*, 2021](#); [Mantzou *et al.*, 2021](#); [Naumova *et al.*, 2021](#); [Taghavi *et al.*, 2021](#); [Aba and AYTEK ŞİK, 2022](#); [Ashrafi *et al.*, 2022](#); [Çetinkaya Altuntaş *et al.*, 2022](#); [Daneshfar *et al.*, 2022](#); [Mojahed *et al.*, 2023](#)).

Eight studies used different scales: the CSFQ ([Stovall *et al.*, 2012](#)), the SQ-F ([Zueff *et al.*, 2015](#)), the MFSC ([Karsten *et al.*, 2021](#)), the FSDQ ([Elkhayat *et al.*, 2015](#)), the ISS ([Drosdzol *et al.*, 2007](#)), the MSQ ([Kowalczyk *et al.*, 2015](#)), Sexual Satisfaction Scales ([Glowinska *et al.*, 2020](#)), and the SSQ ([Kałużna *et al.*, 2021](#)).

Finally, four studies used VAS to assess sexual function and impact of clinical characteristics on sexual function ([Elsenbruch *et al.*, 2003](#); [Hahn *et al.*, 2005](#); [Tan *et al.*, 2008](#); [Caruso *et al.*, 2009](#)). These are the same studies as in our analysis from 2018 ([Pastoor *et al.*, 2018](#)). No new studies using VAS were found ([Supplementary Fig. S1](#)).

Study characteristics for all of the included studies are presented in [Table 1](#).

Quality assessment and grading

The quality assessment of the included studies showed that most studies were of low to moderate quality mostly due to selection bias and confounding ([Table 1](#)). GRADE assessments showed that all outcomes were of low quality mostly due to risk of bias, inconsistency, and imprecision ([Table 2](#)). There was no evidence of publication bias for any outcomes based on visual inspection of funnel plots ([Supplementary Fig. S2](#)).

Meta-analysis

Sexual function

There were significant differences in total sexual function assessed with the combined questionnaires (Hg [95% CI] = -0.66 [-1.20 , -0.12], $I^2 = 98%$, $P = 0.02$) as well as with the FSFI only (Hg [95% CI] = -0.75 [-1.37 , -0.12], $I^2 = 98%$, $P = 0.02$), both being lower in women with PCOS compared to control women ([Fig. 2A and B](#)).

For all subdomains of sexual function, significant differences were found for desire (combined Hg [95% CI] = -0.21 [-0.39 , -0.02], $I^2 = 87%$, $P = 0.03$, arousal (combined Hg [95% CI] = -0.33 [-0.50 , -0.16], $I^2 = 82%$, $P < 0.001$; FSFI only Hg [95% CI] = -0.35 [-0.53 , -0.17], $I^2 = 82%$, $P < 0.001$), lubrication (combined [95% CI] Hg = -0.50 [-0.74 , -0.26], $I^2 = 91%$, $P < 0.001$; FSFI only Hg [95% CI] = -0.54 [-0.79 , -0.30], $I^2 = 90%$, $P < 0.001$), orgasm (combined Hg [95% CI] = -0.35 [-0.52 , -0.18], $I^2 = 83%$, $P < 0.001$; FSFI only Hg [95% CI] = -0.37 [-0.56 , -0.19], $I^2 = 83%$, $P < 0.001$), and pain (combined not applicable; FSFI only [95% CI] Hg = -0.36 [-0.59 , -0.13], $I^2 = 90%$, $P < 0.001$), with lower scores for women with PCOS compared to control women ([Fig. 3](#) and [Supplementary Fig. S3](#)).

No differences were found for sexual desire ($P = 0.06$) with the FSFI only analyses.

Sexual satisfaction

Women with PCOS reported lower sexual satisfaction compared to control women in the analysis with the different questionnaires combined (Hg [95% CI] = -0.26 [-0.37 , -0.15], $I^2 = 66%$, $P < 0.001$) as well as for the analysis with only FSFI studies (Hg [95% CI] = -0.31 [-0.45 , -0.18], $I^2 = 68%$, $P < 0.001$) ([Fig. 2C and D](#)).

Subgroup analyses

Fertility status

In subgroup analyses by fertility status, results remained significant for total sexual function in the group with unknown fertility status (Hg [95% CI] = -0.25 [-0.36 , -0.13], $I^2 = 31%$, $P < 0.001$), with lower scores in PCOS versus controls. For both the fertile (Hg [95% CI] = -0.89 [-2.07 , 0.29], $I^2 = 91%$, $P = 0.14$) and the infertile groups (Hg [95% CI] = -1.62 [-3.51 , 0.27], $I^2 = 100%$, $P = 0.09$),

