

# Sexual and reproductive health of patients with spinal cord injuries - Orientation to female fertility and pregnancy

Ariadni Petropoulou<sup>1</sup>, Dimitrios-Sergios Evangelopoulos<sup>1,2,3</sup>, John Vlamis<sup>1,2</sup>, Maria-Eleftheria Evangelopoulos<sup>4</sup>

<sup>1</sup> Postgraduate Training Program, KAT Hospital, National and Kapodistrian University of Athens School of Medicine, KAT Hospital, 2 Nikis str, 14561, Athens, Greece

<sup>2</sup> Third Department of Orthopaedic Surgery, National and Kapodistrian University of Athens School of Medicine, KAT Hospital, 2 Nikis str, 14561, Athens, Greece

<sup>3</sup> Laboratory for Research of the Musculoskeletal System "Th. Garofalidis", National and Kapodistrian University of Athens School of Medicine, KAT Hospital, 2 Nikis str, 14561, Athens, Greece

<sup>4</sup> First Department of Neurology, National and Kapodistrian University of Athens School of Medicine, Eginition Hospital, 72-74 Vas. Sofias Av., 11528, Athens, Greece

## Abstract

This exploratory review focus on the sexual and reproductive health of female spinal cord injury (SCI) patients. This investigation seeks to determine whether or not women with spinal cord impairments can become pregnant. Women with SCI are unable to procreate, contrary to the alternative theory. We searched PubMed and Scopus for relevant articles published between 2003 and 2023. Consideration was given to studies, with an emphasis on the sexual and reproductive health, including reproduction, of women with SCI. Animal studies, studies published in languages other than English, male-focused research, studies on neurological diseases other than SCI, and non-relative studies were all disqualified. The findings of this review shed light on the likelihood of conception among individuals with SCI, while the findings of individual studies contribute to our understanding of female fertility and pregnancy outcomes in this population.

**Keywords:** spinal cord injury, female fertility, pregnancy outcomes, sexual and reproductive health, women with disabilities

## Introduction

Worldwide, spinal cord injuries (SCIs) are the most common cause of catastrophic disability. In addition to sexual and reproductive health, these traumas may have far-reaching consequences in other areas as well. Neurogenic dysfunction after SCI has been linked to significant changes in sexual function, fertility, and

pregnancy outcomes. Several studies have assessed the effects of SCI on men's sexual and reproductive health, but few have examined the effects of SCI on women's fertility and pregnancy outcomes [1, 2].

To provide comprehensive treatment and support, tailored to the specific needs of women with SCI, sexual and reproductive health knowledge is necessary. For women

Corresponding  
Author

Petropoulou A., Student of the Postgraduate Training Program, KAT Hospital, National and Kapodistrian University of Athens School of Medicine, Athens, Greece. Address: KAT Hospital, 2 Nikis Street, Kifisia, 14561. E-mail: ar.petropoulou@gmail.com

with SCI, reproductive health presents unique concerns and problems [3, 4]. Changes in sensation, decreased sexual response, changes in vaginal lubrication, and the inability to attain orgasm are all examples of these problems. Additionally, a SCI may have a negative impact on the autonomic nervous system, which affects ovulation, implantation, and uterine contractility [5, 6].

Despite its necessity, research on the sexual and reproductive health of women with SCI is limited. Male sexual function and reproductive health outcomes have been the primary focus of research, whereas women's particular concerns and experiences have been largely ignored. Therefore, it is essential to fill this informational void by analyzing the existing literature on female fertility and pregnancy outcomes in SCI patients [7].

The purpose of this analysis is to provide a comprehensive overview of the sexual and reproductive health of women with SCI. The question at issue is "Can women with SCIs get pregnant and have healthy babies?" A comprehensive literature review was conducted using rigorous inclusion and exclusion criteria to identify relevant papers addressing our research question. This systematic approach aimed to thoroughly examine the available studies on the sexual and reproductive health of women with SCI, specifically focusing on their capacity to conceive and carry a child to term. Through this selection process, the results of these studies aim to bridge knowledge gaps and provide guidance for future research, ultimately ensuring that women with SCIs receive appropriate and effective treatment.

