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Review article

The relationship between sleep disturbances and endometriosis: A systematic review

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ABSTRACT

Objective: Endometriosis is associated with a range of symptoms that can negatively impact a person's quality of life. While pain and infertility have received at lot of attention, sleep disturbances in individuals with endometriosis has been overlooked in both clinical practice and research. Therefore, the primary aim of this systematic review was to gather evidence from the current literature to illustrate the association between sleep disturbances and endometriosis.

Study design: A literature search was conducted using three electronic databases (OVID EMBASE, MEDLINE, and Web of Science). Observational studies, published in English, that involved participants aged 18 years or older that compared sleep outcomes between endometriosis patients and those without a history of endometriosis were included. The quality of each study was assessed using the Joanna Briggs Institute critical appraisal tools.

Results: Nine studies (six case-control and three cross-sectional) were included in this review; 7 with low risk of bias and 2 with moderate risk of bias. The studies demonstrated heterogeneity in the assessment of sleep disturbances. However, 7 studies reported a significant positive association between endometriosis and sleep disturbances. Moreover, this impact on sleep was further complicated by the complex interaction between pain, fatigue and quality of life.

Conclusion: Current studies suggest an association between sleep disturbances and endometriosis, which may provide a blueprint for future clinical recommendations to screen and treat sleep disturbances in individuals with endometriosis to improve their quality of life. Future studies should aim to standardise the methods of assessing sleep disturbances and explore potential contributing factors.

Introduction

Endometriosis is a chronic inflammatory condition where tissue similar to the lining of the uterus grows outside the uterine cavity [1]. A cohort study in Australia found that approximately one in nine women were diagnosed with endometriosis by age of 44 years, with most diagnoses occurring in their early thirties [2]. Globally, approximately 10 to 15 % of women of reproductive age experience endometriosis [3]. The definitive diagnosis of endometriosis is typically achieved through a laparoscopic surgical procedure, followed by histopathological examination [4]. Based on the laparoscopic findings, endometriosis can be staged based on the extent and severity of the disease [5]. However, the

Abbreviations: BMI, body mass index; EHP-30, Endometriosis Health Profile-30; ESS, Epworth Sleepiness Scale; ISI, Insomnia Severity Index; JBI, Joanna Briggs Institute; NHP, Nottingham Health Profile; PRISMA, Preferred Reporting Items for Systematic Reviews and Meta-Analyses; PSI, Post Sleep Inventory; PSQI, Pittsburgh Sleep Quality Index.

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stage of endometriosis does not correlate with symptom severity [6].

Symptomatic endometriosis can have a significant impact, physically and psychologically, on a person's quality of life, leading to increased stress, fatigue, limited daily life activities, impaired work productivity, and mental health disorders [7,8]. Pain is the key symptom of endometriosis, but due to the heterogeneous nature of the condition, many other nonspecific symptoms are experienced by patients. Other common symptoms include nonspecific bladder disorder [9,10], bowel dysfunction [9,10], spotting and heavy menstrual bleeding [9], vomiting and gastric disorders [9,10], headaches [9,10], anxiety or low mood [9], chronic fatigue [9] and poor sleep [10].

Among the vast array of sleep disturbances, the most common ones include insomnia, obstructive sleep apnea, restless leg syndrome and circadian rhythm disorders. Sleep quality encompasses various measures, including sleep latency, sleep efficiency, sleep disturbances, sleep duration, and use of sleeping medication, among others [11]. The prevalence of insomnia and restless leg syndrome in women is particularly noteworthy; female sex is a risk factor for insomnia and male-to-female ratio for restless leg syndrome is approximately 1:2 [12]. One study found that 47 % of women (n = 838, mean age 43.3 years) reported poor sleep quality of 6 h or less per night [13].

While sleep disturbances and fatigue often coexist, it is essential to note that fatigue is a distinct concept. Individuals who experience inadequate sleep tend to report higher fatigue levels [14]. Disrupted sleep has broader implications beyond fatigue, negatively affecting daytime functioning and mood [14]. Additionally, disrupted sleep has detrimental effects on various aspects of physical health, including chronic pain, risk of type 2 diabetes, hypertension, and other adverse outcomes [11]. It is also associated with negative psychological consequences such as anxiety, depression, aggression, and altered cognitive functioning [11]. The association of sleep conditions with comorbidities such as mood disorders or chronic pain further exacerbates sleep problems [15]. Thus, as sleep disturbance is linked to chronic pain conditions, it is reasonable to conclude that disrupted sleep may significantly negatively influence the quality of life of individuals with endometriosis. Furthermore, fluctuations in female reproductive hormones can influence sleep patterns [16]. The chronic estrogen-dependent nature of endometriosis intensifies hormonal changes, which may play a further role in sleep disruption [16,17].