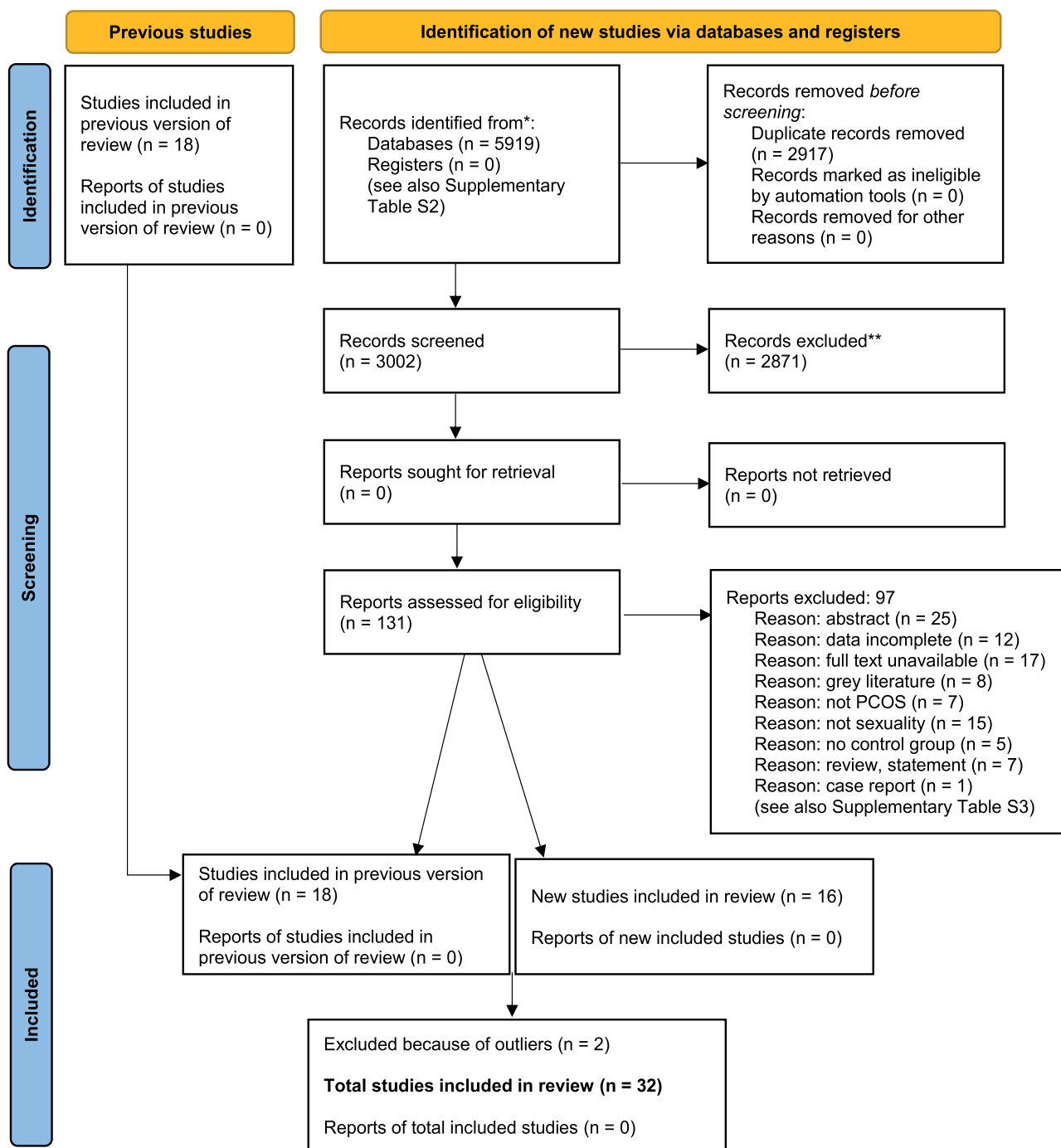


Figure 1. PRISMA flowchart.

results were not significant, but still showed the same pattern (Supplementary Fig. S3).

Only a single study (Aydoğan Kirmizi et al., 2020) was represented in the fertile subgroup for all subdomains of sexual function, including desire, arousal, lubrication, orgasm and pain, and for sexual satisfaction. Hence, there were no pooled results to accurately assess differences by fertility status for these outcomes. All results can be found in Supplementary Fig. S3.

BMI category

In subgroup analyses by BMI, results remained significant for total sexual function in the subgroups Overweight/Obese (OW/O) (Hg

[95% CI] = -0.59 [-1.15, -0.03], $I^2 = 95%$, $P = 0.04$) and Lean (Hg [95% CI] = -0.52 [-0.94, -0.10], $I^2 = 89%$, $P = 0.02$) (Supplementary Fig. S3). For sexual satisfaction, lower satisfaction in PCOS was significant in all BMI subgroups, mixed (Hg [95% CI] = -0.21 [-0.37, -0.05], $I^2 = 60%$, $P = 0.01$), OW/O (Hg [95% CI] = -0.30 [-0.55, -0.04], $I^2 = 79%$, $P = 0.02$), and Lean (Hg [95% CI] = -0.29 [-0.50, -0.09], $I^2 = 64%$, $P < 0.001$) (Supplementary Fig. S3).