A thorough examination of the PubMed and Scopus databases was conducted to locate relevant publications published between 2003 and 2023. In addition to terms related to SCI, the search terms included terms related to sexual and reproductive health, fertility, and pregnancy. Inclusion criteria prioritized human clinical trials and observational studies investigating sexual and reproductive health, including pregnancy outcomes, among women with SCI. Studies that were not published in English, utilized animals as subjects, focused primarily on male populations, or dealt with neurological diseases other than SCI were excluded (Figure 1).

### **Epidemiology**

SCI may have a significant impact on a person's fertility, and an understanding of epidemiology is required

to comprehend this impact. The fact that 50% of SCI occurs in patients aged between 15 and 25 years, with 15–20% being women, can have a detrimental impact on their desire to start a family. [8] In the United States, approximately 78% of newly diagnosed SCI patients are male, with an average injury age of 43[9]. According to national estimates, approximately 40,000 to 45,000 women with SCI are living in the United States [10]. It is estimated that there are currently 20,000 women between the ages of 16 and 30 years with SCI in the USA [11]. Traumatic SCI affects 16–54 new individuals per million each year in Western countries with a four times higher incidence in males, while non-traumatic SCI, estimated incidence ranges from 6 to 76 cases per million individuals/year [12].

Traumatic SCI occurs when an external physical impact acutely damages the spinal cord, whereas non-traumatic SCI occurs when an acute or chronic disease process, such as a tumor, infection or degenerative disc disease, generates the primary injury [13]. The leading causes of traumatic SCI are motor vehicle accidents, falls, violence (including firearm wounds), and sports-related injuries [14]. The commonest cause of non-traumatic SCI in developed countries is represented by degenerative myelopathy [12].

Sexual function and reproductive health are frequently affected as a consequence of SCI. Patients with SCI experience sexual dysfunction involving different domains. It is reported that 50% of women and 29% of men report impaired sexual desire, 70–81% of men have erectile dysfunction, 50–80% of women experience reduced arousal or vaginal dryness [15]. Approximately 95% of males with SCI have ejaculatory difficulties, such as an inability to ejaculate or diminished ejaculatory function [11]. In addition, men with SCI commonly have low sperm concentration and quality, making it difficult for them to conceive without medical intervention, such as assisted reproductive technologies [16].

It has been shown that the fertility outcomes for women with SCI differ from those for men. According to studies, women with SCI have an equal probability of conceiving and giving birth. Injuries to the spinal cord may affect a person's quality of life, but they have little effect on fertility. This differentiation highlights the specific sexual and reproductive health needs of