Sleep disturbances in people with endometriosis have received limited attention in both clinical practice and research. If an association between sleep disturbance and a diagnosis of endometriosis can be demonstrated, this may allow for improved diagnosis and management of sleep disturbances (and other symptoms including fatigue) experienced by people with endometriosis. Therefore, the aim of this review was to systematically search and assess the evidence from the current literature to evaluate the potential association between sleep disturbances and endometriosis. The findings of this review may provide a blueprint for future clinical recommendations to screen for sleep disturbances in patients with endometriosis.

Methods

This systematic review was conducted following the guidelines provided by the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) [18]. A comprehensive electronic literature search was conducted using three databases, MEDLINE (1946 - present), OVID EMBASE (1972 - present), and Web of Science (1900 - present). The electronic database searches were conducted on 28 February 2023. The detailed search strategy is presented in Supplementary Table 1.

Peer-reviewed studies were eligible to be included in this systematic review (Table 1 and Table 2) if they met the following criteria: participants were aged ≥ 18 years, participants in the case group had been diagnosed with endometriosis, participants in the comparison group had no history of endometriosis, observational studies and the studies reported any sleep disturbance as one of the outcomes of interests. Studies were excluded if they were not done in humans, participants were < 18 years, articles were published in languages other than English, articles without full-text versions available, reviews, opinion pieces, abstracts, conference papers, or book chapters and interventional studies.

The results of the database searches were imported into Endnote X9, where duplicates were removed. Covidence systematic review software (Veritas Health Innovation, Melbourne, Australia) was employed to screen titles and abstracts for relevant articles before full-text screening was conducted. The data extracted from the observational studies included study design, year conducted, sample size, basic participant demographics, characteristics of endometriosis, sleep disturbance assessment tools and outcomes, and outcome of interests for other relevant findings (quality of life, fatigue, pain). Extracted data from the selected studies was summarized in a single summary table.

Risk of bias assessments were conducted using the Joanna Briggs Institute (JBI) Critical Appraisal Tool. Further details of the tools can be found in Supplementary Table 2 and 3. The JBI checklist assesses particular study domains to determine the potential risk of bias, answered with 'yes', 'no', or 'unclear'. The risk of bias for each individual study was determined with the following cut-offs: 1) low risk, if studies reached 70 % or more 'yes' score; 2) moderate risk, if studies reached 50 % to 69 % 'yes' score and 3) high risk, if studies reached 49 % or less of 'yes' scores. Thus, the higher the 'yes' scores, the lower the risk of bias [19]. Studies were arranged based on the highest JBI quality to the lowest quality in Table 1.

C.D.S performed the literature search, screen, data synthesis and risk of bias assessment, and a second author (S.J.H-C) resolved any indecisions.

Results

Study Characteristics

An initial literature search yielded a total of 435 potentially relevant articles (EMBASE database yielded 243 articles, MEDLINE database yielded 73 articles, Web of Science yielded 119 articles). After removing duplicate articles, 320 articles were screened based on the titles and abstracts, resulting in 23 potentially eligible articles. Screening of the full texts resulted in the inclusion of 9 articles in this systematic review (Fig. 1).

The characteristics of the 9 articles included in this review are summarised in Table 1. All studies were published within the last eight years (2015–2023). Of all the observational studies included, 6 were case-control studies [20–25], and 3 were cross-sectional [26–28]. The studies were conducted in various European countries, Australia, Brazil, Iran, and the United States. Seven studies compared 'cases' diagnosed with endometriosis to 'controls' or those without any history of endometriosis or endometriosis-related symptoms [20–22,24–27]. However, control groups in 2 studies exhibited endometriosis-related symptoms in the absence of an endometriosis diagnosis [23,28]. In the study by Youseflu et al., both cases and controls were infertile [23], while in the study by Ortiz et al., both cases and controls experienced chronic pelvic pain [28].