For the subgroup analyses of sexual function subdomains by BMI status, the pattern of results remained the same with PCOS showing lower scores than controls. Significant results were found in the subgroups arousal OW/O (Hg [95% CI] = -0.42 [-0.82, -0.01], $I^2 = 91%$, $P = 0.04$), arousal Lean (Hg [95% CI] = -0.46

Table 2. GRADE assessment and evidence profile.

No. studies		Quality assessment							No. participants		Effect estimate: Hedges' g [95% CI]	Favours	Certainty	Importance
		Design	Risk of bias	Inconsistency	Indirectness	Imprecision	Other	PCOS	Control					
Outcome: total sexual function														
22	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1630	1684	-0.66 [-1.20, -0.12]	Controls	⊕⊕⊕⊕ LOW	CRITICAL		
Outcome: sexual desire														
21	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1735	1977	-0.21 [-0.39, 0.02]	Controls	⊕⊕⊕⊕ LOW	CRITICAL		
Outcome: sexual arousal														
19	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1577	1811	-0.33 [-0.50, -0.16]	Controls	⊕⊕⊕⊕ LOW	CRITICAL		
Outcome: lubrication														
19	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1549	1801	-0.50 [-0.74, -0.26]	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: orgasm														
20	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1641	1780	-0.35 [-0.52, -0.18]	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: satisfaction														
24	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1962	2246	-0.26 [-0.37, -0.15]	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: pain														
18	Case control, cross-sectional	Serious ¹	Serious ²	Not serious	Not serious	None	1485	1732	-0.36 [-0.59, 0.13]	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS sexual thoughts and fantasies														
3	Case control, cross-sectional	Serious ¹	Not applicable	Not applicable	Not applicable	None	225	50	NA	No difference	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS sex life satisfaction														
3	Case control, cross-sectional	Serious ¹	Not applicable	Not applicable	Not applicable	None	225	50	NA	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS importance of satisfying sex life														
3	Case control, cross-sectional	Serious ¹	Not applicable	Not applicable	Not applicable	None	225	50	NA	No difference	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS pain during intercourse														
2	Case control, cross-sectional	serious ¹	Not applicable	Not applicable	Not applicable	None	105	50	NA	No difference	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS body hair impact														
4	Case control, cross-sectional	serious ¹	not applicable	not applicable	not applicable	none	297	50	NA	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS social contact impact														
4	Case control, cross-sectional	serious ¹	not applicable	not applicable	not applicable	none	297	50	NA	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		
Outcome: VAS sexual attractiveness														
4	Case control, cross-sectional	serious ¹	not applicable	not applicable	not applicable	none	297	50	NA	Controls	⊕⊕⊕⊕ LOW	IMPORTANT		

GRADE, Grading of Recommendations, Assessment, Development and Evaluations; VAS, visual analogue scale; NA, not applicable.

¹ Downgraded once due to most studies being of moderate risk of bias.² Downgraded once due to high statistical heterogeneity.³ Downgraded once due to small sample size of control group and the same controls used across all studies.

