Determinants of sexual dysfunction and interventions for patients with obstructive sleep apnoea: a systematic review

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SUMMARY

Aims: Obstructive sleep apnoea (OSA) may negatively affect a couple’s sexual relationship. This systematic review evaluated what characteristics are determinants of sexual function and dysfunction in women and men with OSA, and what interventions are shown to be effective. Methods: A systematic literature review was conducted using PubMed, CINAHL, Cochrane and TRIP, and articles published between January 2004 and December 2014 in English; original research; adults ≥ 18 years; and both experimental and non-experimental designs. The Effective Public Health Practice Project Quality Assessment Tool for Quantitative Studies was used to assess study quality. Of 21 studies, six studies (no randomised control trials, RCTs) included women and 15 (with six RCTs) studies included men. Extracted data were scrutinised and adjusted until consensus was reached; suitable quantitative data were pooled in statistical meta-analysis. Results: Sexual function was affected similarly in both genders, but effective interventions were reported only for men. In some studies, OSA severity and medications contributed to greater sexual dysfunction. In women, menopausal status, hormone levels and SaO2 < 90% were determinants of sexual dysfunction, while for men factors included BMI, hormonal status and inflammatory markers. Continuous positive airway pressure (CPAP) not only improved clinical measures such as excessive daytime sleepiness but also the erectile and orgasmic function. Nevertheless, sildenafil was superior CPAP with regard to erectile dysfunction. Conclusions: The findings illustrate important contributors to sexual dysfunction; however, firm generalisations cannot be made. There were limited RCTs and none for women, indicating further RCTs are needed to determine how OSA affects sexual function.

Introduction

Sexual dysfunction is characterised by a significant alteration in a person’s ability to respond sexually, and includes a variety of sexual problems (1). While some sexual dysfunctions differ, men and women may report similar problems (Table 1). Both men and women commonly describe changes in sexual desire and orgasmic function, while erectile dysfunction (ED) is a common concern for men, and pelvic pain and problems with vaginal lubrication for women (2). Sexual dysfunction can be categorised in different ways: primary sexual dysfunction (i.e. referring to organic causes directly related to an illness); secondary (i.e. attributed to physical changes indirectly causing sexual problems, such as shortness of breath or fatigue); or tertiary (i.e. related to psychological stress from illness) (3). It may also be seen as generalised or situational, referring to whether sexual problems are not limited (generalised) or are limited (situational) to, e.g. types of stimulation, certain situations or partners. Thirdly, it may be categorised by severity; as mild, moderate or severe (1). Importantly, individuals with chronic illness and physical disability have expressed the need for professional help in dealing with sexual problems, and guidance in how to adapt to physical difficulties and maintain sexual function (4). This includes those with obstructive sleep apnoea (OSA).

Obstructive sleep apnoea is an often lifelong sleep-related breathing disorder characterised by symptoms such as loud snoring, witnessed breathing pauses and frequent awakenings. If daytime symptoms occur (e.g. excessive daytime sleepiness or depression), the
term OSA syndrome (OSAS) or obstructive sleep apnoea–hypopnoea syndrome (OSAHS) is used (5,6). Because of the varied terms used in the literature, and to minimise confusion, the authors use the term OSA throughout the narrative when discussing results of the systematic review and related literature. Within the tables, the term used by the respective authors within an article reviewed is used, i.e. OSA, OSAS or OSAHS, to provide an accurate representation of the variables studied.

The breathing events, with a duration of at least 10 s, are defined as a total (i.e. apnoea) or partial (i.e. hypopnoeas) obstruction of the upper airway leading to a cessation of airflow and often oxygen desaturation, despite continued respiratory movements (7). Hypoxia, i.e. the time spent with oxygenation less than 90% (T90) and lowest SaO2 (Nadir SaO2) are often measured and of importance for the pathophysiological processes causing comorbidity (8). The Apnoea–Hypopnoea Index (AHI) (i.e. the average number of apnoeas and hypopnoeas per hour of sleep) is used to grade the severity into mild (AHI 5–14.9/h), moderate (AHI 15–30/h) or severe OSA (AHI >30) (6,9). The breathing events leads to a hypoxia induced process which contributes to an increased risk to develop hypertension, diabetes, stroke and cardiovascular disease (CVD) (10). The prevalence in patients with CVD is high, and one study found that 29%, 16% and 14% with mild, moderate or severe untreated OSA, respectively, in a hypertensive primary care population (10). Oldenburg et al. found that 36% of patients with heart failure had at least moderate OSA, and more than 50% had sleep disordered breathing with a AHI ≥15/h (11). In the general population, the prevalence rates for OSA varies between 2% and 7% (7,12,13). Continuous positive airway pressure (CPAP) is the treatment of choice and, if adherently used (14), it might abolish breathing events, improve patients’ daytime symptoms, as well as decrease cardiovascular morbidity and mortality (15,16).

Obstructive sleep apnoea affects both the patient and the partner (17–19) and may negatively affect the relationship in general, including the sexual relationship (20). In a cross-sectional study of 401 men referred to a sleep lab for suspected OSA, 92% were diagnosed with OSA, and ED was present in 69% of those with OSA and 34% without OSA (21). A large proportion of individuals with moderate to severe OSA are, however, undiagnosed (9), which is unfortunate as those using CPAP may experience improved overall sexual function, ED, orgasmic function and sexual satisfaction, with similar improvements for partners (22). Psychosocial issues such as depression, anxiety and stressful life events, can be prevalent among patients with OSA (10,18), and may contribute to sexual dysfunction; such psychological concerns are amenable to intervention from healthcare personnel. Increased knowledge among healthcare personnel about characteristics that might act as determinants of sexual function and dysfunction, and appropriate interventions, is of importance, and can be used to educate, encourage and support patients with OSA to improve their sexual dysfunction. Thus, the aim of this systematic review was to determine: In men and women with OSA, what characteristics are determinants of sexual function and dysfunction, and what interventions are shown to be effective?

**Method**

**Design**

A systematic review of studies to determine the physical, psychological and relationship factors that contribute to sexual function/dysfunction in OSA was conducted. The PRISMA framework was used to guide accurate and complete conduct and reporting of this systematic review (Figure 1) (23).