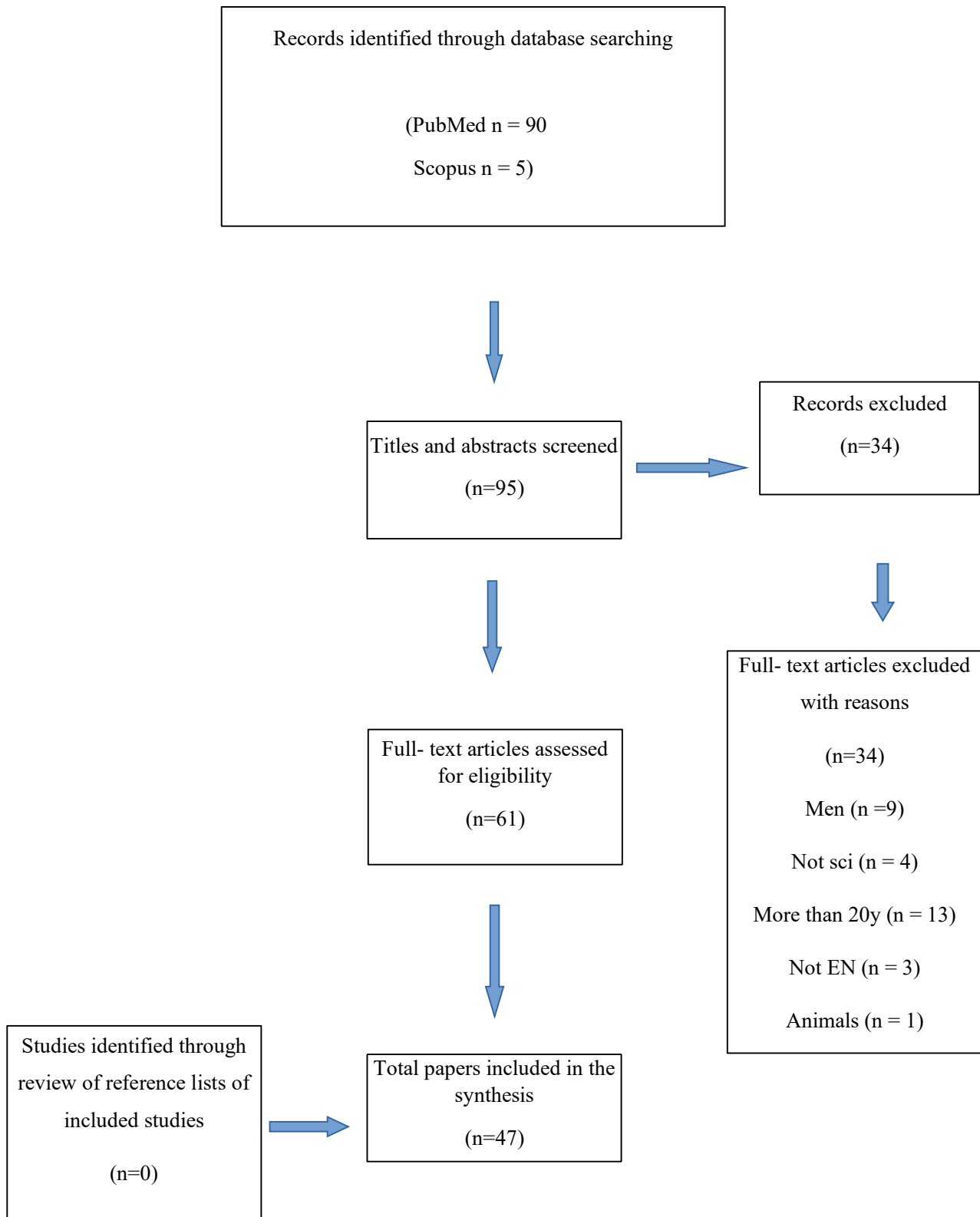


Figure 1. Flowchart of the study.

women with SCI, particularly during pregnancy and delivery [17]. When queried [18], people with SCI indicate that their ability to engage in sexual and reproductive activities has a significant impact on their quality of life. These results demonstrate the detrimental effects of SCI on the sexual and reproductive health of men and women. Healthcare professionals are obligated to address these challenges and provide patients with a comprehensive treatment plan that addresses sexual dysfunction, fertility issues, and a lack of access to essential reproductive health treatments.

Notably, sexual dysfunction may also result from non-traumatic injuries to the spinal cord, such as a herniated disc. Although SCI is the primary focus of this document, it is essential to keep in mind that other spinal cord diseases may also affect reproductive health [19].

#### **Sexual function and satisfaction in women with spinal cord injuries**

When a person suffers from SCI, their sexual health and contentment become crucial to their overall well-being and quality of life. The World Health Organization recognizes sexual health as a fundamental human right for all individuals. However, people living with disabilities frequently encounter exclusion from active sexuality and incorrect assumptions of asexuality [20]. The significance of sexuality for individuals experiencing a SCI is underscored by the fact that enhancing sexuality ranks as the primary priority for paraplegic patients. Among tetraplegics, it is second only to the recovery of arm function, highlighting the importance placed on improving sexual well-being. It's noteworthy that this priority is applicable to both male and female sexuality [21].

To provide women with SCI with the necessary care and support, it is necessary to comprehend how SCI impacts their intimate experiences [22]. The level and completeness of SCI play a significant role in determining sexual functioning. In the immediate post-injury period, women experience a loss of the ability to have reflexive sexual responses. As reflexes gradually return, reflexive arousal – vaginal lubrication – can be achieved through genital stimulation, provided that the sacral spinal segments and peripheral pathways conveying sensations (cauda equina) remain intact [23].