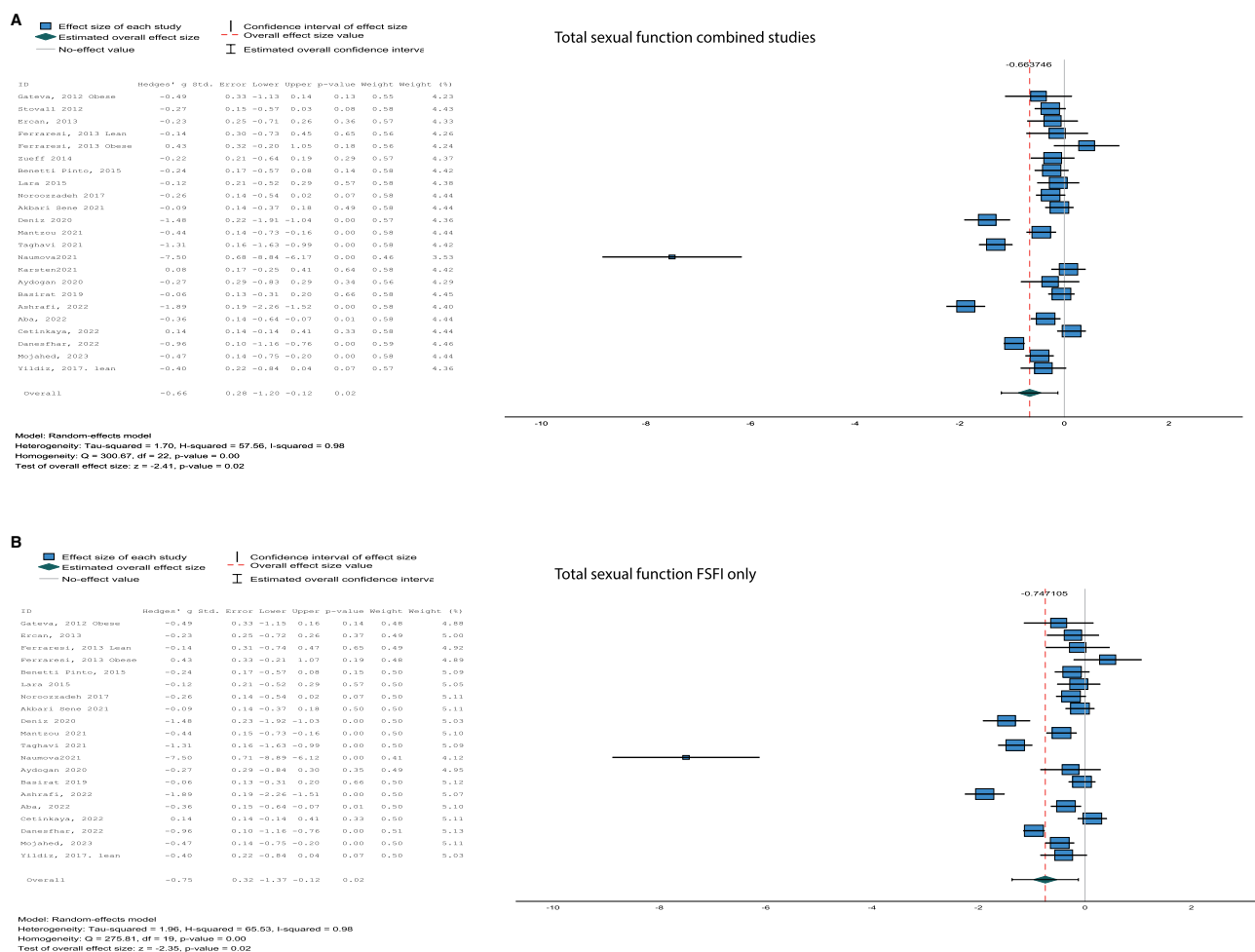


Figure 2. Forest plots of questionnaires. Forest plots for total sexual function (A, B) and sexual satisfaction (C, D) both for all studies combined (A, C) and for studies using the Female Sexual Function Index (FSFI) (B, D) only.

[-0.60, -0.31], $I^2=0\%$, $P<0.001$), lubrication OW/O (Hg [95% CI] = -0.21 [-0.90, -0.08], $I^2=92\%$, $P=0.02$), lubrication Lean (Hg [95% CI] = -0.88 [-1.42, -0.34], $I^2=91\%$, $P<0.001$), orgasm mixed (Hg [95% CI] = -0.22 [-0.42, -0.02], $I^2=68\%$, $P=0.03$), orgasm OW/O (Hg [95% CI] = -0.21 [-0.32, -0.10]), $I^2=0\%$, $P<0.001$), orgasm Lean (Hg [95% CI] = -0.75 [-1.18, -0.31], $I^2=87\%$, $P<0.001$), and pain Lean (Hg [95% CI] = -0.71 [-1.24, -0.19], $I^2=91\%$, $P=0.01$) (Supplementary Fig. S3).

Discussion

The present systematic review and meta-analysis analysed 32 original studies on sexual function in women with PCOS and introduced a sensitivity analysis by questionnaire type as well as subgroup analyses by fertility and BMI status. Results show impaired sexual function in women with PCOS relative to control women. Women with PCOS scored lower on the total sexual function score, all sexuality questionnaire subdomains and on sexual satisfaction. Sensitivity analysis by questionnaire type and subgroup analyses by BMI and fertility status (where possible) did not dramatically alter the results. The quality of the present studies was low or moderate with low certainty of evidence for all outcomes.

Comparing the present results to other meta-analyses shows similar significant results between women with and without PCOS for arousal and lubrication (Zhao et al., 2019) and for pain and satisfaction scores (Loh et al., 2020). However, other studies

did not find significant results for total sexual function scores (Murgel et al., 2019; Zhao et al., 2019), including after subgroup analyses by BMI and diagnostic criteria (Rotterdam) (Loh et al., 2020). Notably, all previous meta-analyses included only a few studies (four to six in total) with two of the reviews (Zhao et al., 2019; Loh et al., 2020) also including a secondary analysis of a large infertility trial (Diamond et al., 2017). This infertility trial required sexual intercourse three times a week and may not accurately represent sexual function in women with PCOS in the general population. Given the large sample size of this trial and its relative weighting on results, meta-analyses incorporating data from this trial may have biased sexual function scores in PCOS. Therefore, in our current and 2018 meta-analyses (Pastoor et al., 2018), we excluded the data from this large infertility trial (Diamond et al., 2017) in order to mitigate this potential bias. The study by Mansson et al. (2011) was also excluded for being an outlier on the orgasm scale which may have been due to only being able to use the orgasm frequency score and the finding that more women with PCOS took initiative for sexual behaviour than control women.

