BMC Musculoskeletal Disorders

SYSTEMATIC REVIEW

Open Access

The implications of surgery on sexual dysfunction in patients with lumbar disc herniation with cauda equina syndrome: a systematic review

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Abstract

Background Despite extensive literature on lumbar disc herniation and cauda equina syndrome, sexual dysfunction in these patients has been overlooked. We conducted a systematic review to gather scientific evidence on this issue following surgical treatment in this population.

Methods On January 30, 2025, several databases, including PubMed, Web of Science, Scopus, and Google Scholar, were searched on the topic for English-language biomedical literature from 2014 to 2024. Two researchers assessed the quality of the articles using the Mixed Methods Appraisal Tool version 2018. The findings were narratively synthesized to effectively describe, compare, and combine the study results.

Results A total of 5,893 studies were identified, but after removing duplicates and irrelevant documents, only 20 studies were eligible for analysis. Of these, 90% were rated as high quality, indicating a strong level of certainty in the evidence. The analysis revealed that the prevalence of sexual dysfunction in this population ranged from 26.6% to 100%. The most common sexual disorder among women was sexual desire and arousal disorder (35% to 60%), while erectile dysfunction was the most prevalent among men (14% to 100%). Overall, dissatisfaction with sexual activities was reported by 37% to 69% of women and 69% of men. Improvements in sexual function following surgery for lumbar disc herniation were noted in 83.33% of studies (5 out of 6), compared to only 7.14% in patients with cauda equina syndrome (1 out of 14 studies).

Conclusion Studies indicated a considerable enhancement in sexual function post-surgery for lumbar disc herniation patients (68% to 99%). However, long-term follow-up of cauda equina syndrome patients revealed that many continued to experience sexual issues (14% to 100%).

Keywords Intervertebral Disc Herniation, Lumbar vertebrae, Cauda Equina Syndrome, Sexual activity, Discectomy, Systematic Review

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Introduction

Lumbar disc herniation (LDH) occurs when the soft, gel-like center of a disc pushes through a weakened spot in the disc's outer layer, causing nerve compression and pain [1]. Lumbar disc herniation (LDH) is a common condition with varying incidence rates depending on case definition. Annual incidence estimates range from 0.3 to 2.7 per 1,000 persons for surgical cases and 0.1 to 298.3 per 1,000 for clinical cases [2]. For patients undergoing percutaneous endoscopic lumbar discectomy (PELD), the prevalence of recurrent herniation is 3.6%, with most recurrences occurring within 6 months postoperatively [3].

Cauda Equina Syndrome (CES) is a rare but serious neurological condition that occurs when the bundle of nerves known as the cauda equina (L2-L5, S1-S5) at the base of the spinal cord is compressed. The cauda equina consists of multiple nerve roots responsible for controlling bowel and bladder function, as well as sensation in the buttocks and lower limbs [4]. The link between LDH and CES lies in the anatomical proximity of the lumbar discs to the cauda equina. LDH involves the soft, gel-like center of a spinal disc pushing through a weakened area in the outer layer of the disc. When this occurs in the lumbar region (lower back), it can lead to compression of the nerve roots, including those that make up the cauda equine [5, 6]. Cauda equina syndrome (CES) is a rare but serious condition with varying reported incidence rates. A systematic review found CES incidence to be 0.3–0.5 per 100,000 per year in asymptomatic community populations [7]. However, a more recent population-based study in Scotland reported a higher incidence of 2.7 per 100,000 per year, with higher rates in females and those aged 30–49 [8].

The nervous system involved in sexual function includes the central nervous system (CNS), peripheral nervous system (PNS) and spinal cord [9]. In the CNS, the hypothalamus regulates libido, lubrication and erection, also coordinates autonomic functions during sexual behavior. The amygdala processes sexual sensory stimuli and thus affects libido. The frontal cortex is responsible for making decisions and controlling sexual impulses. The thalamus transmits sexual impulses from the spinal cord to higher brain regions and helps process, sexual preferences. The cerebellum manages the motor responses necessary for sexual activity [10]. In the peripheral nervous system, the pudendal nerve transmits sensory and motor responses to the genitals. The pudendal nerve innervates the penis/clitoris and perineum, That It is important for erectile function [11]. The spinal cord, through the sacral (S2-S4) and tracholumbar (T11-L2) nerves, regulates sexual function. Through parasympathetic control, the sacral nerves increase erection and lubrication by releasing nitric oxide, which relaxes the smooth muscles of erectile tissues. Tracholumbar nerves regulate ejaculation and orgasm through sympathetic fibers and coordinate glandular secretions during arousal [12].

So In cases where a herniated lumbar disc compresses the cauda equina, it can result in symptoms associated with CES. These symptoms may include severe lower back pain, leg weakness, numbness or tingling in the buttocks or lower extremities, bowel and bladder dysfunction (such as incontinence or difficulty controlling bowel movements), and sexual dysfunction [13].

Both LDH and CES may contribute to sexual dysfunction in both men and women, through a combination of physical and neurological factors. Additionally, the psychological impact of dealing with chronic pain, mobility issues, and the challenges associated with these conditions, can further influence sexual well-being [14]. Despite 64% of neurosurgeons acknowledging their responsibility for addressing sexual health, 73% admit rarely inquiring about it [15]. Surgery on LDH and CES patients can affect sexual function, but the long-term impact is not well understood. Most studies on surgery's impact on sexual function focus on cauda equina syndrome, with few examining lumbar disc herniation. Additionally, sexual function is assessed post-surgery, but there is limited information on preoperation-related symptoms. Most studies do not specify the types of sexual dysfunction and only use a general question to assess its presence. Furthermore, postoperative follow-up varies across studies, prompting our decision to a systematic review to provide scientific evidence on the topic after surgical treatment among these populations.