While sexual desire and arousal may be maintained in women with SCI [24], the researchers observed that neurological disturbances may make it more difficult to have an orgasmic experience. The presence of sensation in the genital area suggests the preservation of the sacral reflex arc, enhancing the likelihood of achieving orgasm. According to literature, women with SCI at all levels and degrees were found to be significantly less likely than able-bodied control subjects to achieve orgasm. Specifically, 55% of women with SCI reported the ability to achieve orgasm, in contrast to 100% of able-bodied control subjects [25]. It's important to inform all women with SCIs that they may require longer or more intense genital stimulation to achieve orgasm and that the experience might be less intense than before [21].

While fundamental motives persist after SCI, there are notable physiological changes affecting sensation, voluntary motor function, and autonomic function. These alterations impact sexual arousal, orgasmic potential, ejaculation in men, and sexual positioning for both sexes [26]. The impact of SCI on sensory perception and motor function can hinder the ability to achieve climax. Conditions related to SCI, such as pain, weakness, pressure ulcers, sensory loss, fatigue, and lack of bowel and bladder control, contribute to dissatisfaction with sexual intimacy [27]. Additionally, depression and pharmacological management further complicate sexual self-esteem, expression, and satisfaction [26]. Women have been found to experience depression or other psychological disorders more often than men after the injury [28]

Research suggests that individuals with SCI may have comparable levels of sexual desire to those without such injuries. Both groups can participate in positive sexual relationships, with some reporting varying degrees of sexual satisfaction. Factors like personal choice, cultural and religious beliefs, the severity and timing of the injury, opportunities for intimacy, privacy, and access to meet others can influence the expression of intimacy and desire after a SCI [29].

Nevertheless, sexual satisfaction is still attainable through imaginative planning and open communication between partners. By experimenting with new erogenous zones, new sexual approaches, and assistive technologies, women with SCI can enhance

their sexual satisfaction [27]. However sexual function and satisfaction is often overlooked in the rehabilitation process [20]. Assessing patients with SCI using the International Standards for Neurological Classification of Spinal Cord Injury (ISNCSCI) is vital. This evaluation helps tailor education about sexual potential and improve responses. By documenting the level of injury, clinicians can determine the necessary assistance for mobility and daily activities, crucial factors affecting the individual's ability to self-manage during sexual activity [30].

A female oriented approach to sexuality rehabilitation should commence early preparing women for psychological impact, altered sexual sensation and disclosure of altered sexual function to partners [31]. In addition, emotional or psychological difficulties that may arise as a result of a change in sexual function may be best treated with psychological assistance and therapy. By diagnosing the effects of the condition on sexual function and promoting an open dialogue about sexuality, healthcare professionals can help women with SCI regain control of their sexual lives [24].

It is crucial for individuals with SCI to receive accessible support and psychoeducational resources regarding post-injury sexuality. This is essential to reduce reluctance and discomfort in initiating conversations about their sexual lives. [20] It is important to identify both barriers and facilitators in rehabilitative practices and create an inclusive environment that encourages open discussions. The goal is to ensure optimal care for sexual health following SCI [26].

### **Fertility in women with SCIs**

Over the past half-century, notable advancements in health outcomes for individuals with SCI and progress in medicine and assisted reproductive techniques have made the prospect of becoming pregnant increasingly successful for women with SCI [9].

Literature data support that pregnancy rates among reproductive-aged women with SCI in the United States was comparable to rates of women in the general population [9]. Immediately after the injury, there is an episode of acute amenorrhea that lasts for approximately 6 months, and then menstruation returns to normal levels [8]. This phenomenon happens due to a temporary rise in prolactin concentration, caused by

stress from the trauma [32]. There was no correlation between the level of injury, injury classification (complete versus incomplete) and the disruption of menstrual cycle [8]. Regarding women with SCI, a period of amenorrhea is followed by a resumption of fertility comparable to that of unaffected women [33].

Age, general health, and the underlying causes of infertility are just a few of the numerous factors that can influence fertility and pregnancy outcomes. Factors associated with age are commonly seen as influential in fertility and pregnancy rates, a consideration that applies to both the general population and individuals with SCI [1].

Due to advances in ART, individuals with SCI now have access to a greater variety of reproductive options. When determining the most suitable reproductive strategy for their circumstances, individuals may benefit from a comprehensive examination and discussion of the available options. [34].