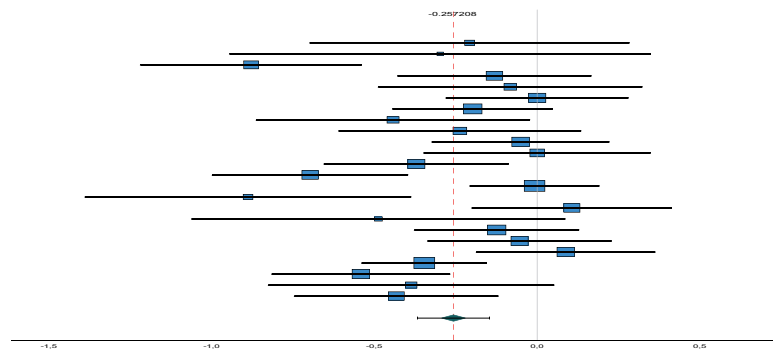
The present study showed some interesting results. Most unexpected were the findings that lean women with PCOS showed significantly lower results for arousal, lubrication, orgasm, and pain (with lower scores indicating worse pain) when compared to women with PCOS in OW/O or mixed BMI groups. This is contrary to the common belief that women with obesity report lower sexual function. An explanation might be that body image is

C

ID	Hedges' g	Std. Error	Lower	Upper	p-value	Weight	Weight (%)
Evans, 2013	-0.21	0.25	-0.70	0.28	0.41	6.08	2.00
Osawa, 2012 Osawa	-0.20	0.23	-0.95	0.55	0.27	6.39	2.08
Beneiti Pinto, 2015	-0.88	0.17	-1.22	-0.54	0.00	19.90	6.13
Stovall 2012	-0.13	0.15	-0.43	0.17	0.29	14.20	4.84
Lava 2015	-0.08	0.21	-0.49	0.32	0.49	11.08	3.85
Hosozasadeh 2017	0.00	0.14	-0.28	0.28	1.00	14.74	4.52
Shafiqi 2016	-0.20	0.13	-0.44	0.05	0.12	16.83	5.07
Dowdall 2007	-0.44	0.21	-0.86	-0.02	0.04	10.70	3.42
Tomilova 2005	-0.24	0.19	-0.61	0.14	0.21	11.98	3.63
Abbasi Sana 2021	-0.05	0.14	-0.32	0.22	0.71	14.99	4.80
Glavincka 2020	0.00	0.18	-0.35	0.35	1.00	12.44	4.05
Ravanan 2021	-0.27	0.14	-0.44	-0.09	0.01	14.43	4.48
Taghavi 2021	-0.70	0.15	-1.00	-0.40	0.00	14.10	4.81
Kalena 2021	-0.01	0.10	-0.21	0.19	0.94	17.34	5.55
Nahmova2021	-0.89	0.26	-1.39	-0.39	0.00	8.47	2.88
Makarawung 2023	0.11	0.16	-0.20	0.43	0.30	19.90	6.13
Ayroun 2020	-0.49	0.29	-1.04	0.06	0.10	7.51	2.40
Basirat 2019	-0.12	0.13	-0.38	0.13	0.34	14.47	4.67
Aba, 2022	-0.05	0.14	-0.34	0.23	0.71	14.97	4.80
CetinKaya, 2022	0.09	0.14	-0.19	0.36	0.53	14.92	4.77
Darekhar, 2022	-0.35	0.10	-0.54	-0.15	0.00	17.55	5.41
Nojima, 2023	-0.54	0.14	-0.82	-0.27	0.00	14.95	4.78
Vilijai, 2017, Iran	-0.29	0.22	-0.83	0.25	0.08	10.25	3.28
Ashvafi, 2022	-0.43	0.16	-0.75	-0.12	0.01	13.71	4.39
Overall	-0.26	0.06	-0.37	-0.15	0.00		

Model: Random-effects model
 Heterogeneity: Tau-squared = 0.05, I-squared = 2.94, H-squared = 0.66
 Homogeneity: $Q = 64.66$, $df = 23$, p -value = 0.00
 Test of overall effect size: $z = -4.55$, p -value = 0.00

Sexual satisfaction combined studies



D

ID	Hedges' g	Std. Error	Lower	Upper	p-value	Weight	Weight (%)
Evans, 2013	-0.21	0.25	-0.70	0.28	0.41	6.07	2.00
Osawa, 2012 Osawa	-0.20	0.23	-0.95	0.55	0.27	6.19	2.85
Beneiti Pinto, 2015	-0.88	0.17	-1.22	-0.54	0.00	12.11	5.59
Lava 2015	-0.08	0.21	-0.49	0.32	0.49	10.49	4.84
Hosozasadeh 2017	0.00	0.14	-0.28	0.28	1.00	13.71	6.33
Shafiqi 2016	-0.20	0.13	-0.44	0.05	0.12	14.65	6.76
Abbasi Sana 2021	-0.05	0.14	-0.32	0.22	0.71	13.93	6.43
Mantou 2021	-0.27	0.14	-0.66	-0.09	0.01	13.62	6.28
Taghavi 2021	-0.70	0.15	-1.00	-0.40	0.00	13.15	6.01
Nahmova2021	-0.89	0.26	-1.39	-0.39	0.00	8.48	3.97
Ayroun 2020	-0.49	0.29	-1.04	0.06	0.10	7.23	3.23
Basirat 2019	-0.12	0.13	-0.38	0.13	0.34	14.47	6.67
Aba, 2022	-0.05	0.14	-0.34	0.23	0.71	13.65	6.30
CetinKaya, 2022	0.09	0.14	-0.19	0.36	0.53	13.87	6.40
Darekhar, 2022	-0.35	0.10	-0.54	-0.15	0.00	16.11	7.43
Nojima, 2023	-0.54	0.14	-0.82	-0.27	0.00	13.89	6.41
Vilijai, 2017, Iran	-0.29	0.22	-0.83	0.25	0.08	9.74	4.49
Ashvafi, 2022	-0.43	0.16	-0.75	-0.12	0.01	12.82	5.91
Overall	-0.31	0.07	-0.45	-0.18	0.00		