Systematic review questions

We used the Population, Intervention, Comparison, and Outcome framework (Table 1) to define the research questions:

1. What alterations in sexual dysfunction occur post-surgery in individuals with LDH or CES?

Table 1 PICO tool

Population	Patients with Lumbar Disc Herniation or Cauda Equina Syndrome due to Lumbar Disc Herniation
Intervention	Surgery
Comparators	Study not have a comparison group
Outcome	Sexual dysfunction

2. Is there a difference in sexual dysfunction between people with LDH with or without CES?
3. Is there a difference in sexual dysfunction presentations between males and females with LDH with and without CES?

Methods

Design

The systematic review was conducted on quantitative studies of the implications of surgery on sexual dysfunction in patients with lumbar disc herniation or cauda equina syndrome, covering the literature for the last ten years from 2014 to 2024. The Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA) statement was followed for reporting [16]. The protocol was registered on the Prospero (CRD42022381571). In 2013, the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders (DSM-5) updated the criteria for female sexual dysfunction, prompting us to begin our search in 2014.

Search strategy

A literature search was carried out on January 30, 2025, in the following electronic databases: Pubmed, Web of Science, Scopus, and Google scholar. Search strings were written and developed for all electronic databases separately (Supplement file1). Additionally, a manual search was conducted on the bibliography of included studies to find more potentially eligible articles.

Inclusion criteria

All original articles (quantitative studies) in English in human patient diagnosed with LDH or CES due to lumbar disc herniation and undergoing surgery. Patient should be adults, in reproductive age, should include clinical outcome measures, patients followed for at least two months after surgery.

Exclusion criteria

Overviews, meta-analyses, systematic reviews and non-peer systematic review articles. Studies in languages other than English, CES due to other causes such as tumor/metastasis, trauma, postoperative CES, etc. Surgery for spinal stenosis, animal studies, case reports, case series with less than five patients, studies with less than two months of follow-up and low-quality studies.

Study selection

According to the inclusion and exclusion criteria, one author (ZM) first individually systematic reviewed the titles and abstracts of the studies found in the complete searches. The author uses the standard method of selecting studies by using a screening tool. Two other systematic reviewers (SS, FA) made separate assessments of the retrieved studies, and in case of disagreement, the last author (AM) reached a consensus. The studies were categorized, and then the authors received the full text of the studies and finalized the classification using double independent screening.

Data extraction

In order to ensure consistency and transparency, the data extraction process was facilitated by a standardized evidence table where data on the study's authors, setting, aim, study design, methods, population characteristics and key findings were extracted. This was done by two systematic reviewers (ZM and SS) and when a discrepancy arose, the other two systematic reviewers (FA and AM) were invited to resolve the issue before the extraction process proceeded. This use of multiple reviewers was to 'verify' data extraction from the initial two reviewers. This collaborative approach leaded to more reliable assessments [17].

Quality assessment

To evaluate the quality of the studies, we used the Mixed Methods Appraisal Tool (MMAT) version 2018 and its associated scoring system [16]. Briefly, studies were scored according to the five criteria outlined in the guideline. In this tool, studies are rated as low quality if they meet only 2 criteria and were excluded from the review. The rest of the studies were rated moderate if they had 3 criteria, and high if they had 4 or 5 criteria. These studies were included in the review. Additionally, the MMAT identifies 5 levels of evidence as follows: level I (qualitative studies), level II (randomized trials), level III (non-randomized trial), level IV (descriptive studies), level V (mix methods) [16]. ZM performed the critical appraisal for each included paper and this was verified by SS for validation purposes.

Analysis

The results were narratively synthesized as the best procedure for describing, comparing, and combining study findings. In this study, data were reported using tables. The study design, number of participants, mean age, follow-up period and outcome measures of sexual function at final follow-up were extracted and entered into spreadsheets. Since the studies included in this systematic review were diverse in design, interventions, and outcome measures, there was clear study heterogeneity and therefore a meta-analysis was not appropriate. We consulted the BIBLIO guideline for data analysis and reporting the results section [18].

Results

Search results

The PRISMA flow diagram shows that the preliminary search results. Finally, 20 quantitative articles met the inclusion criteria and were retained for analysis (Fig. 1).

Critical appraisal

Most of the evidence were Level III ($n = 18$; 90%) and after that level V ($n = 2$; 10%).

Study characteristics

There were 16 Cohort study [15, 19–33], one case–control study [34, 35], and two mixed method research studies [4, 36]. The year of release varied from 2014 to 2024. A total of 20 studies with 3989 patients were included in this systematic review. This included 1870 males (46.87%) and 2119 females (53.13%). Eleven studies were conducted in Asian countries, seven studies were conducted in European countries, one in African country and one study in USA. (Tables 2 and 3).