Intravaginal insemination (IVI), also known as "at-home insemination," is the least invasive and least expensive of assisted reproductive technology (ART) techniques. IVI is the placement of sperm in the vagina so that a normal pregnancy can develop. Semen is collected in a specimen cup, is drawn up into an appropriately-sized syringe barrel and then introduced into the vagina. [29] There are no specific recommendations for establishing the minimum acceptable quantity of motile sperm for couples in which one partner has SCI, and this may impact the efficacy of IVI. While there are no definitive guidelines on the subject, it's typically recommended to consider self-insemination and/or Intrauterine Insemination (IUI) when there are at least four million motile sperm present in the ejaculate. If the sperm count is lower than four million, the options may involve in Vitro Fertilization (IVF) either with or without Intracytoplasmic Sperm Injection (ICSI) [35].

IUI should be the next option if multiple IVI attempts have failed or if it is not indicated [34]. This procedure involves gathering sperm from men with spinal cord injuries using penile vibratory stimulation (PVS) or electro-ejaculation (EEJ) in accordance with standard safety protocols. The sperm are separated from the sample of semen in the laboratory. Sperm is collected and inserted directly into a woman's uterus. IUI can be administered without stimulating the reproductive

system of the female partner (unstimulated cycles), or fertility medications can be prescribed to stimulate egg production and ovulation [29].

ICSI is a more advanced ART option when IVI or IUI fail [10]. In conventional IVF, sperm is extracted from the testis or epididymis of males with SCI via PVS, EEJ, or surgical extraction. The female partner is subjected to ovarian stimulation, and the retrieved eggs and sperm are combined in a laboratory container. The highest-quality embryos are transferred into the female partner's uterus after being incubated in an incubator until they reach the blastocyst stage. IVF-ICSI is frequently used when there are insufficient embryos for conventional IVF [29].

Recent studies conclude that successful pregnancies and live births have been reported in partners of men with spinal cord injuries through the use of ART [35-37]. Couples with an SCI male partner who have poor semen parameters can benefit from ART. The pregnancy and delivery rates for these couples appear to be similar to those of other couples with infertility but without an SCI situation [36].

Women with SCI choose specific methods of reproduction for several significant reasons. Firstly, despite the challenges they face, they are informed that their endocrine function returns to normal after a brief period of amenorrhea following acute SCI, enhancing their ability for natural conception. Additionally, methods such as IUI and artificial insemination have been successfully performed without increasing the risk of thrombosis, providing viable options. This approach minimizes the risk of multiple pregnancies, allowing women to choose the number of embryos transferred [38].

However, it is essential for couples to consult fertility specialists with experience treating SCI patients. Clinicians typically adopt a graduated approach, initiating treatment with natural and less invasive methods before progressing to more invasive and costly options within a fertility clinic [34].

Given that SCI does not seem to significantly impact female fertility, most research focuses on male infertility and how it can be better addressed through ART. While significant health challenges exist for women with SCI, there is an overall lack of rigorous studies addressing many of these issues. Population-based stud-

ies on the reproductive experiences of women with disabilities, including SCI, are nearly nonexistent [39].

### **Pregnancy outcomes and maternal health**

Women with SCI encounter distinct challenges that require specialized care to improve pregnancy outcomes and maternal health. They may face obstetrical challenges such as preterm labor, unattended delivery, and an increased risk of prematurity [40]. To ensure the well-being of both the pregnant mother and her unborn child, it is crucial to recognize and address these obstacles. Women with SCIs confront unique pregnancy-related risks that demand close medical monitoring and, in certain instances, medical intervention [38].

According to the research, the outcomes of pregnancy and delivery in women with SCIs generally show favorable results, with only minor differences in adverse outcomes when compared to the general population.[32,42] Neonatal mortality rates of congenital malformations were not observed to be higher than those in the general population, but high rates of maternal and infant complications were reported.[43] Our study revealed that infants born to women with these conditions did not face a higher risk of long-term adverse outcomes, such as rehospitalization and death, despite being more prone to preterm birth or being small for gestational age. However, their mothers exhibited elevated risks of various complications compared to healthy women [38]

The level of injury plays a significant role in preventing complications during pregnancy, so it should be taken seriously into consideration. Injuries above the T10 level may prevent the patient from perceiving pain during childbirth, and above the T6 level, there is a risk of autonomous dysreflexia (AD) [44]. In lesions above T10, labor may not be perceived at all or perception of labor may be by concurrent sympathetic symptoms, such as AD, scalp tingling, an increase in the frequency of spasms, abdominal self-palpation. [3]