Risk of Bias Assessment

Quality assessment of the 9 articles using the JBI Tool is summarised in Table 2. Seven articles were considered to have a low risk of bias [20–23,26–28], while 2 articles had a moderate risk of bias [24,25]. None of the studies had a high risk of bias. One of the details that affected risk of bias included the observation that none of the studies used the same diagnostic tools for cases and controls. In particular, the study by Ramin-Wright et al., measured outcomes using an unvalidated researcher-designed instrument, which may introduce additional measurement bias [26]. Of the 3 cross-sectional studies, 2 low-risk studies did not identify and control for any potential confounding factors

Table 1
Data Extraction Table.

Study	Design	Sample size case: control	Sample demographic		Characteristics of endometriosis		Outcomes measurement tools			Primary findings	Secondary findings		
			Location	Mean age (years) case: control	Diagnostic methods	Pelvic pain	Sleep disturbances	Fatigue	Quality of life (QOL)	Sleep disturbances	Fatigue	QOL	Associations between sleep and pain, fatigue, QOL
Ramin-Wright (2018)	Cross-sectional	560: 560	Western Europe	37.9: 37.6	Histopathological and surgical	Chronic pelvic pain (CPP)	Researcher designed questionnaire	Researcher designed questionnaire	N/A	Endometriosis was associated with more frequent insomnia ($p < 0.001$)	Endometriosis was associated with more frequent fatigue ($p < 0.001$)	N/A	Within both groups, frequent fatigue was associated with frequent insomnia ($p < 0.001$) and pelvic pain ($p < 0.001$).
Leone Roberti Maggiore (2017)	Case-control	145: 145	Italy	32.9: 32.1	Histopathological and surgical	Dysmenorrhea, CPP, dyspareunia, dyschezia	Pittsburgh Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Insomnia Severity Index (ISI)	N/A	Endometriosis Health Profile (EHP-30)	Endometriosis was associated with poorer sleep quality ($p < 0.001$), higher excessive daytime sleepiness ($p = 0.033$), subthreshold insomnia and moderate clinical insomnia ($p = 0.002$)	N/A	N/A	Within cases, poorer sleep quality was associated with higher dysmenorrhea intensity ($p < 0.001$), chronic pelvic pain intensity ($p < 0.001$) and some aspects of QOL such as lower self-image ($p = 0.012$) and emotional well- being ($p = 0.002$)
Alvarez-Salvago (2020)	Case-control	25: 25	Spain	36.2: 34.5	Clinical and surgical	CPP	PSQI	Piper Fatigue Scale (PFS)	Health- Related Quality of Life (HRQOL)	Endometriosis was associated with poorer sleep quality ($p = 0.017$)	Endometriosis was associated with higher fatigue ($p < 0.001$)	Endometriosis was associated with lower physical health ($p < 0.001$)	N/A
Facchin (2021)	Case-control	123: 123	Italy	34.1: 34.0	Clinical and surgical	Dysmenorrhea, CPP, dyspareunia, dyschezia, intermenstrual pain	PSQI, ESS, ISI	Researcher-designed questionnaire	Short-Form-12 (SF-12)	Endometriosis was associated with poorer sleep quality ($p = 0.004$) and higher daytime sleepiness ($p = 0.013$).	Endometriosis was associated with more frequent fatigue ($p = 0.003$)	N/A	Within both groups, CPP and dyschezia intensity was associated with higher daytime sleepiness ($p = 0.005$), insomnia severity ($p < 0.001$), poorer sleep quality ($p < 0.001$) and higher fatigue ($p = 0.006$). Within cases, poorer sleep quality was associated with higher fatigue ($p < 0.001$) and lower

(*continued on next page*)

Table 1 (*continued*)