Instruments/measures

Validated scales used consisted of: the Female Sexual Function Index (FSFI) [22, 26, 27, 34, 35], the Arizona Sexual Experience Scale (ASEX) [4, 24, 25, 33], the Impairment Index of Erectile Function (IIEF) [20, 22, 23, 26, 27, 34], the Oswestry Disability Inventory (ODI) [28], the Golombok-Rust Inventory of Sexual Satisfaction

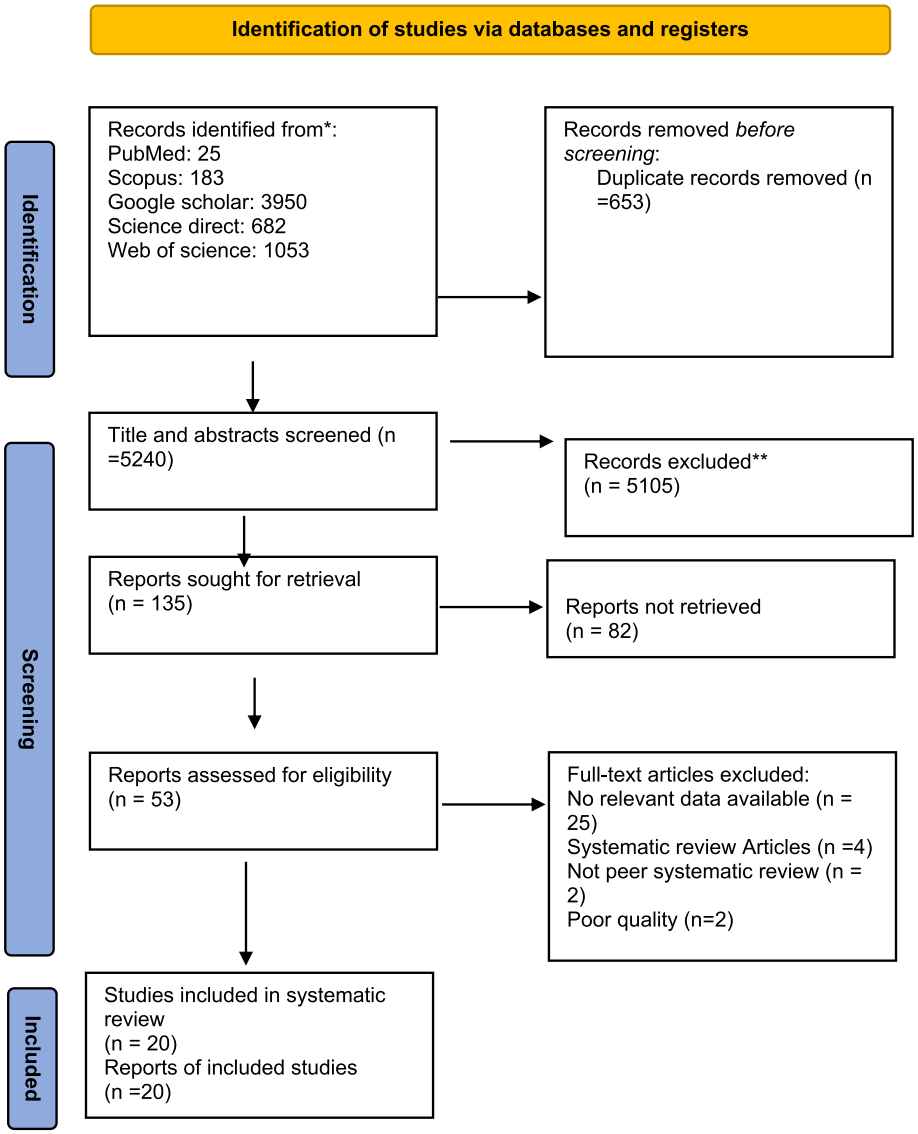

Fig. 1 PRISMA 2020 flow diagram

Table 2 Details of studies reported sexual function in patients with LDH after surgery

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/measures	Findings	Level of evidence	Quality assessment
Elsharkawy 2018 [15] Germany	Evaluation of the long-term outcome of sexual function after surgical treatment of single-level LDH	*n* = 114 Male = 51 Female = 63 Mean age = 46.9 year (20–70) Follow-up = 4.1 years (1–6 y)	Retrospective cohort	Questionnaire abstracted from validated sexual index	Compared with their status before LDH and spine surgery, 69.3% rated their current overall quantitative and qualitative sexual function as the same, 16.7% as better, and 14% as worse. The same ability to have an orgasm as before LDH was reported by 76.3%, 12.3% experienced better orgasm, and 11.4% experienced worse. Women reported more sexual problems such as decreased sexual desire and interest. The majority of patients (82%) reported full satisfaction with the overall outcome of the surgery including sexual function. The majority of patients returned to their previous sexual activities during the long-term follow-up after surgery for LDH	III	high
Nakajima 2021 [28] Japan	Assessment of 1. The ODI and reveal characteristics of the ODI-8 non-responders compared with the full-responders 2. Risk factors associated with deterioration of sexual function, as measured by the ODI-8 score	*n* = 2,610 Male = 1169 Female = 1441 Mean age = 64.1 follow-up = 1 year	Prospective cohort	ODI-8	All of the postoperative scores of pain and dysesthesia for both groups (FR and NR) showed significant improvement compared with the preoperative scores Elderly patients or females tended not to answer the ODI-8. 81% of patients recovered after surgery	III	high
Sahin 2022 [19] Turkey	Compared the preoperative and postoperative sexual dysfunction in male patients diagnosed with LDH	*n* = 32 male Age = 44.93 ± 8.98 (30–60) Follow up = 15 months	Prospective cohort	GRISS	Before LDH surgery, male patients had problems with sub-dimensions of sexual function, such as frequency, communication, avoidance, touching, impotence, and premature ejaculation. A significant improvement was achieved after the operation		

Table 2 (continued)