**Eligibility criteria**

**Inclusion criteria**

Studies were included in the systematic review if they met these criteria: original research, adult ≥18 years or ‘all adults’ with OSA and ED or sexual dysfunction; outcomes assessed included physical, psychological and/or sexual relationship factors; the study report was published in the English language, and between the dates of January 2004 and December 2011. (Table 1)

| Both men and women | Men | Women |
|--------------------|-----|-------|
| Orgasmic disorder  | Erectile disorder | Female sexual interest/arousal disorder |
| Substance or medication induced sexual dysfunction | Delayed or premature ejaculation | Genito-pelvic pain |
| | Penetration disorder | Insufficient vaginal lubrication |
| | Male hypoactive sexual desire disorder | |

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Int J Clin Pract, January 2016, 70, 1, 5–19
and used experimental, quasi-experimental, non-experimental and/or mixed methods designs.

Exclusion criteria
To focus our search, studies in the field of pediatrics, participants < 18 years, animal studies and studies older than 10 years were excluded.

Search strategy
The databases PubMed, CINAHL, Cochrane and TRIP were searched for relevant studies. We used both controlled vocabulary [e.g. Medical Subject Headings (MeSH)] and free-text words to search titles and abstracts of potential articles. An initial search was undertaken to ensure that all relevant keywords were included to obtain the maximum possible articles for inclusion. The search terms were ‘obstructive sleep apnoea’ or ‘obstructive sleep apnoea syndrome,’ and gender or sex factors; the operands of ‘AND’ and ‘OR’ were used for follow-up searches. Keywords were used to search in all databases. A total of 39 references were found, 34 through database searching and 5 from online search engines or hand searching. Most references were found by searching in PubMed, with only two additional unique references obtained from CINAHL, and one from the TRIP evidence-based search engine. Of the total, 15 articles were excluded because sexual function/dysfunction was not the primary aim or outcome (n = 2), a focus on snoring alone and not OSA (n = 1), primary population studied was not OSA (n = 3), articles that were literature reviews or case reports (n = 7), insufficient information was provided about the study to judge quality and outcomes (n = 1) and articles not available in English (n = 1). A total of 21 studies met the selection criteria and were included in the systematic review (see Figure 1). Of these, six studies included women and 15 studies included men.

Study selection and data abstraction
All retrieved titles and abstracts were screened by two main reviewers (ES, PPJ) to determine eligibility. Duplicate records and those studies not meeting study criteria were excluded. Reports were screened using names of authors (to exclude duplicates), location, setting, details of the study design, date and duration of the study, number of subjects and consistency with inclusion criteria for the systematic review.

Quality assessment
Studies meeting eligibility criteria were screened by the authors, all with extensive experience within...
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Data analysis
The main reviewers (ES, PPJ) scrutinised the extracted data independently and held group discus-
sions concerning quality of the papers using the EPHPP assessment tool, and adjusted component
ratings accordingly when consensus was reached. There were no unresolved disagreements in ratings.
Quantitative data extracted included details about population, study purpose, methods and outcomes of interest to the review questions. Quality of the studies was difficult to gauge in some instances because of incomplete reporting.

Suitable quantitative data were pooled in a statistical meta-analysis using The Cochrane Collaboration’s statistical software Review Manager (RevMan) [Computer program], Version 5.3. Copenhagen: The Nordic Cochrane Centre, The Cochrane Collaboration, 2014. Potential heterogeneity was assessed by using a standard chi-squared value with a significance level of p = 0.10. We assessed heterogeneity using the $I^2$ statistic (26).

Results
Methodological quality
Of the 21 studies reviewed, the global rating of quality resulted in 15 studies that were rated as moderate and six studies as weak; there were no studies meeting the criteria for a strong rating. There were limited studies involving women, and the six studies reported here all used descriptive, cross-sectional designs (Table 2), resulting in a weak component rating for study design. Among men, study designs included six descriptive, cross-sectional studies (Table 3), with one study including a one-group pre-posttest design (27). Five studies had a moderate
design component rating (21,27–30) and one was rated as weak (31).

There were nine intervention studies of men included in this review (Table 4), which included four, one-group cohort/pre-posttest studies with either a weak design component rating (32,33), or moderate design component rating (34,35). One study was a three-group cohort pre-posttest study with a moderate design component rating (36). In addition, four studies were randomised control trials (RCTs) with moderate design component ratings (37–40). Other quality assessment ratings that resulted in weak ratings for a particular component among the 21 studies included selection bias (three studies), confounders (six studies) and blinding (eight studies).

Women and sexual dysfunction
The mean age of women across the five studies for which it was reported was 47.08 years, with the highest individual study mean age was 51 years (41). Given that all six studies of women are descriptive in design and have small samples, firm conclusions cannot be drawn. The studies do, however, provide insights into female sexual dysfunction (FSD) and OSA that can inform future studies. The prevalence of FSD in women with OSA varied from 32.2% to 71% (41,42). In some studies, increasing severity of OSA resulted in FSD (43,44), with a mean AHI of 82.6 in severe OSA in premenopausal women and mean AHI of 56.5 in postmenopausal women (44), while severity was not a factor in other studies (41,45). When examining specific aspects of sexual function, Köseoğlu et al. found that greater severity of OSA (as determined by RDI) significantly affected desire, sensation, lubrication, orgasm and the partner relationship, and lower mean Nadir SaO2 negatively affected orgasm (43). In another study comparing OSA to a control group, those with mild OSA (mean AHI 8.2) experienced significantly more problems with desire, orgasm and overall sexual function, while those with moderate to severe OSA (mean AHI 26.6) had more problems with desire, lubrication and overall sexual function (45). Sexual distress was prevalent among women in one study, occurring in 51% of those with OSA compared with 28% in a population-based sample (41). In addition, both sexual dysfunction and distress were greater in those with OSA. Menopausal status is another factor that may influence FSD, and women who were either premenopausal or postmenopausal and had severe OSA experienced greater FSD (44). In addition, decline in progesterone levels in premenopausal women and oestrogen levels in postmenopausal women negatively affected female sexual function (44).
Table 2: Obstructive sleep apnoea and sexual dysfunction in women