Model: Random-effects model
 Heterogeneity: Tau-squared = 0.05, I-squared = 3.10, H-squared = 0.68
 Homogeneity: $Q = 49.62$, $df = 17$, p -value = 0.00
 Test of overall effect size: $z = -4.61$, p -value = 0.00

Sexual satisfaction FSFI only

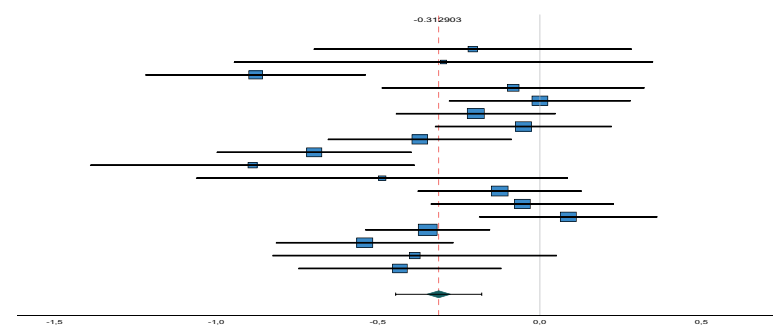


Figure 2. Continued.

confounding for sexual function results. Body image is known to affect sexual function and sexual satisfaction (Woertman and van den Brink, 2012; van den Brink et al., 2013; Brotto et al., 2016; van den Brink et al., 2018), with reports in women with PCOS showing that body dissatisfaction is significantly negatively associated with sexual function and satisfaction (Kogure et al., 2019). Although lean women might not present body dissatisfaction, they seem to be more concerned with appearance and presentation and prefer a smaller ideal body (Makarawung et al., 2023). Additionally, several studies show that women in the underweight or normal weight group often estimate their body weight to be higher than it actually is (Takasaki et al., 2003; Hayashi et al., 2006). Although the VAS studies (Elsenbruch et al., 2003; Hahn et al., 2005; Tan et al., 2008; Caruso et al., 2009) indicate that self-esteem and attractiveness are lower in women with PCOS, the included questionnaire studies did not assess body image and self-esteem. It is however an intriguing area for further exploration in this context.

Additionally, in PCOS, insulin resistance is related to hyperandrogenism through multiple mechanisms including androgen production, binding, and bioavailability (Sarwer et al., 2018; Louwers and Laven, 2020). This may impact sexual function, however this is unclear as yet (Paulukinas et al., 2022). Although androgens play an important role in sexual function, the exact mechanisms by which they exert their influence and their relationship with female sexual function remain unclear (van Lunsen et al., 2018). Studies to date have been conflicting, with

some reporting a relationship (Heiman et al., 2011; Islam et al., 2019; Maseroli and Vignozzi, 2022) while others not (Davis et al., 2005; Basson et al., 2010; Zheng et al., 2020).

A second surprising finding was that fertility status did not seem to influence sexual function or satisfaction in the present results. Subgroup analyses did not change the results, with women with PCOS reporting lower sexual function than women without PCOS, irrespective of fertility status. Infertility is a common cause of sexual dysfunction and low sexual satisfaction in the general population (Starc et al., 2019), implying an additional effect of fertility status on sexual function. Since women with PCOS also often face subfertility (Louwers and Laven, 2020), the absence of an additional effect of fertility status might be explained by the fact that many PCOS characteristics and their comorbidities can influence sexual function, making it nearly impossible to establish the isolated effects of a single aspect. Moreover, a large number of the included studies did not clearly state the fertility status of their participants, leading to a single study in the fertile subgroup for most outcomes. This precluded accurate assessment of differences by fertility status, emphasizing the need for future studies to consider fertility status in their data collection and analysis protocols.