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/measures	Findings	Level of evidence	Quality assessment
					in the communication sub-dimension and pain levels. The decrease in the GRISS total score after the operation was not significant (p= 0.365)	III	high
Panneerselvam 2022 [21] India	Determined of: 1.The effects of LDH on male sexual activity 2.Whether surgical intervention improved any related sexual dysfunction	n = 22 male Mean age = 40.8 ± 6.8	Prospective observational study	BSFI	The mean preoperative BSFI score was 27.8 ± 11.2. At 8 weeks after surgery, the mean BSFI score significantly improved to 33.23 (p = 0.002). Sexual drive was normal in 77.7% of patients, and erection and ejaculation were normal in 77.7% and 91.0%, respectively. Overall, 59.1% had resumed sexual intercourse within 6 weeks of surgery	III	high
Günerhan 2024 [34] Turkey	Evaluation of the effect of lower LDHs on libido and sexual dysfunctions	n = 122 Male = 41 case and 20 control Female = 20 case and 41 control Mean age = 44.6 ± 8.8(28–65 years) Follow-up = 3 months	case–control study	FSFI IIEF	According to the FSFI scores, all 20 female patients had preoperative sexual dysfunction, which improved in 15 (75%) patients after surgery (p < 0.001). According to the IIEF-5 score for men, 38 of 41 male patients had preoperative sexual dysfunction, which improved in 26 (68.4%) patients postoperatively (p < 0.001). FSFI = 23.6 ± 5.9 IIEF-5 = 21.4 ± 3.6	III	high
GamalEl Din 2024 [35] Egypt	Evaluation of the effect of cervical disc herniation (CDH) and lumbar disc herniation (LDH) on female sexual functioning before and after surgical intervention	n = 150 Female = 150 (50 female with LDH, 50 female with CDH and 50 healthy females)	case–control study	FSFI	The baseline FSFI domains and total scores were greatest in the controls, followed by the CDH group. The FSFI domains and total scores were greatest in the control group, followed by the postoperative FSFI domains and total scores in the cervical group. The variations in satisfaction,	III	high

Table 2 (continued)

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/measures	Findings	Level of evidence	Quality assessment
					pain, and overall FSFI ratings were significant across research groups. The difference in desire, arousal, lubrication, and orgasm was substantial in the lumbosacral group, but there were no significant changes between the cervical and control groups. Postoperatively, FSFI domains and overall scores improved in both of the cervical and lumbar groups. Both research groups' ODI score and grade improved after surgery. Finally, both groups' BDI score and grade improved after surgery Female sexual dysfunctions caused by CDH and LDH improved considerably after surgery		

IIEF Impairment Index of Erectile Function, *ODI* The Oswestry Disability Inventory, *LDH* Lumbar Disc Herniation, Female Sexual Function Index, *RR* recovery rate, *GRISS* Golombok-Rust Inventory of Sexual Satisfaction, *ASEX* Arizona Sexual Experiences, *SHIM* Sexual Health Inventory in Males, *mPISQ-12* Modified Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire, *BSFI* Brief Sexual Function Inventory, *FR* full-responders group, *NR* Non-responders

Table 3 Details of studies reported sexual function in patients with (CES) secondary to lumbar disc herniation after surgery

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/ measures	Findings	Level of evidence	Quality assessment
Tamburrelli 2014 [23] Italy	Evaluation of sexual and ano-rectal functions in Cauda Equina Syndrome (CES) patients	*n* = 5 male Mean age = 44.8 Follow up = at least two years	Prospective study	IIEF	At the first clinical control one year after operation, all patients complained a high grade ED (four severe and one moderate) while, two-year later, all patients except one who did not improved, had a substantial improve-ment of at least one category (one patient regained complete sexual ability)	III	high
Korse 2017 [29] The Netherlands	1.Evaluation of outcome of micturition, defecation, and sexual function in CES after decompression 2. Found possible predictors of outcome 3.Presenting features of CES	*n* = 75 Male = 39 Female = 36 Mean age = 43.6 years (range 27–78) Follow up = at hospi-tal discharge (FU 1) 6 weeks post operatively (FU2) More than 6 weeks post-operatively was not reg-ularly planned(FU3)	Prospective study	Systematic reviewing patients'files	Sexual dysfunction: at FU1: 96.2%(*n* = 26), at FU2:53%(*n* = 12), at FU3:80%(*n* = 5)	III	high
Korse 2017 [30] The Netherlands	Evaluation of: 1. Postoperative long term outcome of micturition, def-ecation and sexual function in CES patients 2. Attitude of patients towards received hospital care with regard to (recovery of) these func-tions. 3. the attitude of CES patients toward delivered hospital care before and after decompressive surgery	*n* = 37 Male = 18 Female = 19 Mean age = 44.6 years Mean Follow up = 13.8 years (range 5.8–21.8 years)	Retrospective study	Researcher-made questionnaire	Sexual dysfunction at FU OPD = 55.9%, of whom 9 male and 10 female. At long term follow up = 52.9%. Younger age at presentation was asso-ciated with sexual dysfunction at follow up: for every year younger at presentation, odds ratio for sexual dysfunction at follow up was 1.11	III	high
Lai 2017 [36] China	Assessment of the impact of delayed decompression on long-term neurological and bladder function recov-ery in patients with CES secondary to lumbar disc herniation	*n* = 35 male Mean age = 42.8 years (18–60) Follow-up time = 43.0 months (3–110)	Mix (retrospective Cohort + follow-up interviews were conducted in a cross-sectional manner)	Clinical examina-tion of patients and asking for symptoms	5 (14.28%) patients did not have morning erec-tion and could not finish sexual intercourse	V	moderate

Table 3 (continued)