| Study | Aim | Design/sample/outcomes | Summary of findings |
|-------|-----|------------------------|---------------------|
| Fanulla et al., 2013 | To assess the role of OSA in determining FSD in premenopausal obese women | Descriptive, cross-sectional, January 2016, 70, 1-59 | Of the 31 women with OSA, 14 (30.4%) had FSD reporting both sexual difficulties and sexual distress. Ten women with OSA also had FSD (32.2%); in this group, T90 was higher (23.5 ± 26.3% in women with FSD than in those without FSD (4.8 ± 5.8; p = 0.003). Those with abnormal FSDS scores had greater mean AHI (41.5 ± 35.3 vs. 22.4 ± 18.9 controls; p = 0.02), mean ODI (36.5 ± 31.5 vs. 21 ± 17.7 controls; p = 0.03) and T90 (14.9 ± 21.8% vs. 2.5 ± 4.7% controls; p = 0.005). In a logistic multiple regression analysis, T90 was the only factor associated with an increased risk for FSD (odds ratio 1.07) (confidence interval 1.006–1.13; p = 0.03) |
| Köseoglu et al., 2007 | To determine sexual function in women with OSAS and its relationship with disease parameters of OSAS | Descriptive, prospective, cross-sectional | Greater severity of OSAS resulted in negative effects on sexual function for desire, sensation, lubrication and orgasm and partner relationship, with no effect on enjoyment and pain; similar results were found when controlling for age and comorbid conditions (p < 0.05). Mean Nadir SaO 2 was only negatively correlated with orgasm (p < 0.05). BMI was significantly negatively correlated with partner relationship, controlling for age and comorbidity (p = 0.02). Desire (p < 0.01), sensation (p < 0.05), lubrication (p < 0.05) and orgasm (p < 0.05) were negatively correlated with RDI |
| Onem et al., 2008 | To evaluate sexual function and hormonal status in women with OSAHS in comparison with women without OSAHS and discuss the problems associated with OSAHS on FSD | Descriptive, cross-sectional | There were no significant differences on the FSFI for Group 1 and 2. Hormonal status was non-significant for all levels measured and when compared by group. Significant differences were shown between Group 1 and controls for desire (p = 0.04), orgasm (p = 0.03), and total FSFI (p = 0.01), and between Group 2 and controls for desire (p = 0.04), lubrication (p = 0.04) and total FSFI (p = 0.02). Regression analysis showed that BDI scores independently predicted decreased desire (p = 0.02) and sexual satisfaction (p = 0.03) |
| Petersen et al., 2011 | To investigate sexual dysfunction and sexual distress in female patients with untreated OSA and to determine which factors are of importance for sexual function | Descriptive, cross-sectional | Using a cut-off score ≤ 26.55, 71% of those with OSA and 40% of the population sample reported sexual difficulty, regardless of age. For sexual distress, 51% of those with OSA scored ≥ 15 on the FSDS, and 28% within the population sample, independent of age. Scores on the MFSD, measuring both FSD and distress, were higher in OSA vs. controls, 48% vs. 22% (p ≤ 0.001), regardless of age. Regression analyses supported the negative impact of FSD, sexual distress and MFSD in those with OSA. BMI and AHI were not significant factors in regression analyses of FSFI, FSDS and MFSD and OSA |
| Stavaras et al., 2012 | To evaluate the female sexual function in relation to hormonal status in pre- and postmenopausal women | Descriptive, cross-sectional | In premenopausal women, FSD occurred in all those with severe OSA (n = 8), 67% (n = 6) of not severe OSA and 46% (n = 12) in controls. In postmenopausal women, FSD occurred in 96% (n = 22) of those with severe OSA, 72% (n = 13) in those with not severe OSA and 41% (n = 7) in controls. In both pre- and postmenopausal women, those with severe OSA had significantly lower FSFI scores when compared with less severe OSA (p < 0.05) and controls (p < 0.01). In premenopausal women, |

Note: FSFI = Female Sexual Function Index, FSDS = Female Sexual Distress Scale, BDI = Beck Depression Inventory, FSQ-V2 = Female Sexual Quality of Life Scale-V2, ESS = Epworth Sleepiness Scale, GHQ = General Health Questionnaire, AAHI = Apnea Hypopnea Index, AHI = Apnea-Hypopnea Index, ODI = Oxygen Desaturation Index, T90 = Percentage of total sleep time with SaO2 < 90%, SAOS = Sleep Apnea OSA Syndrome.
| Study Aim Design/sample/outcomes | Summary of findings |
|---------------------------------|---------------------|
| compared with healthy controls  | mean ODI $26.7 \pm 13.5$, mean Nadir SaO$_2$ $79.9 \pm 5.4\%$  
Severe OSA, mean AHI $82.6 \pm 32.1\%$, mean ODI $97.9 \pm 26.3$, mean Nadir SaO$_2$ $66.9 \pm 14.0\%$  
Control, mean AHI $3.8 \pm 2.6\%$, mean ODI $5.6 \pm 5.9$, mean Nadir SaO$_2$ $89.2 \pm 3.2\%$  
Postmenopausal: not severe OSA, mean AHI $17.0 \pm 5.0$, mean ODI $24.1 \pm 14.7$, mean Nadir SaO$_2$ $81.5 \pm 4.3\%$  
Severe OSA, mean AHI $56.5 \pm 23.8$, ODI $71.2 \pm 27.8$, mean Nadir SaO$_2$ $66.8 \pm 14.2\%$  
Control, mean AHI $4.4 \pm 2.9$, ODI $6.6 \pm 5.1$, mean Nadir SaO$_2$ $87.4 \pm 3.3\%$  
ESS, BDI, FSFI and hormones (progesterone, estradiol, total testosterone) | FSFI and AHI were significantly negatively correlated, controlling for age and BMI, and all FSFI domains correlated significantly with mean AHI, mean Nadir SaO$_2$ and mean ODI, with the exception of sexual desire. In postmenopausal women, FSFI was negatively correlated with mean ODI alone, controlling for age and BMI. Significant correlations were found between FSFI and progesterone in premenopausal women ($p < 0.01$), and oestrogen ($p < 0.05$) in postmenopausal women, controlling for age and BMI |
| To assess the prevalence of sexual dysfunction in women with OSA | Of the study group, 11 women (52.4%, $n = 11$) had poor FSFI scores ($< 23$) vs. the control group with no scores in the poor range. Negative mood domain scores were not different when comparing poor to normal FSFI. There was no correlation between BMI, severity of sleep apnoea or mood disorders on overall FSFI scores. Among individual domains, there was a correlation between RDI and FSFI arousal scores ($p < 0.05$), and correlation between sexual satisfaction and mood states ($p < 0.05$) |