Finally, no differences in desire scores assessed with FSFI, the most used questionnaire in this meta-analysis, were found between women with and without PCOS, consistent with previous findings (Pastoor et al., 2018). The absence of a difference in desire suggests that women with PCOS, despite having lower sexual

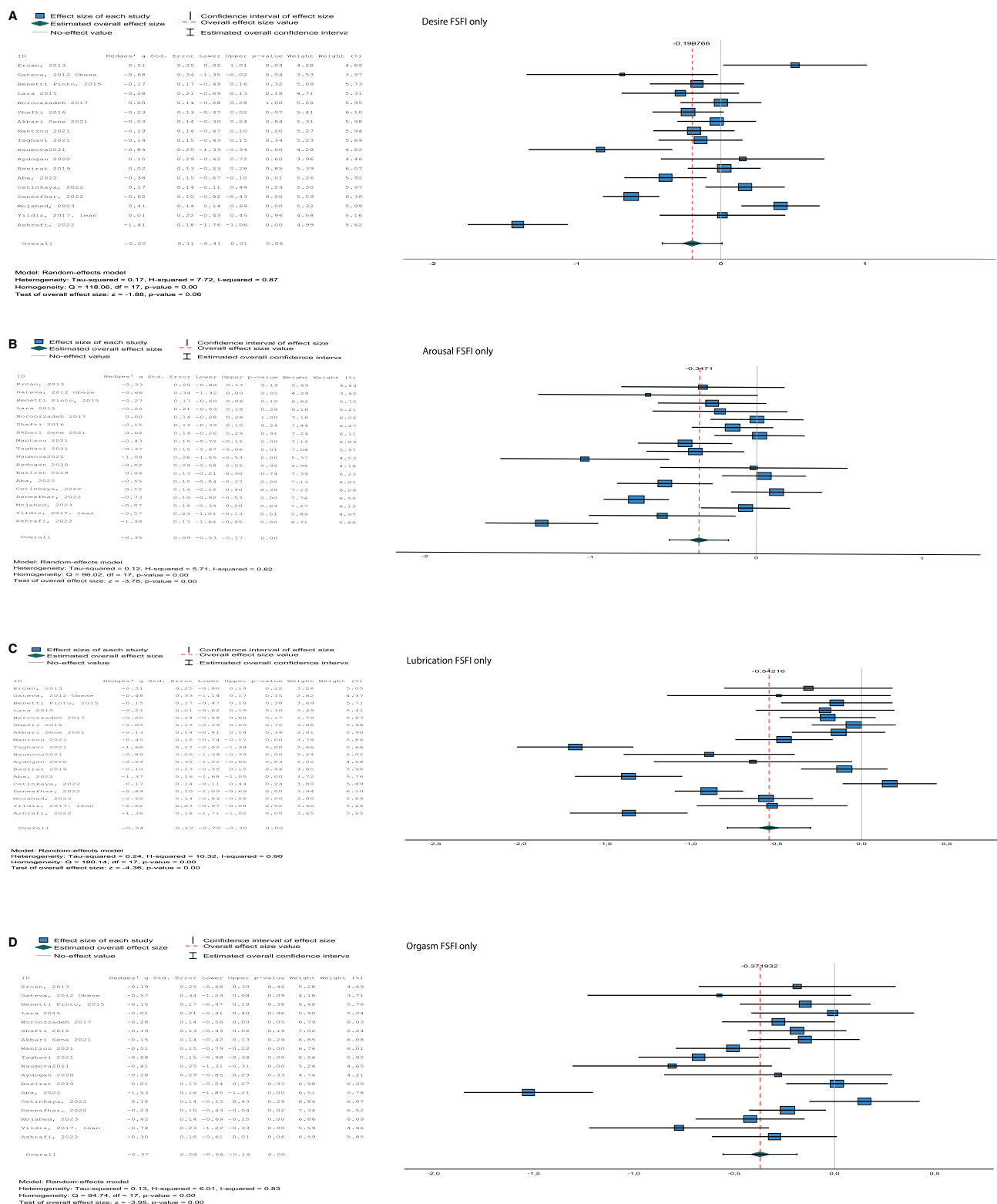


Figure 3. Forest plots for subdomains with only the studies using the Female Sexual Function Index (FSFI). (A) Desire, (B) arousal, (C) lubrication, (D) orgasm, (E) pain. ID, included study; Std. error, standard error; Df, degrees of freedom.

function on other domains, have as much sexual desire as women without PCOS. This corresponds with the low sexual satisfaction scores and might explain them. Also, this may indicate that perturbed endocrine function does not directly influence sexual desire as the relationship between androgen levels and sexual function is not yet fully understood. Studies assessing

changes in androgen levels and their effects on sexual desire in women with PCOS further confirm no significant change in sexual desire or sexual thoughts after normalizing androgen levels using COCPs (Conaglen and Conaglen, 2003; Caruso et al., 2009; Steinberg Weiss et al., 2021) or metformin (Hahn et al., 2006; Gatava and Kamenov, 2012).