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/ measures	Findings	Level of evidence	Quality assessment
Hazelwood 2019 [4] UK	Assessment of long-term bladder, bowel, sexual and physical function using validated questionnaires in a CES patient	*n* = 46 Males = 19 Females = 27 Mean age = 45 years (21–83) Follow-up = 43 months (range 36–60)	Mixed method (retrospective Cohort + semi-structured interview	ASEX	The prevalence of sexual dysfunction was 39%. Patients presenting with CES-R had significantly worse long-term outcomes in sexual function in compared to those with CES-I. Dysfunctional in the domains of sex drive (35% *n* = 16), ease (37% *n* = 17) and maintenance (35% *n* = 16) of arousal and ease of orgasm (39% *n* = 18) with orgasm satisfaction less affected (23% *n* = 11)	V	moderate
Krishnan 2020 [31] India	Analyses of the results of CES operated by Percutaneous transforaminal Endoscopic Lumbar Discectomy	*n* = 15 Male = 13 Females = 2 Mean age = 38.5 years Follow-up = 12–20 months	Retrospective study	Female sexual function with an invalid questionnaire and (SHIM) for men	Three of the male patients had erectile dysfunction, which was present before the operation too. However, none of the women had sexual dysfunction	III	high
Lam 2020 [20] UK	Evaluation of 1.The long-term prevalence of CES-related bladder, bowel, and sexual dysfunction 2.Impact on quality of life to inform service provision	*n* = 71 Male = 42 Female = 29 Follow-up = 1–6 year	Retrospective study	mPISQ-12, IIEF	Pain during sex (8.7% pre-CES; 34.8% post-CES). Notably difficulty maintaining erection (10% pre-CES; 47.5% post-CES) and dissatisfaction with their sex life (7.4% pre-CES; 36.6% post-CES). (10%) reported that back pain affected their sex lives pre-CES versus (45%) post-CES	III	high
Sangondimath 2020 [22] India	Analyses of clinical and sphincter outcomes and rates of sexual dysfunction in individuals with CES 2. Examining their associations with patient-provided clinical/urodynamic parameters	*n* = 43 Male = 33 Female = 10 Mean age = 43.4 years(20 to 72) Follow-up = up to 2.94 year	Retrospective study	FSFI, IIEF	There is a relationship between sexual dysfunction and the patient's age and the duration of bladder involvement before the operation. 70% of male patients had SD (Orgasmic dysfunction in men = 70%, it had significant correlation with age, bowel involvement at follow-up, Visual	III	high

Table 3 (continued)

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/ measures	Findings	Level of evidence	Quality assessment
					Analog Scale–back pain and VAC. ED = 65%, it had significant correlation with days of bladder involvement before surgery. Dysfunction in desire = 57% it had significant correlation with age, duration to operation from onset of bladder symptoms, bowel involvement at follow-up and VAC. Dissatisfaction in sexual intercourse = 63%, it had significant correlation with age, DOBLD and PAS. Dysfunction in overall satisfaction = 66%, it had significant correlation with DOBLD and VAC). 60% of female had SD and the only variable that correlated with SD was age. 67% had SD in total		
Barker 2021 [25] UK	Evaluation the main long-term outcomes of a CES cohort and comparison the outcomes for patients presenting with painless urinary retention (CESR) and incomplete urinary retention (CESI) and for those who underwent timely decompression with those who underwent delayed decompression	*n* = 61 Male = 31 Female = 30 Mean age = 42.7y (20–70) Follow up = 58.2 months (11–182 months)	Retrospective study	ASEX	Sexual dysfunction was present in 53%, and was significantly more common in those with CESR than in those with CESI 43% reported difficulty with the physical ability to have sexual intercourse (ability to establish and maintain an erection or vaginal lubrication). This was more common in patients with CESR than in those with CESI, but the difference was not statistically significant. 47% reported long-term genital numbness, which was significantly more frequent in those with CESR than in those with CESI	III	high

Table 3 (continued)

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/ measures	Findings	Level of evidence	Quality assessment
Kumar [32] 2021 India	Evaluation of the effectiveness of surgical decompression on recovery of CES symptoms at long-term follow-up & role of timing of surgery on the outcome	*n* = 24 Male = 15 Females = 9 Mean Age = 40 years (30–65) Follow-up = 28 months (1–5 years) Mean duration of LDH(in days) = 152.3 (10–730))	Retrospective study	Clinical exam and history	The least common complaint reported was sexual dysfunction = 25% in whole sample Pre-operative ED = 40%., Perineal hypoesthesia = 54.1%. None of the females reported any sexual dysfunction At follow-up, ED = 26.6%	III	high
Debnath [26] 2022 India	Evaluation of the functional outcome after lumbar discectomy in CES retention type (CESR) patients with delayed presentation	*n* = 14 Male = 9 Female = 5 Mean age = 35(26–45) Mean duration of CES(in day) = 9.7(2–42) Follow-up = 30 months	Retrospective cohort	IIEF FSFI	SD was reported by all at the final follow-up	III	high
Kim 2023 [27] USA	The objectives were two: (1) to employ a novel multidisciplinary stepped care management algorithm designed to identify a subgroup of patients with PGAD/GPD and sacral radiculopathy due to lumbar annulus rupture who might benefit from endoscopic lumbar spine surgery And (2) to see how safe and effective LESS is over the long term	*n* = 20 Male = 5 Female = 15 Mean age = 40.3 ± 16.8 years Follow-up = 20 months (12–37 months)	Prospective cohort	FSFI IIEF	80% reported improvement on the Patient Global Impression of Improvement; 65% reported improvement as much better or very much better	III	high
Wang [24] 2023 China	Determination of the predictive factors of CES and postoperative recovery in patients with symptoms lasting > 3 months	*n* = 45 Male = 19 Female = 26 Mean age = 56 years Pre-operative CES symptoms = 79.6 weeks (range, 13–730 weeks	Prospective cohort	ASEX	Sexual dysfunction preoperative = 64.4% and sexual dysfunction after 2 year follow up = 48.9%	III	high