Table 2 Continued

Subramanian et al., 2009

| Design/sample/outcomes | Summary of findings |
|------------------------|---------------------|
| $N = 21$ consecutive premenopausal women with OSA, referred for polysomnography with positive study for sleep apnoea (RDI $> 5$), and $n = 11$ healthy premenopausal women as control group |  |
| FSFI $< 23$, mean RDI $18.1 \pm 6.8$  
FSFI $> 23$, mean RDI $23.4 \pm 11.5$  
FSFI Profile of Mood States |  |
Table 3: Obstructive sleep apnoea and sexual dysfunction in men – descriptive studies

| Study          | Aim                                                                 | Design/sample/outcomes/intervention                                                                 | Summary of findings                                                                                           |
|---------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Ak et al., 2012 | To examine whether reproductive hormones or the quality of sexual life and the severity of the loss of function are affected in male patients with untreated OSA | Descriptive, prospective 85 male participants, 42 apnoea and 43 non-apnoea controls; mean age 38.29 ± 8.36, all admitted to sleep centre Grouped by AHI: low = 5–15, medium 15–30, high > 30 GRSS, hormones (FSH, LH, prolactin, testosterone and estradiol) | The apnoea group had a higher BMI (p < 0.001) and lower LH (p < 0.05) and testosterone (p < 0.01) levels than the non-apnoea group. There were no differences between the apnoea, non-apnoea groups and within the apnoea groups (mild, moderate and high apnoea) in terms of sexual satisfaction, including impotence, premature ejaculation, non-communication, infrequency, avoidance, non-sensuality, dissatisfaction and total scores on the GRISS. There were changes in hormonal levels of OSA patients; regression analysis showed FSH predicted impotence and total GRSS score (p < 0.05) and prolactin predicted premature ejaculation, avoidance, dissatisfaction (all p < 0.05) and total GRSS score (p < 0.01) Overall ED prevalence was 40.9%, and those with severe OSA had greater ED (53.5%) compared with mild/moderate OSA (27.1%, p = 0.005) of the total population (N = 404). Of the sample of 31 patients qualifying for the study, higher levels of hsCRP, TNF-α levels, IL-6 and IL-8 occurred more frequently in OSAHS patients with ED compared with controls. Serum adiponectin levels were lower in OSAHS-ED patients, but not statistically significant. There was a significant association between OSAHS severity and CRP in those with ED (p < 0.001, r = 0.896) |
| Bouloukaki et al., 2014 | To assess if OSAHS is associated with inflammatory cytokine system activation in patients with ED compared with matched OSAHS patients with normal sexual function | Descriptive, prospective n = 31 men with newly diagnosed severe OSAHS and ED, mean age 48.5 ± 8.55, mean AHI 48.09 ± 26.39, mean ODI 46 ± 22, mean Nadir SaO2 79.32 ± 9.68%, mean SaO2 92.5 ± 3.6% n = 15 controls with severe OSAHS and without ED, mean age 47.9 ± 7.9, mean AHI 47.82 ± 23.56, mean ODI 30 ± 18, mean Nadir SaO2 80.14 ± 8.91%, mean SaO2 92.3 ± 3.87% IIEF-15, ESS, Polysomography test, blood samples postpolysomography-hsCRP, TNF-α, interleukin-6 (IL-6), interleukin-8 (IL-8) and adiponectin | ED prevalence overall was 66.1% (n = 265), and prevalence of ED occurred in 65.6% with mild OSA, 68.2% with moderate OSA and 70.9% with severe OSA. There was a significant difference between those with no ED and ED for lowest SaO2 (82% vs. 80%; p = 0.001), mean SaO2 (93.7% vs. 92.5%; p < 0.001) and the desaturation index (18.4/h vs. 25.4/h; p = 0.001). The IIEF-15 scores compared with different levels of AHI scores showed significant differences in erectile function (p = 0.007), intercourse satisfaction (p = 0.017) and IIEF total score (p = 0.019). IIEF-15 summary scores compared with quartiles of mean nocturnal SaO2 (severity) revealed significant differences in erectile function (p < 0.001), intercourse satisfaction (p = 0.002), orgasmic function (p = 0.007), sexual desire (p = 0.006) and IIEF total (p = 0.001). Multivariate regression confirmed that age, hypertension, peripheral occlusive disease, prostate intervention and mean nocturnal SaO2 were independently associated with ED (p < 0.05) In moderate to severe ED (EF domain < 17), CPAP users had improved overall sexual function (p = 0.014), orgasmic function (p = 0.012), sexual desire (p = 0.007) and overall satisfaction (p = 0.033), with similar results for those with poor overall sexual dysfunction (IIEF-15 summary score < 44, n = 40). For those with moderate to severe ED and low mean nocturnal oxygen saturation (median ≤ 93%), the EF subdomain improved in CPAP users vs. non-users (p = 0.047). Predictors of decline in EF domain at follow-up were higher age (p = 0.027), lower AHI (p = 0.018) and irregular CPAP use (p = 0.033), although in multivariate regression analyses, only AHI and age remained predictive |