Study	Design	Sample size case: control	Sample demographic		Characteristics of endometriosis		Outcomes measurement tools			Primary findings	Secondary findings		
			Location	Mean age (years) case: control	Diagnostic methods	Pelvic pain	Sleep disturbances	Fatigue	Quality of life (QOL)	Sleep disturbances	Fatigue	QOL	Associations between sleep and pain, fatigue, QOL
													physical ($p < 0.001$) and mental ($p < 0.001$) aspects of QoL.
Youseflu (2020)	Case-control	78: 77 (endometriosis with infertility: control with infertility)	Iran	31.0: 29.4	Histopathological and surgical	Dysmenorrhea, CPP, dyspareunia	PSQI	N/A	N/A	Endometriosis was associated with poorer sleep quality ($p < 0.001$)	N/A	N/A	Within cases, poorer sleep quality was associated with the presence of chronic pelvic pain ($p = 0.020$), dysmenorrhea ($p = 0.030$) and dyspareunia ($p = 0.040$)
Chmaj-Wierzchowska (2020)	Cross-sectional	23: 36	Poland	29.8: 28.3	Histopathological and surgical	N/A	Nottingham Health Profile (NHP)	N/A	Nottingham Health Profile (NHP)	No association between endometriosis and sleep disturbances ($p = 0.941$)	N/A	Endometriosis s was associated with lower physical fitness ($p < 0.001$) and higher inconvenience in daily life ($p < 0.001$)	N/A
Ortiz (2020)	Cross-sectional	22: 12 (endometriosis with CPP: control with CPP)	USA	31.4: 36.7	Surgical	Dysmenorrhea, CPP, dyspareunia	EHP-30	N/A	EHP-30	No association between endometriosis and sleep disturbances ($p = 1.000$)	N/A	No association between endometriosis and any aspect of QoL	N/A
Davie (2020)	Case-control	30: 30	Australia	30.4: 39.5	Histopathological	Dysmenorrhea, dyspareunia, dyschezia, intermenstrual pain	PSQI	N/A	WHO Quality of Life-BREF (WHOQOL-BREF)	Endometriosis was associated with poorer sleep quality ($p = 0.015$)	N/A	Endometriosis was associated with lower physical ($p < 0.001$) and physical health ($p = 0.018$)	Within cases, poorer sleep quality was associated with higher intensity of overall pelvic pain in the last 4 weeks ($p = 0.050$)
Nunes, 2015	Case-control	257: 235	Brazil	34.4: 33.3	Histopathological	N/A	Post-Sleep Inventory (PSI)	N/A	N/A	Endometriosis was associated with poorer sleep quality ($p = 0.011$)	N/A	N/A	N/A