Table 3 (continued)

Author/Year/Country	Study aim/objectives	Sample size/follow up	Type of study	Instruments/ measures	Findings	Level of evidence	Quality assessment
Wang 2024 [33] China	The objectives were two: 1) investigated the most valuable predictors (MVPs) of poor postoperative recovery (PPR) in patients with CES 2) construct a nomogram for discerning those who will experience PPR	*n* = 448 Male = 252 Female = 196 Training group (*n* = 238) validation cohorts group (*n* = 118) at a 2:1 ratio Testing cohort group *n* = 92 follow-up = 3- 5 years	Retrospective cohort	ASEX	At the last follow-up, the residual rates of CES symptoms was 63.7% (109/171) for sexual dysfunction, and 29.0% (80/276) for saddle anesthesia This study revealed that stress urinary incontinence, overactive bladder, low stream, difficult defecation, fecal incontinence, and saddle anesthesia are MVPs of PPR after decompression surgery in CES secondary to LDDs	III	high

IIEF Impairment Index of Erectile Function, *ODI* The Oswestry Disability Inventory, *FSFI* Female Sexual Function Index, *ASEX* Arizona Sexual Experiences, *SHIM* Sexual Health Inventory in Males, *mPISQ-12* Modified Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire, *mIIEF* modified International Index of Erectile Function Questionnaire, *CESI* incomplete cauda equina syndrome, *CESR* cauda equina syndrome with painless urinary retention, *FU* Follow-up, *ED* Erectile dysfunction, *PGAD/GPD* Persistent genital arousal disorder/genitopelvic dysesthesia, *LESS* lumbar endoscopic spine surgery, *VAC* voluntary anal contraction, *SD* Sexual dysfunction, *DOBLD* duration to operation from onset of bladder symptoms

(GRISS) [19], the Sexual Health Inventory in Males (SHIM) [31], the Brief Sexual Function Inventory (BSFI) [21], the Modified Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire (mPISQ-12) [20] There were also a number of study-specific questionnaires or sexual function was assessed using information from the patient's medical records [15, 29, 30, 32, 36]. The detailed results are shown in Table 4.

Postoperative sexual function recovery

Six studies, were carried out on individuals with LDH [15, 19, 21, 28, 34, 35] that all but one study [19] showed a significant improvement in sexual function after surgery (68% to 99%). (Table 2). Fourteen studies were carried out on individuals with CES [4, 20, 22–27, 29–33, 36]. The surgeries performed did not entirely fix the sexual issues experienced by the patients. Even after long-term follow up, numerous patients still faced sexual problems (14% to 100%). In the case of CES, only one study showed that sexual function improved after surgery [25]. The follow-up period varied from 3 months to 21 years in the studies (Table 3).

Improvements in sexual function after surgery in LDH was more evident than that of it in patients who were suffering from CES. No studies have been found that compare the effect of surgery on sexual function in LDH with that in CES. However, given that CES is a surgical emergency that takes a long time to resolve, it is reasonable to assume that sexual function may not improve, or recovery may be slow or prolonged, in individuals with CES following surgery [4, 30].

Sexual dysfunction patterns specific to each gender

In women, all domains of the FSFI were consistent with a multidimensional sexual dysfunction [20, 25] such as: dysfunctional sexual desire and libido (from 35 to 100%) [21, 22, 33, 37], difficulty in ease and maintenance of arousal (36%) [4], challenges in ease of orgasm (from 9 to 70%) [4, 22, 29, 30], inability to establish and maintain lubrication (43%) [23], altered genital sensation [25, 29], including dysaesthesia (42%) [25, 30], combination of dysaesthesia of the genital region with problems to reach orgasm (29%) [25, 30]), pain during sexual activities (35%) [20], discomfort and dissatisfaction in sexual activities (from 37 to 69%) [20–22]. Distressing sensations of genital arousal were most commonly experienced in the clitoris, vagina, and urethra (50%) [27]. However, women experienced more sexual dysfunction than men, and they were more likely to seek medical attention for pain and to use more pain medication [15]. Back pain was the most common physical symptom for which patients sought medical help by 57% [4]. Men experienced overall satisfaction dysfunction (69%) [22, 27], erection dysfunction (from 21 to 100%) [20–25, 27, 29–32, 36] and ejaculation dysfunction (9%) [21] and priapism (5%) [29]. they had problems in preoperative sexual function, frequency, communication, avoidance, touching, impotence, and premature ejaculation [19]. Loss of sexual desire, with 18% of male patients was reported [37] and 14% explored new sexual positions [15]. The prevalence of sexual dysfunction in these studies varied from 26.6% to 100% [29, 31].

Discussion

Summary of evidence

The prevalence of sexual dysfunction in this population ranged from 26.6% to 100%. The most common sexual disorder among women was sexual desire and arousal disorder (35% to 60%), while erectile dysfunction was the most prevalent among men (14% to 100%). Overall, dissatisfaction with sexual activities was reported by 37% to 69% of women and 69% of men. Post-surgery improvements in sexual function have been noted in 68% to 99% of patients with lumbar disc herniation. However, long-term follow-up of cauda equina syndrome patients reveals that many still face sexual issues, ranging from 14 to 100%.