| Budweiser et al., 2009 | To evaluate the relationship between ED and sexual dysfunction and polysomographic measures of sleep apnoea in patients with known risk for ED | Descriptive, observational 401 men age 49–66 referred for polysomography 91.2% with OSA ED group, mean age 61.7 ± 53.7–69.6, mean AHI 27.9 ± 13.5–48.8, mean Nadir SaO2 80.0 ± 74–84%* No ED group, mean age 49.9 ± 42.0–55.4, mean AHI 21.2 ± 9.2–42.5; mean Nadir SaO2 82 ± 78.3–86%* SD, medians with interquartile ranges AHI, Mean/lowest nocturnal SaO2, IIEF-15 | ED prevalence overall was 66.1% (n = 265), and prevalence of ED occurred in 65.6% with mild OSA, 68.2% with moderate OSA and 70.9% with severe OSA. There was a significant difference between those with no ED and ED for lowest SaO2 (82% vs. 80%; p = 0.001), mean SaO2 (93.7% vs. 92.5%; p < 0.001) and the desaturation index (18.4/h vs. 25.4/h; p = 0.001). The IIEF-15 scores compared with different levels of AHI scores showed significant differences in erectile function (p = 0.007), intercourse satisfaction (p = 0.017) and IIEF total score (p = 0.019). IIEF-15 summary scores compared with quartiles of mean nocturnal SaO2 (severity) revealed significant differences in erectile function (p < 0.001), intercourse satisfaction (p = 0.002), orgasmic function (p = 0.007), sexual desire (p = 0.006) and IIEF total (p = 0.001). Multivariate regression confirmed that age, hypertension, peripheral occlusive disease, prostate intervention and mean nocturnal SaO2 were independently associated with ED (p < 0.05) In moderate to severe ED (EF domain < 17), CPAP users had improved overall sexual function (p = 0.014), orgasmic function (p = 0.012), sexual desire (p = 0.007) and overall satisfaction (p = 0.033), with similar results for those with poor overall sexual dysfunction (IIEF-15 summary score < 44, n = 40). For those with moderate to severe ED and low mean nocturnal oxygen saturation (median ≤ 93%), the EF subdomain improved in CPAP users vs. non-users (p = 0.047). Predictors of decline in EF domain at follow-up were higher age (p = 0.027), lower AHI (p = 0.018) and irregular CPAP use (p = 0.033), although in multivariate regression analyses, only AHI and age remained predictive |
| Budweiser et al., 2013 | To investigate whether CPAP therapy has a long-term effect on sexual function, including ED, in the presence of other risk factors for ED in OSA patients | Descriptive, observational 401 men age 49–66 referred for polysomography. 91.2% having OSA N = 91 completed valid IIEF-15 at follow-up, mean age 55.2 years CPAP users (n = 56), mean age 54.9 ± 48.0–61.8, mean AHI 28.1 ± 18–40, mean Nadir SaO2 80.5 ± 74–84%, mean SaO2 93.2 ± 92–94.8%* Non-CPAP users (n = 35), mean age 57.6 ± 45–69, mean AHI 14.7 ± 6.8–23.7, mean | ED prevalence overall was 66.1% (n = 265), and prevalence of ED occurred in 65.6% with mild OSA, 68.2% with moderate OSA and 70.9% with severe OSA. There was a significant difference between those with no ED and ED for lowest SaO2 (82% vs. 80%; p = 0.001), mean SaO2 (93.7% vs. 92.5%; p < 0.001) and the desaturation index (18.4/h vs. 25.4/h; p = 0.001). The IIEF-15 scores compared with different levels of AHI scores showed significant differences in erectile function (p = 0.007), intercourse satisfaction (p = 0.017) and IIEF total score (p = 0.019). IIEF-15 summary scores compared with quartiles of mean nocturnal SaO2 (severity) revealed significant differences in erectile function (p < 0.001), intercourse satisfaction (p = 0.002), orgasmic function (p = 0.007), sexual desire (p = 0.006) and IIEF total (p = 0.001). Multivariate regression confirmed that age, hypertension, peripheral occlusive disease, prostate intervention and mean nocturnal SaO2 were independently associated with ED (p < 0.05) In moderate to severe ED (EF domain < 17), CPAP users had improved overall sexual function (p = 0.014), orgasmic function (p = 0.012), sexual desire (p = 0.007) and overall satisfaction (p = 0.033), with similar results for those with poor overall sexual dysfunction (IIEF-15 summary score < 44, n = 40). For those with moderate to severe ED and low mean nocturnal oxygen saturation (median ≤ 93%), the EF subdomain improved in CPAP users vs. non-users (p = 0.047). Predictors of decline in EF domain at follow-up were higher age (p = 0.027), lower AHI (p = 0.018) and irregular CPAP use (p = 0.033), although in multivariate regression analyses, only AHI and age remained predictive |
| Study | Aim | Design/sample/outcomes/intervention | Summary of findings |
|-------|-----|-------------------------------------|--------------------|
| Petersen et al., 2010 | To evaluate general and functional aspects of sexuality in male patients with a confirmed diagnosis of OSA compared with normative data | Nadir SaO₂ 83 ± 79–86%, mean SaO₂ 93 ± 92–94.2%*  
*IIEF-15 | On the sexual life subscale of the Fugl-Meyer LiSat, OSA patients in the age ranges of 40–49 (p < 0.001), 50–59 (p < 0.0005) and 60–69 (p < 0.05) had significantly worse ratings of sexual life when compared with controls, and ages 50–59 had worse ratings for partner relationship compared with controls (p < 0.01). Sexual life was negatively affected by BMI (p = 0.032) and positively affected by being in a relationship (p = 0.032). BSFI subscale scores were significantly worse for OSA patients in the areas of sexual drive, erection, ejaculation, sexual problem assessment and total score, and overall sexual satisfaction when compared with normative data. |
| Stannk et al., 2009 | To compare self-reported sexuality in men with newly diagnosed sleep apnoea with a group of disease-free men, and to evaluate the impact of disease severity and age on the response pattern | 315 male patients with OSA diagnosed in a sleep laboratory age mean age 50.6 ± 10.3  
308 patients were compared with a normative population: mean AHI 39.9 ± 24.2  
Fugl-Meyer LiSat, BFSI, BMI, ESS | Men with OSAS reported significantly more problems with erection (p = 0.024), but no difference in use of medications or devices for ED. Overall sexual satisfaction differed between OSAS men, compared with those without OSAS (p = 0.04). Disease severity did not significantly influence erection, desired frequency for tenderness, sexual desire or frequency of petting. Frequency of desire for sexual intercourse or actual frequency was non-significant between groups. Frequency of masturbation decreased with increased disease severity (p = 0.02), although sexual satisfaction was not negatively affected (p = 0.20). Older men with OSAS had more difficulty attaining or keeping an erection (p = 0.001). |