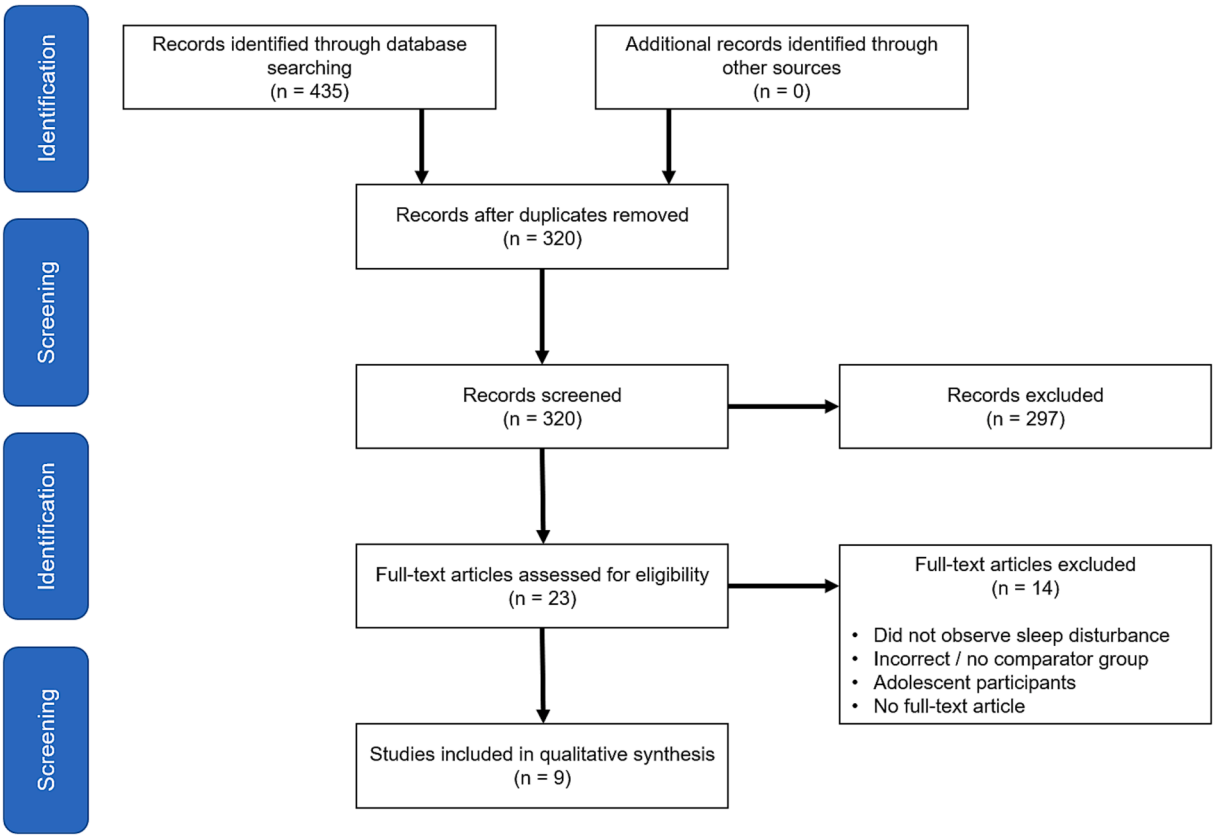

Fig. 1. PRISMA Flowchart of the Study Selection Process.

Table 2
Risk of Bias Assessment.

	JBI Critical Appraisal for Case-Control Studies										
Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Yes (%)	Risk
Leone Roberti Maggiore, 2017	Y	Y	Y	Y	N	Y	Y	Y	U	Y	80 %	Low
Alvarez-Salvago, 2020	Y	Y	Y	Y	N	Y	Y	Y	U	Y	80 %	Low
Davie, 2020	Y	N	Y	Y	N	Y	N	Y	U	U	50 %	Moderate
Facchin, 2021	Y	Y	Y	Y	N	Y	Y	Y	U	Y	80 %	Low
Nunes, 2015	Y	N	Y	Y	N	N	N	Y	U	Y	50 %	Moderate
Youseflu, 2020	Y	Y	Y	Y	N	Y	Y	Y	U	Y	80 %	Low
	JBI Critical Appraisal for Cross-Sectional Studies										
Study	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Yes (%)	Risk		
Ramin-Wright, 2018	Y	Y	Y	Y	Y	Y	N	Y	87.5 %	Low		
Chmaj-Wierzchowska, 2020	Y	Y	Y	Y	N	N	Y	Y	75 %	Low		
Ortiz, 2020	Y	Y	Y	Y	N	N	Y	Y	75 %	Low		

JBI = Joanna Briggs Institute; Q = question; Y = yes; N = no; U = unclear.
Ranking the risk of bias; High = ≤ 49 % of "yes" scores, moderate = 50 to 69 % of "yes" scores, and low = ≥ 70 % of "yes" scores.

[27,28]. Two of the 6 case-control studies, that were assessed as moderate risk, did not state any statistical analysis strategy to deal with potential confounding factors [24,25]. Furthermore, both studies did not have matched cases and controls [24,25], unlike other studies that were either age-matched, body mass index (BMI)-matched, and/or height-matched. Finally, the study period in all case-control studies was not clearly stated; therefore, it is difficult to determine whether it was long enough to be meaningful.

Primary Findings - Evidence for an Association between Endometriosis and Sleep Disturbances

Various questionnaires and tools were used to assess different sleep outcomes across the 9 studies. Eight studies used standardized and well-validated self-reported questionnaires [20–25,27,28], and 1 study used a researcher-designed questionnaire [26]. The 19-item Pittsburgh Sleep Quality Index (PSQI) was the most commonly used tool [20–24]. The 8-item Epworth Sleepiness Scale (ESS) and 7-item Insomnia Severity Index (ISI) were used in 2 studies [20,22]. The 16-item Post Sleep Inventory (PSI) was only used in 1 study [25]. While the previous studies used questionnaires designed for assessing sleep disturbances, the Nottingham Health Profile (NHP) [27] and the Endometriosis Health Profile-30 (EHP-30) questionnaires [28] were also used. The NHP and EHP-30 are both intended to measure health-related quality of life outcomes, but also include 5 questions and one question relating to sleep, respectively.

The primary findings suggest that sleep disturbances are significantly more common in individuals with endometriosis compared to those without endometriosis. Out of 9 studies, 7 reported a significant positive

association between endometriosis and sleep disturbances, specifically, poor sleep quality, daytime sleepiness and insomnia [20–26]. Poor sleep quality was reported to be associated with endometriosis in 6 studies [20–25], higher daytime sleepiness in 2 studies [20,22], subthreshold insomnia and clinical insomnia in 1 study [20], and higher insomnia frequency in 1 study [26]. In contrast, 1 study which compared cases with control groups that also exhibited endometriosis-related symptoms (chronic pelvic pain), showed no association between endometriosis and sleep disturbances [28]. Furthermore, one study with an unmatched sample size also showed no association [27].