Interpretation

There is limited research on specific effects of lumbar disc surgery on sexual function. Sexual function is less reported than other disorders associated with LDH and CES. This is because discussing sexual health is controversial and there are barriers in this area from both the patient and the physician [32]. Inadequate and variable definitions of sexual dysfunction may also contribute to underreporting of sexual dysfunction in patients with the syndrome [38]. However, information on the sexual function of men with LDH has been recorded more than that of women [31, 32, 38].

LDH has a direct and indirect impact on sexual function. A direct consequence of LDH is root compression, which leads to radiculopathy and has the potential to adversely impact erectile mechanisms by disrupting nerve-derived nitric oxide release regulated by the parasympathetic nervous system [37]. LDH indirectly causes spinal nerve irritation, inflammation or edema and causes back pain. Blunt pain is frequently observed in the vicinity of the lumbar spine and gluteal regions and may be accompanied by leg and leg numbness, tingling, and loss of sensation that may impact physical activity. In addition, pain can have a significant limiting effect on sex life. Chronic pain and the stress of surgery can contribute to feelings of anxiety, depression and decreased libido, which may impact sexual function [39]. Indeed, lumbar disc surgery can help alleviate chronic back pain, which

Table 4 Details of Instruments/measures

Instruments/ measures	Questionnaire designer	Number of questions and items	Cut off	Questionnaire scoring method
FSFI Female Sexual Function Index	Rosen	19-item self-report tool includes sexual desire (range: 1.2–6), arousal (range: 0–6), lubrication (range: 0–6), orgasm (range: 0–6), satisfaction (range: 0–6), and pain (range: 0–6)	26.55	The highest and lowest scores obtained from the scale were determined as 36 and 2, respectively. A total score of FSFI below 26.55 indicates SD
IIEF International Sexual Function Index	Chavda	The IIEF form 15 questions with 5 subdomain: erectile function (0–5), Orgasmic Function (0–5), Sexual Desire (1–5), Intercourse Satisfaction (0–5) and Overall Satisfaction (1–5)	25	severe SD (1–10), moderate SD (11–16), mild to moderate SD (17–21), mild SD (22–25), and no SD (26–30)
ODI-8 Oswestry Disability Questionnaire	Fairbank	For each section the total possible score is 5: if the first statement is marked the section score = 0; if the last statement is marked, it = 5	-	0% to 20%: minimal disability: The patient can cope with most living activities. Usually no treatment is indicated apart from advice on lifting sitting and exercise. 21%–40%: moderate disability: The patient experiences more pain and difficulty with sitting, lifting and standing. Travel and social life are more difficult and they may be disabled from work. Personal care, sexual activity and sleeping are not grossly affected and the patient can usually be managed by conservative means. 41%–60%: severe disability: Pain remains the main problem in this group but activities of daily living are affected. These patients require a detailed investigation. 61%–80%: crippled: Back pain impinges on all aspects of the patient's life. Positive intervention is required. 81%–100%: These patients are either bed-bound or exaggerating their symptoms
ASEX Arizona Sexual Experiences Scale score	Mcgahuey	A five-item rating scale that quantifies sex drive, arousal, vaginal lubrication/penile erection, ability to reach orgasm, and satisfaction from orgasm. Possible total scores range from 5 to 30, with the higher scores indicating more sexual dysfunction	19	dysfunction is described by an overall score of ≥ 19, one domain ≥ 5 or 3 domains ≥ 4
SHIM Sexual Health Inventory in Males	Adapted with permission from: Rosen	A five-item questionnaire validated as a screening tool for erectile dysfunction	21	Severe ED (1–7) Moderate ED (8–11) Mild to Moderate ED (12–16) Mild ED (17–21) No signs of ED (22–25)
GRISS The Golombok–Rust Inventory of Sexual Satisfaction	Rust and Golombok	28 questions with communication, satisfaction, Premature ejaculation avoidance, Touching, Frequency and impotence sub dimensional score	5	The raw scores can be converted into standard scores ranging from 1 to 9. Scores of five and above indicate a problem in that specific sub-dimension

Table 4 (continued)

Instruments/ measures	Questionnaire designer	Number of questions and items	Cut off	Questionnaire scoring method
BSFI Brief Sexual Function Inventory	O'Leary	In the BFSI the first 10 items cover functional aspects of male sexuality, while the last item covers overall sexual satisfaction. The functional items cover sexual drive (two items), erection (three items), ejaculation (two items), whereas the other questions focus on subjective problem assessment about drive, erection and ejaculation (three items). The scaling is from zero (no function, big problem, etc.) to four (good function, no problem, etc.) Among these five components, each had a maximum score of 9, 12, 8, 12, and 4, respectively, with a maximum total score of 45	-	A score of < 50% in each component showed impairment
mPISQ-12 Modified Pelvic Organ Prolapse/Urinary Incontinence Sexual Questionnaire	Rogers	The PISQ-12 is a validated and reliable short form that evaluates sexual function in heterosexual women with urinary incontinence and/or pelvic organ prolapse in the past six months	-	Scores are calculated by totaling the scores for each question with 0 = never, 4 = always. Reverse scoring is used for items 1, 2, 3 and 4

SD Sexual dysfunction, *ED* erectile dysfunction

may improve overall comfort and mobility during sexual activity. Panneerselvam showed that patients with lumbar disc disease may have lower sexual function before surgery, but after the surgery, there can be improvements in sexual function and satisfaction among some individuals. The majority of men (59.1%) were able to resume sexual intercourse within 6 weeks of surgery [21]. Surgical treatment improved quality of sexual activities, but more females did not regain sexual desire, felt sexual discomfort, and thereby resumed sexual activities later than males [40].