AHI, Apnoea–Hypopnoea Index; BMI, Body Mass Index; BFSI, Brief Sexual Function Inventory; CPAP, continuous positive airway pressure; ED, erectile dysfunction; EF, erectile function; ESS, Epworth Sleepiness Scale; FSH, follicle-stimulating hormone; Fugl-Meyer LiSat, Fugl-Meyer Life satisfaction checklist; GRISS, Golombok Rust Inventory of Sexual Satisfaction; hsCRP, high-sensitivity C-reactive protein; IIEF-15, international index of erectile function 15 item questionnaire; LH, Lutenising Hormone; MSLT, Multiple Sleep Latency Test; Nadir SaO₂, lowest oxygen saturation; ODI, Oxygen Desaturation Index; OSA, obstructive sleep apnoea; OSAHS, obstructive sleep apnoea–hypopnoea syndrome; OSAS, obstructive sleep apnoea syndrome; SaO₂, arterial oxygen saturation; TNF-α, tumour necrosis factor-α.
## Table 4 Obstructive sleep apnoea and sexual dysfunction in men – intervention studies

| Study | Aim | Design/sample/outcomes | Intervention | Summary of findings |
|-------|-----|------------------------|--------------|---------------------|
| Hoekema et al., 2007 | To determine the extent to which untreated men with OSAHS experience sexual dysfunction compared with control subjects, and second, to evaluate the effects of oral appliance or CPAP therapy on sexual function | RCT | Randomised to either oral appliance or CPAP therapy 6–12 weeks | GRISS scores for ED (p = 0.01) and sexual dissatisfaction (p = 0.03) were significantly worse in OSA compared with controls; changes from baseline to follow-up not significant for the oral appliance or CPAP groups. Oral appliance was effective in 90% of patients 90% and 92.6% of CPAP users. Both groups significantly improved in ESS scores, AH1 and lowest SaO2 readings during sleep; ED at baseline and improved erectile function after treatment (r = −0.547, p = 0.000) |
| Karkoulias et al., 2007 | To examine the characteristics of ED in men with OSAS and whether treatment with CPAP improves ED | Randomised to either oral appliance or CPAP therapy 6–12 weeks | Patients were treated with CPAP every night for 3 months | CPAP and surgical groups had significant improvement in ESS and SaO2 with fewer AH1 episodes. Posttreatment with CPAP showed that both subjective (IIEF-5 scores; p < 0.001) and objective (Rigiscan; p < 0.05) measures of erectile function were improved, with nocturnal rigidity |
| Khafray et al., 2012 | To determine the impact of long-term treatment with CPAP and obstruction relieving surgical procedure on OSAS patients on E1 | One-group pre- and postmeasures, no controls | CPAP treatment for 12 weeks | CPAP treated patients had 138 intercourse attempts (mean 9.2 per patient), 23.9% successful. After CPAP treatment, scores for erectile function (p = 0.018), orgasmic function (p = 0.019), intercourse satisfaction (p = 0.016), overall satisfaction (p = 0.048) and total IIEF score (p = 0.014) were significantly improved, although sexual desire did not improve |
| Knapp et al., 2014 | To determine whether CPAP improves sexual and gonadal function in men with type 2 diabetes and a pre-CPAP apnoea-hypopnoea index > 15h | One-group pre- and postmeasures, no controls | Treatment with sildenafil (100 mg 1 h before sexual activity) vs. nasal CPAP at night | Three months of high-compliance CPAP did not alter serum testosterone, free testosterone or SHIM score. ADAM score after 1 month was slightly reduced which was maintained at 3 months (p = 0.015), and significant improvements in ESS (p = 0.02), physical activity (p = 0.17) and the physical component of the SF-12 questionnaire (p = 0.037). The ESS means changed from before CPAP (8.0), 1-month CPAP (4.0) and 3-month CPAP (5.0) |
| Pastore et al., 2014 | To compare the efficacy of sildenafil to CPAP in men with ED and OSA | RCT | Treatment with sildenafil (100 mg 1 h before sexual activity) vs. nasal CPAP at night | Sildenafil group had more successful attempted intercourses (58.2%, 7.6 ± 1.6 per patient) compared with CPAP (30.4%, 3.8 ± 1.7, p < 0.0001); mean successful intercourses per week was higher for sildenafil (2.9 ± 0.8) compared with CPAP (1.7 ± 0.6, p < 0.0001). Both groups IIEF-5 scores improved from baseline (p < 0.0001), but significantly higher with |
**Table 4 Continued**

| Study | Aim | Design/sample/outcomes | Intervention | Summary of findings |
|-------|-----|-------------------------|--------------|---------------------|
| Perimenis et al., 2004 | To evaluate the efficacy of sildenafil and CPAP in men with ED and OSAS | RCT | Patients were randomised to either with sildenafil or CPAP for ≥ 3 months | Successful intercourse attempts were greater with sildenafil (n = 180 attempts, mean = 12 per patient, p = 0.005, 53.9% successful, p = 0.001) compared with CPAP (n = 138 attempts, mean = 9.2 per patient, 23.9% successful). IEF total and domain scores were increased in both groups compared with baseline, and all total and domain scores (except sexual desire) were significantly higher in those treated with sildenafil vs. those with CPAP. Treatment satisfaction was higher for the sildenafil group (53.3% vs. 20%, p = 0.13) |
| Reisstein et al., 2010 | To examine intimate and sexual relationships in patients with OSA, the association with daytime sleepiness and the change in these outcomes with CPAP | One-group pre- and postmeasures, no controls | Patients underwent nasal CPAP for ≥ 3 months | At baseline, 70% had MSLT value < 10 min and ESS ≥ 11, with no difference in severity in SMLT scores, although ESS scores were significantly different for those with AHI of 40 to < 60 (13.05 ± 4.63) and AHI ≥ 60 (15.32 ± 4.84) After 3 months of CPAP, the Intimate and Sexual Relationship subscale mean was significantly better for the total sample (p < 0.0001); those with the most severe OSA had greater improvement. There were fewer sexual problems from baseline to posttreatment for desire (69% vs. 40%, p < 0.001), arousal (46% vs. 2%, p < 0.001) and orgasm (29% vs. 18%, p < 0.05) |
| Shin et al., 2013 | To evaluate the effects of uvulopalatopharyngoplasty (UPPP) surgical treatment and non-surgical approach (oral appliance and CPAP) on sexual functioning and quality of life in male OSAS patients | Quasi-experimental non-randomised prospective study, 3 group, pre-posttest | Patients underwent respectively UPPP, CPAP or MAD for a median of 7 months of treatment (interquartile range, 4–15 months) | CPAP group showed older age, higher body mass index and more severe OSAS than other groups. AHI and Nadir SaO₂ improved significantly in all groups, but ESS decreased significantly in UPPP (p = 0.002) and MAD groups (p = 0.007). Significant increase in KIEF-5 was observed only in UPPP patients (p = 0.039). All groups had improved QOL after treatment, but significant only in MAD group for overall QOL (p = 0.040) |
| Taskin et al., 2010 | To investigate frequency and degree of ED in patients with severe OSAS and to evaluate the results of CPAP therapy alone on ED | RCT | Patients were randomised to either CPAP treatment for 1 month or control. Both groups were placed on antidepressant | Before CPAP treatment ED was significantly correlated only to BMI (p = 0.007), but after 1 month of regular CPAP usage, mean values of IIEF-5, BDI and ESS scores significantly improved (all p < 0.001). When divided into groups by SaO₂ ≤ 80% vs. > 80%, and before and after CPAP, IIEF-5, BDI and ESS |
Physiological factors may also play a role in FSD. Oxygen saturation, specifically, $\text{SaO}_2 < 90\%$ ($T_{90}$), was significantly associated with FSD compared with those without FSD, and was the only factor in a regression analysis that predicted increased risk for FSD (42). Low oxygen saturation was also a significantly, negatively associated with orgasm (43). Most studies of women in this review included BMI in their analysis, but did not find evidence that BMI was a significant factor in FSD. Köseoğlu et al., however, found that BMI was significantly negatively correlated with partner relationship (43).