Secondary findings - associations with fatigue, quality of life and pain

Three studies specifically reported an association between endometriosis and experience of fatigue [21,22,26]. Three studies also reported an association between endometriosis and lower quality of life, in the areas of physical health, psychological health, and daily life inconvenience [21,24,27]. Adding further complexity, in association with endometriosis, sleep disturbances were positively associated with the presence and intensity of pelvic pain (especially with dysmenorrhea and CPP) [20,23,24]; lower quality of life, impacting both physical and psychological aspects [20,22]; and fatigue [22].

In both cases and controls, one study determined that sleep disturbance was associated with pelvic pain, [22], and another study reported that fatigue was significantly linked to both insomnia and pelvic pain [26]. The various questionnaires used for these additional outcomes can be seen in Table 1.

Discussion

The findings from this systematic review provide strong evidence that individuals with symptomatic endometriosis experience higher levels of sleep disturbances compared to those without endometriosis. This association was further complicated by the complex interactions between pain, fatigue, and reduced quality of life.

The findings regarding the association between sleep disturbances and endometriosis add weight to a previous study, which revealed a significant association between night shift work, changes in sleep patterns during days off and the risk of endometriosis [29].

A pilot study exclusively done in endometriosis patients (and therefore not captured in this systematic review) attempted an objective measurement using radio-wave sensing technology to monitor sleep [30]. In contrast, all the studies included in this review relied on self-reported questionnaires to assess sleep. The findings of the pilot study indicated that an increase in latency in deep sleep onset was associated with poor sleep quality and heightened pain sensitivity in endometriosis patients [30]. It is important to note that the pilot study had a small sample size of only 3 patients [30], and no similar studies have been conducted thus far. Despite these interesting findings, self-report questionnaires remain the most commonly used tool for assessing sleep.

In the study by Facchin et al., when the effects of hormonal therapy were controlled for, the previously observed significant differences in sleep disturbances between endometriosis cases and controls lost their significance [22]. This indicates that hormonal treatment may have played a role in the observed variations in sleep, without providing a clear indication of whether the hormonal treatment itself is beneficial or causative for sleep disturbances. A prior review focusing on women in their reproductive years found no significant associations between hormonal contraceptives and notable alterations in sleep patterns [31]. However, the relationship between sleep and hormonal treatment in patients with endometriosis remains unexplored in the current literature.

Additionally, in a study included in this review by Maggiore et al., [20] older age and lower BMI remained predictors of poor sleep quality in association with endometriosis, even after multivariate analysis. Similarly, Davie et al., showed that age was significantly different between the endometriosis and controls; however, the impact of age on sleep disturbances was not controlled for [24]. Although there is lacking evidence specifically linking older age and low BMI to sleep disturbances in endometriosis, a study conducted on patients with various chronic pain conditions revealed that older age and abnormal BMI (underweight or overweight) were risk factors associated with longer pain duration [32]. Therefore, it is important to recognize that longer pain duration itself may contribute to sleep disturbances, and future endometriosis research should include this measure of time.

Similar associations have been observed between sleep disturbances and other chronic conditions, such as those experienced by cancer survivors [33] and conditions related to chronic pelvic pain like fibromyalgia [34], among others. Four studies in this review revealed a significant association between sleep disturbances and the intensity of pelvic pain or type of pelvic pain, including chronic pelvic pain, dysmenorrhea, dyspareunia, or dyschezia [20,22–24]. These findings support a previous study, which reported a positive association between insomnia, pain intensity, pain duration, and low education level in endometriosis patients [35]. Collectively, these studies suggest a bidirectional relationship that aligns with previous chronic pain theories [36,37]. For example, pain can interfere with falling asleep or disrupt sleep, while sleep disturbances can contribute to hyperalgesic changes (such as heightened sensitivity to pain and reduced pain threshold), causing patients to experience pain more intensely than they would if they were well-rested [36,37]. Reduced pain threshold at certain body sites, specifically at the greater trochanter and abdomen, in patients with endometriosis compared to those without endometriosis was demonstrated in the study by Nunes et al. [25]. Notably, melatonin has been shown to reduce endometriosis-related pain and improve sleep quality, offering a potential novel pharmacological management for both pain and sleep issues in endometriosis patients [38].