Some studies suggest that sexual activities may not change or could even get worse after certain types of surgery [41, 42]. The frequency of sexual intercourse was reduced by 78% compared to the pain-free period before surgery. Adjustment in sexual position was required in large number of patients to avoid discomfort during sexual activities [43]. Sexual position adjustment was required in 44% of men and 54% of women [41].

Overall, the impact of lumbar disc surgery on sexual function varies from person to person. Factors such as persistent pain, mechanical changes and psychological issues can impact the restoration of sexual function after surgery [42]. Some risk factors for sexual dysfunction in LDD that caused the deterioration of the sexual function in people after lumbar spine surgery are: being in the 3rd and 4th class compared to the 1st and 2nd according to the classification of the physical condition of the patients, increasing age and spine defects [29], duration of bladder involvement [21], current smoking, pain duration of more than 12 months, previous spine surgery, onset of complications within 3 months [37], the intensity of pain, the presence of leg pain and employment status [15] the onset of CES occurs at a younger age [30], age increase [16], defecation dysfunction at presentation [44]. However, it has been shown that having a partner, college education, and working until surgery predicted improvement in pain during sexual activity [37]. What we need to prepare our patients for, after the diagnosis of CES, is that: recovery after decompression for CES takes a long time, and most of the time it does not recover completely [30]. Therefore, a detailed long-term follow-up plan for all CES patients is important [32]. If patients with CES are referred before the onset of bladder paralysis and their sexual dysfunction is diagnosed faster, it will help to triage the patients. The improvement of sexual dysfunction is related to better sphincter function [38]. Post-surgical complications such as hematoma, neurological damage, physical limitations, and psychological factors are the common causes of sexual dysfunction after surgery for CES. Addressing these factors through appropriate medical and psychological interventions can help manage and improve sexual function in patients undergoing surgery for this condition [45]. Late presentation of patients in developing countries delays surgery in CES patients. They end up becoming the CESR (acute-onset group) type with more severe neurological impairments. On the other hand, decline in sexual function naturally occurs at an earlier in the Asian population compared to the Western European population. It is argued that some reasons for delay are: poverty, ignorance, remote living, unavailability of skilled spinal surgeon, fear of expected nerve damage during spine surgery and permanent disability [26].

Considering that the symptoms of CES are diverse and usually patients have several symptoms together (bladder, bowel, and sexual function are an important area to consider), the needs of these patients are not met. Therefore, one-step multidisciplinary care is needed for these patients with urological and psychosexual management. In the absence of dedicated centers for CES, CES patients may benefit from follow-up programs in spinal cord injury units. Neurology and sexual function services are rarely directly linked to neurosurgery units, but referral of patients with sexual dysfunction can lead to specialized multidisciplinary support in the form of education, support groups, physical therapy, occupational therapy, and symptom management [20]. Kim used a multidisciplinary management algorithm in the management of this disease, which identified and treated patients in time [27]. Since most patients are not aware of the connection between CES and sexual dysfunction or are embarrassed to ask, it is up to the doctor to discuss this issue [29]. Therefore, when taking a history, sexual history should be mentioned and Sexual health should be integrated into the disc herniation care plan [15, 19]. It is suggested that brochures and educational pamphlets should be given to patients undergoing LDH surgery in neurosurgery clinics, and training should be done before discharge and its continuation should be ensured [46].

Strengths and limitations

This study has several strengths, including: its exclusive focus on postoperative sexual function in patients with lumbar disc herniation and cauda equina syndrome, and its emphasis on long-term follow-up data. A thorough examination of postoperative sexual dysfunction outcomes and their prevalence offers valuable insights for clinicians and patients, helping to set realistic expectations for those undergoing surgery for CES or LDH. The long-term follow-up focus sheds light on the enduring effects of surgical interventions on sexual dysfunction, which is crucial since outcomes related to CES and LDH may change over time. However, two notable limitations exist: the search was restricted to English-language publications, likely omitting eligible studies in other

languages, and a meta-analysis was not feasible due to data heterogeneity.

Conclusion

Studies indicated a considerable enhancement in sexual function post-surgery for lumbar disc herniation patients (68% to 99%). However, long-term follow-up of cauda equina syndrome patients revealed that many continued to experience sexual issues (14% to 100%). Decreased sexual desire, erectile dysfunction, pain, physical limitations, and psychological factors are the most common contributors to sexual dysfunction after surgery for lumbar disc herniation.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12891-025-08736-3.

Supplementary Material 1.

Acknowledgements
This research is the outcome of a project at the Tarbiat Modares University. We appreciate the staff of Tarbiat Modares University.

Patient and public involvement
Patients or the public were not involved in the research.

Province and peer systematic review
Not commissioned; externally peer systematic reviewed.

Authors' contributions
Z.M.: reviewing texts, collecting and organizing data, analyzing data and preparing the draft of the article, correcting the final version of the article. S.S.: supervisor, research design, literature review, data analysis, modification and approval of the final version of the article F.A.: consultant professor, data analysis and cooperation in compiling the final report, reviewing the article, correcting and approving the final version of the article A.M.: Consultant professor, data analysis and cooperation in compiling the final report, reviewing the article, correcting and approving the final version of the article.

Funding
There are no specific grant for this research from any funding agency in the public, commercial or non -for- profit sectors.

Data availability
No datasets were generated or analysed during the current study.

Declarations

Ethics approval and consent to participate
Not applicable.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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Received: 16 July 2024 Accepted: 9 May 2025
Published online: 16 May 2025

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