Medications may adversely affect sexual function and were reported in two studies of women (41,42). Fanfulla et al. showed that antidepressant medication use did not adversely affect sexual function (42). Petersen et al. examined the use of cardiovascular medications, psychopharmaca and antidiabetic agents in those with OSA as compared with the general population (41). For those with OSA, psychopharmac use was negatively associated with female sexual function ($p = 0.037$), sexual dysfunction ($p = 0.04$) and sexual distress ($p = 0.011$) (41).

### Men with sexual dysfunction

The mean age of men in the six descriptive studies was 48.82 years, although the study by Ak et al. reported a considerably lower mean age of 38.29 years (27). A variety of methods, comparison groups and measures makes comparisons across studies more difficult, particularly those that are descriptive in nature (Table 3). The prevalence of ED is varied, and has been reported as 40.9% (28), 66.1% (21) or as significantly greater in men with OSA (30). Sexual satisfaction was significantly worse with OSA as reported in two studies (30,37) but non-significant when comparing apnoea to non-apnoea groups in another study (27). Petersen et al. reported that sexual function scores were worse in OSA in the areas of sexual drive, ejaculation, sexual problems and sexual satisfaction (29). Some descriptive studies examined scores on the International Index of Erectile Function (IIEF) and severity of OSA (AHI), finding significantly greater negative effects on erectile function, intercourse satisfaction and IIEF total score (21), while Stannek et al. reported that disease severity did not significantly affect erectile function, desired sexual frequency, sexual desire or frequency of petting, although the frequency of masturbation did significantly decline with worsened OSA (30). The use of CPAP by those with moderate to severe ED improved overall sexual function, sexual desire and sexual satisfaction, including improvements in those with $\text{SaO}_2 \leq 93\%$ prior to CPAP (31).
Certain physiological measures were shown to be significant factors in several studies. In contrast to studies of women, increased BMI was much higher in men with OSA (27) and sex life was negatively affected by BMI (29). The role of various hormones were reported in two studies, showing that men with OSA had significantly lower luteinizing hormone and testosterone, and changes in follicle-stimulating hormone significantly predicted impotence and Golombok Rust Inventory of Sexual Satisfaction (GRISS) score (27). In this same study, prolactin level predicted premature ejaculation, avoidance, dissatisfaction and total GRISS score.

Medication use was reported in two descriptive studies and negatively affected sexual function in men (21,29). Budweiser et al. compared medication use by drug classification for those with ED and those without ED (21). Men with ED were more likely to be prescribed angiotensin-converting enzyme inhibitors (ACEI, p = 0.001), beta blockers (p = 0.001), diuretics (p < 0.001), statins (p = 0.024) and antidiabetic agents (n = 0.013) (21). Petersen et al. examined the use of cardiovascular medications (digoxin, antihypertensive agents, diuretics, beta blockers, calcium antagonists, ACEI), psychopharmaca and antidiabetics drugs (29). Life satisfaction was negatively affected for those taking cardiovascular medications (p = 0.012) and psychopharmaca (p = 0.001) (29). Cardiovascular medications adversely affected sexual drive (p = 0.015), and ejaculation was negatively impacted by both cardiovascular medications (p = 0.016) and psychopharmaca (p = 0.043) (29). Sexual problem assessment and sexual function were similarly affected.

For this systematic review, descriptive studies that included CPAP as a variable are discussed in this section, while intervention studies and RCTs using CPAP as an intervention are discussed in the following section. When comparing high-compliance CPAP to hormonal levels, it was found that CPAP did not alter serum testosterone, free testosterone or SHIM score in men with type 2 diabetes mellitus, although a mild reduction in Androgen Deficiency in the Aging Male score (ADAM) occurred at 1 month and was maintained at 3 months (34). Other blood values measured revealed that hsCRP, TNFa, IL-6, IL-8 were significantly higher in men with both ED and OSA, and serum adiponectin was decreased but non-significant (28). As these studies illustrate, sexual dysfunction in men is multifactorial. Although firm conclusions cannot be drawn from the results presented, it is clear that problems with erectile function, sexual desire and sexual satisfaction are common across several studies.

**Interventions in the management of sexual dysfunction**

The mean age of men across studies receiving an intervention was 51.54 years, somewhat higher than that reported in descriptive studies. While different measures and comparisons are used in the intervention studies reported (Table 4), there are greater commonalities as CPAP is used in all studies. In studies using pre- and postmeasures without a control group, CPAP treatment in general resulted in improved erectile function (32,33), gonadal function (34) orgasmic function, intercourse satisfaction, overall satisfaction and overall sexual function, although sexual desire did not improve (32). Reishten et al. found that after CPAP of 3 months, intimacy and the sexual relationship was significantly improved, and more so for those with severe OSA (AHI ≥ 60), including fewer problems with desire, intimacy, arousal and orgasm (35). Objective measurements using Rigiscan also demonstrated significant improvement in erectile function (33). CPAP improved physical activity measures as well (34).

Shin et al. compared CPAP to patients using an oral appliance or surgery with UPPP. There were mixed results with the surgical group as the only group with increased erectile function scores, while the oral appliance group had better quality of life, and all study groups had improved SaO2 (36).

The remaining four studies were RCTs, although sample sizes were small ranging from 30 to 82 men. Sildenafil was compared with CPAP in two studies, with results indicating that there were more successful intercourse attempts in the sildenafil group (38,39). In both studies, erectile function was improved for the CPAP and the sildenafil groups, but the sildenafil groups scored significantly higher on the IIEF. In the Perimenis et al. study, sexual desire was the only domain score not to show improvement (39). Men taking sildenafil reported greater therapeutic satisfaction when compared with CPAP (38).

As the studies of Pastore et al. (38) and Perimenis et al. (39) included the same intervention and the same continuous outcome, specifically, the sum score from the erectile function domain in the IIEF questionnaire, we were able to pool data. Effect sizes expressed as weighted mean difference and their 95% confidence intervals (CI) were calculated for analysis. We found that comparing CPAP with sildenafil after 3 months of treatment showed a favour for sildenafil with a mean difference on −5.25 95% CI −8.17 to −2.23, p = 0.0004. $I^2 = 0\%$ (Figure 2).
A RCT that compared an oral appliance to CPAP revealed that the oral appliance was effective as a treatment in 90% of patients, and CPAP was effective in 92.6%, and both groups had improved erectile function posttreatment (37). In another study, CPAP alone was compared with controls with no treatment, although both groups received antidepressant medication for 1 month (40). Regular CPAP usage resulted in significantly improved erectile function, depression and daytime sleepiness scores, while in the control group, there were no significant changes in erectile function or daytime sleepiness, but improved depression scores. Participants were further divided into groups by SaO2 levels of < 80% and ≥ 80%, and before and after CPAP, and results showed that erectile function, depressive symptoms and daytime sleepiness improved for both SaO2 groups (40).