All of this evidence collectively suggests that chronic pelvic pain or chronic pain could potentially act as a mediating factor in the relationship between endometriosis and sleep disturbances. This suggestion can help explain the lack of a significant association between endometriosis and sleep disturbances in the study by Ortiz et al., where both cases and controls had chronic pelvic pain and sleep disturbances were observed in both groups [28].

Beyond pain, examining the symptom of fatigue is also crucial. Two studies in this review reported a significant association between sleep disturbances and fatigue [22,26]. Similar connections have been observed in other chronic pain conditions, such as multiple sclerosis and rheumatic diseases [39,40]. Furthermore, the same two studies also showed that both sleep disturbances and fatigue are associated with chronic pelvic pain [22,26]. Notably, previous research on cancer patients revealed that chronic pain affects fatigue directly, independent of sleep disturbances, and indirectly through the mediation of sleep disruptions [41].

Furthermore, the relationship between infertility and sleep disturbances deserved consideration. A study included in this review by Chmaj-Wierzchowska et al., demonstrated a notable difference in sleep disturbances between endometriosis patients and controls, both with infertility [27]. This suggests a potential association between sleep and endometriosis-associated infertility rather than infertility itself. Perhaps the layering of multiple comorbid conditions contributes to worsened sleep quality. There is currently limited literature available that significantly contributes to our understanding of the association between sleep disturbances, infertility and endometriosis-associated infertility.

Our findings regarding the association between low quality of life scores and both endometriosis and sleep disturbances are unsurprising, and are supported by the existing literature [7,8,11,14]. By confirming these associations, these findings provide additional support for the need to address both the physical and psychological impact of endometriosis and sleep disturbances on affected individuals. Recognising these established relationships is a crucial step in delivering interventions and strategies targeting improvement to quality of life and

better sleep for individuals with endometriosis.

Despite the limited number of publications, we were able to merge the findings and provide evidence supporting a relationship between endometriosis and sleep disturbance. Promisingly, the majority of studies were deemed high quality. The inclusion of studies from different countries enhances the diversity and representativeness of the study populations. However, restricting our search to English language publications may have resulted in the exclusion of studies based on language barriers. We observed heterogeneity in the assessment of sleep disturbances in the studies. While the primary objective of this review was to examine the relationship between sleep disturbances and endometriosis, there is variation in the specific sleep outcomes that were evaluated. Some studies solely focused on insomnia, while others measured daytime sleepiness or poor sleep quality.

Conclusion

This review supports an association between sleep disturbances and endometriosis, further complicated by a complex interaction between pain, fatigue, quality of life and sleep disturbances. Although the outcomes were generally similar across the studies, there was notable heterogeneity in the assessment of sleep disturbances, making it challenging to determine a single sleep disturbance most commonly associated with endometriosis. Further research in this area would be valuable, with interventional clinical trials and screening programs providing the first steps toward evidence-based care regimes for endometriosis patients who suffer from sleep problems. To address the existing research gaps, future studies should focus on standardizing the methods used to assess sleep disturbances in endometriosis patients, and include the collection of objective data (for example, polysomnography) in addition to subjective questionnaire data. Future studies should also include control groups with similar symptomatology (such as chronic pain or pelvic pain) not caused by endometriosis to help distinguish unique aspects and contributions of endometriosis to sleep disturbances. Additionally, future research should explore potential contributing factors, such as hormonal fluctuations, age, BMI, and other relevant factors. By adopting these approaches, our understanding of the relationship between sleep disturbances and endometriosis may be advanced, offering potential guidance towards the development of screening tests and targeted interventions for affected individuals.

Author contributorship

Authors C.D.S, K.T, J.L, M.M and S.J.H-C conceived and developed the protocol. C.D.S performed the literature search, screen and synthesised the data, S.J.H-C resolved indecisions. Authors C.D.S, S.M, and S.J.H-C interpreted results. C.D.S drafted the manuscript and K.T, S.M, J. L, M.M and S.J.H-C provided feedback, edited and approved the final version of the manuscript.

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Chyntia Diva Sumbodo: . **Kate Tyson:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Writing – original draft, Writing – review & editing. **Samantha Mooney:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Resources, Supervision, Writing – original draft, Writing – review & editing. **Julie Lamont:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Marcus McMahon:** Conceptualization, Data curation, Formal analysis, Investigation, Methodology, Supervision, Writing – original draft, Writing – review & editing. **Sarah J. Holdsworth-Carson:** .

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.ejogrb.2023.12.010.

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