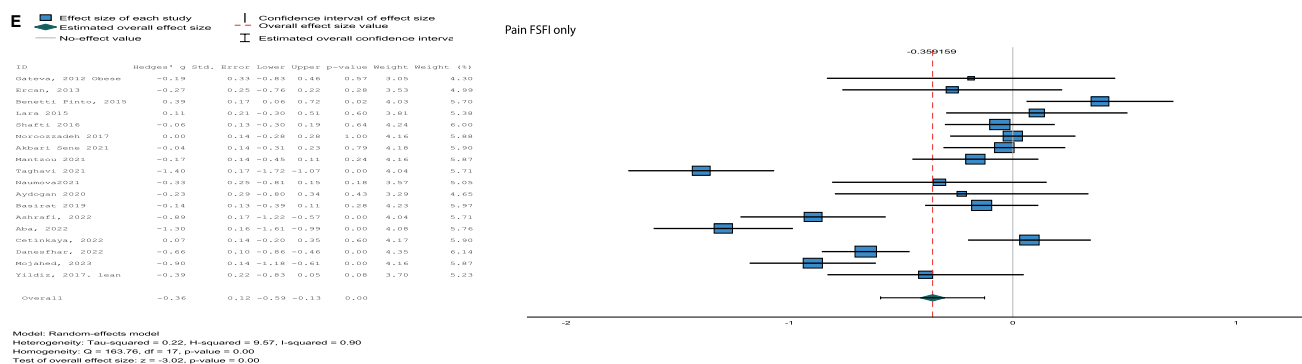


Figure 3. Continued.

An important strength of this study is that it represents an extensive systematic quantitative analysis of the relationship between PCOS and sexual function including sensitivity and subgroup analyses. The studies included in this meta-analysis were carefully assessed for quality and the certainty across outcomes was assessed using the validated GRADE tool (Schunemann et al., 2000). Also, we included studies using all different PCOS diagnostic criteria to be able to report on the complete PCOS literature over time. Since these criteria are all similar to or based on the Rotterdam criteria, except for the NIH criteria, and we only used data for the complete PCOS group, we believe we have minimized any selection bias. Although all results pointed in the same direction, even after subgroup analyses, the certainty of evidence was low; hence, the evidence should be interpreted in light of this.

The main limitation of this study is that none of the included studies assessed true sexual 'dys' function, which relates to examining sexual distress stemming from low sexual function. Without assessing a distress score, it is difficult to interpret the meaning of the low sexual function scores for the women involved. Also, as is visible in the subgroup analyses, not all studies clearly stated the fertility status or BMI of their participants, making it difficult to interpret the effect of specific PCOS-related factors on sexual function scores. Additionally, not all ethnic populations (e.g. Asian) were represented which might limit generalization to the global PCOS population. Finally, we excluded non-English language studies and grey literature, hence publication bias cannot be ruled out. However, visual inspection of funnel plots did not give an indication of publication bias and sensitivity and subgroup analyses did not change the results.

To gain more reliable insights on the sexual function of women with PCOS, studies of higher quality are needed. Factors that could be improved include recruiting larger numbers of participants, using reliable assessments of PCOS diagnosis in both the PCOS and the control group, with clear inclusion criteria, comparable groups and assessment of sexual distress as a key outcome measure, alongside collection of key confounding variables including BMI, androgen status, and fertility status. Since sexual function as well as PCOS are biopsychosocial phenomena, study designs should incorporate a range of biopsychosocial assessments including questionnaires, endocrine measures, and genital response measures using psychophysiological tools. Ideally, the sexual function of partners and their relative distress should also be assessed.

To conclude, psychosexual function appears to be impaired in those with PCOS but there is a lack of evidence on the related distress scores which are required to meet the criteria for

psychosexual dysfunction. Sexual distress seems to be high in women with PCOS as was shown in a recent study by our group, consequently leading to a high prevalence of sexual dysfunction (Pastoor et al., 2023). Health professionals should discuss sexual function and distress and be aware of the multiple factors that can influence psychosexual function in PCOS including infertility, excess weight, hirsutism, mood disorders, and PCOS medications. Psychosexual counselling has been shown to be effective in women with PCOS as well as in other populations (Golbabaei et al., 2019; Mashhadi et al., 2022; Tuncer and Oskay, 2022). Future research needs to assess both psychosexual function and distress concurrently before evidence-based clinical recommendations on routine assessment for psychosexual dysfunction can be made. Finally, future studies should include more diverse populations (e.g. non-heterosexual and more ethnically diverse groups) and focus on the range of different PCOS symptoms. Also, intervention studies on treatment effectiveness for sexual dysfunction (e.g. lifestyle and pharmacological interventions) are needed.

Supplementary data

Supplementary data are available at *Human Reproduction Update* online.

Data availability

This study uses secondary aggregate data from published studies; with no primary data collected for this study. All data underlying this article are available in the article tables and figures and in the online [Supplementary Material](#).

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Authors' roles

H.P.: study design, execution of all parts of the study, critical discussion, writing and revising manuscript. A.M.: study design, performing meta-analyses and sensitivity and subgroup meta-analyses, GRADE assessments, critical revision of manuscript. H.B.: conducting systematic review, quality assessment of included studies, critical revision of manuscript. W.B.: design and execution literature search, critical revision of manuscript. T.B.,

A.D., C.T.T., H.J.T., J.L.: study design, critical revision of manuscript. All authors approved the final version of this manuscript and agree to be accountable for all aspects of the work.

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Conflict of interest

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