Discussion

This systematic review clearly illustrates that sexual dysfunction is common in men and women with OSA and that sexual assessment and intervention are needed to promote sexual quality of life. The high prevalence of sexual dysfunction among both men and women reported here is similar and also concerning. Not only is overall sexual function and the relationship affected but also specific multiple factors are impacted, including sexual desire, orgasmic function, ejaculation, ED and sexual satisfaction (21,27,43,45). Of interest, the role of severity of OSA (mild, moderate or severe) is unclear in regard to sexual function in women and men, with varying results among studies. Thus, further studies with larger samples are needed to further examine OSA severity and sexual function. In one study of women, sexual distress occurred in women with greater severity of OSA, and contributing to sexual dysfunction (41); further evaluation of sexual distress in women and men may be useful. In addition, T_{90} put women at significant risk of FSD, and low SaO2 negatively affected orgasm (42); therefore, including these variables in future studies is important. Menopausal status, OSA and FSD merit further study as only two studies addressed these variables, but with different comparisons (44,46). Like studies of women, a variety of outcomes were assessed in men beyond standard OSA measures, such as hormonal factors (27,32,34,37–40) and inflammatory markers (28). Clear conclusions from these data cannot be made as further study is warranted. However, hypoxaemia commonly occurs among patients with OSA and is a well-known factor that promotes oxidative stress. This can occur through a chain of events (i.e. including systemic and vascular inflammation, as well as endothelial dysfunction) leading to ED, a frequent occurrence in men with OSA. Further evaluation of the causes for sexual dysfunction, including comorbid conditions such as CVD that may add to morbidity and mortality, is needed. In addition, the effect of medications on sexual function merits additional study. For men and women, psychopharmaca (29,41) and cardiovascular medications (29) may contribute to sexual dysfunction. Few studies specifically analysed the role of medications in causing sexual dysfunction in OSA. In general, beta blockers, cardiac glycosides and diuretics have been shown in general to negatively affect sexual function, while there have been mixed results with alpha blockers, ACEI and calcium channel blockers (47). In addition, certain antidepressants can contribute to sexual dysfunction, e.g. selective serotonin reuptake inhibitors and serotonin/norepinephrine reuptake inhibitors (48); from a clinical perspective choosing drugs with less known sexual side effects, where possible, may improve the patient’s sexual quality of life. Given that there are considerable gaps in knowledge regarding medications and sexual dysfunction and specifically to patients with OSA, further study is needed.

So what works? It is clear from the intervention studies reported, and from some of the descriptive studies of men, that effective interventions do exist to promote sexual function. CPAP not only improves clinical measures such as AHI, mean Nadir SaO2, T_{90} and daytime sleepiness but also improved erectile and
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orgasmic function (32,33,37–40). As adherence to CPAP treatment is a significant clinical problem (14), it is of key importance for healthcare providers to optimise their care interventions (49), and if suitable, stress to patients that regular CPAP usage has been shown to improve sexual function. This might particularly help younger patients/couples to avoid the risk for early CPAP treatment drop outs related to intimacy issues. Similarly, the use of an oral appliance as a non-surgical approach, and UPPP as a surgical treatment, may have a role in treatment, although in one study, UPPP resulted in improved erectile function that was not shown in the oral appliance group (36).

Rosen et al. investigated the minimal clinically important difference (MCID) in the Erectile Function domain of the IIEF questionnaire (50). They found that according to baseline status of ED, the MCID was two for patients with mild ED, five for patients with moderate ED and seven for patients with severe ED. The baseline ED scores of the CPAP group and the sildenafil group in the Perimenis et al. (39) study was 7.0 ± 2.1 and 7.9 ± 1.9, respectively, indicating severe ED. Results were similar in the Pastore et al. (38) trial with baseline scores on 7.4 ± 1.4 in the CPAP group and 7.8 ± 1.2 in the sildenafil group. For both studies, baseline scores indicated a baseline level of severe ED. The meta-analysis showed an overall mean difference of 5.25 in favour of 100 mg of sildenafil not corresponding to the required MCID. The Pastore et al. (38) study, however, found a significant increase within the sildenafil group indicating a clinical impact from the medication (Figure 2). Thus, the use of sildenafil is a promising treatment in promoting sexual function when compared with CPAP alone (38,39).

Limitations

Although this review was based on quality assessments at both design and criteria level, it is difficult to make firm generalisations because of several factors. As noted, there were only six studies of women found, none of which were RCTs. For studies of women and men, the types of measures and outcomes assessed, particularly as related to sexual function, were quite variable. Some studies added other variables such as hormonal factors, cytokines and the like, but only in a few studies. In addition, results of this analysis should be interpreted cautiously because of the number of studies rated as weak. Further study with clearly defined and consistent measures among studies is needed to better understand sexual dysfunction in men and women with OSA.

Conclusion

The prevalence of sexual dysfunction such as FSD and ED is substantial, varying from one- to two-thirds, in both women and men with OSA, and showing a worsened partner relationship through an affected desire and sexual satisfaction. In some studies, OSA severity contributed to greater sexual dysfunction. In women, menopausal status, hormone levels and SaO₂ < 90% were determinants of sexual dysfunction, while for men factors included BMI, hormonal status and inflammatory markers. Medications contributed to sexual dysfunction in a few studies. CPAP not only improved clinical measures such as excessive daytime sleepiness, but also overall sexual function and sexual satisfaction, but not sexual desire in men. Nevertheless, sildenafil was superior CPAP with regard to ED. This study gives healthcare personnel further insight into the problems that OSA yields concerning sexual dysfunction. As a result of limited RCTs, and none for women, generalisations must be made with caution. Further RCTs are needed to increase the knowledge on how OSA affects patients’ sexual function.

Author contributions

EES: concept/design, data analysis/interpretation, drafting article, critical revision of article, approval of article, statistics. PPJ: data analysis/interpretation, drafting article, critical revisions of article, approval of article, statistics. BF: data analysis/interpretation, drafting article, critical revisions of article, approval of article. AB: concept/design, data analysis/interpretation, drafting article, critical revision of article, approval of article.

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Paper received June 2015, accepted September 2015

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