The most common complication observed in pregnant women with SCI was urinary tract infection (UTI). Managing urological issues proved to be more challenging, as a quarter of the women reported the necessity to alter their standard bladder management method during pregnancy. Additionally, between 27% and 70% of these women had to increase the frequency

of intermittent catheterizations per day [41]. The main goal of bladder management is to achieve low-pressure urine storage and effective bladder emptying. Most individuals with SCI require regular urologic assessments and treatment for their bladder dysfunction. If left untreated, UTI can cause significant pain and pose a risk to the kidneys. Preventing and treating UTIs in pregnant women with SCI requires careful monitoring of urinary health and proactive management of bladder function, including practices such as intermittent catheterization [45]. UTIs have been observed to be associated with low birth weight and preterm delivery, and the increased frequency of UTIs in these women is a parameter of concern regarding these complications [40]

Pregnancy introduces an additional risk factor for women with SCI, as AD has been reported to occur in 60% of cases [8]. AD, a potentially life-threatening complication of SCI, predominantly affects individuals with an injury level at T6 or above. This condition results from dysregulation of the autonomic system and is characterized by a sudden increase in systolic blood pressure ( $\geq 20$  mmHg), triggered by a non-specific stimulus below the level of injury [12]. Women with spinal lesions at or above the sixth thoracic vertebra may experience potentially life-threatening AD during vaginal birth due to painful stimuli below the injury level. The risk of this complication diminishes with the use of epidural analgesia. The absence of epidural analgesia potentially heightens the risk of AD during vaginal birth, increasing the likelihood of acute cesarean section and potential harm for both mother and infant [32].

Pregnancy-related respiratory complications are more likely to occur in women with SCI. Changes in lung capacity, particularly in women with severe injuries, may have an effect on respiratory function. Depending on the level of injury, varying degrees of pulmonary dysfunction occur following SCI. As the gravid uterus enlarges, its pressure on the diaphragm may further compromise lung vital capacity, resulting in poor oxygenation, increased fatigue, and limitations in mobility [9]. Women with spinal cord lesions above T4 may experience partial or complete paralysis of respiratory muscles, posing challenges in breathing as pregnancy progresses. If respiratory function is com-

promised, interventions such as chest physiotherapy, continuous positive airway pressure, and mechanical ventilation may be necessary [3].

Special consideration should be given to alterations in the cushion-skin interface, as the risk of decubitus ulcers increases in this population. Factors contributing to this heightened risk include weight gain, changes in body habitus, increased spasms, pain, immobility, and even anemia [8]. It is advisable to undergo an assessment by a physiatrist and a physical therapist to ensure appropriate adjustments in seating and assistive devices are made to accommodate the woman's evolving body [39].

Spasticity, a symptom of upper motor neuron disorders, results from intact spinal reflexes persisting below the level of injury. It can be severe enough to lead to falls from wheelchairs, with a reported 12% incidence of worsening spasms during pregnancy [44]. Currently, there are no specific treatment guidelines for managing spasticity in this population [45]. Managing spasticity poses challenges as most medications can have potentially harmful effects on the fetus during pregnancy and lactation [38]. Preconception counseling, regular follow-up, reviewing and modifying bowel, bladder, and exercise programs, educating about the effects of pregnancy on SCI and maintaining overall health are crucial for optimizing spasticity management during this period [45].

Literature findings suggest that women with SCI can successfully and safely achieved vaginal delivery, regardless of the level of injury [46]. To make informed decisions, women with SCI should engage in discussions with obstetric physicians who specialize in high-risk pregnancies, exploring the risks associated with spontaneous vaginal delivery versus planned cesarean delivery [8].

People with spinal cord injuries (SCIs) often encounter challenges when planning a family or during pregnancy, stemming from issues like inaccessible healthcare providers and societal misconceptions. Both men and women face barriers, with women struggling to find wheelchair, accessible healthcare provider offices, as well as offices equipped with accessible exam tables [47].

Specialized treatment and multidisciplinary team involving specialists of neurological disability and preg-

nancy are required to improve pregnancy outcomes and maternal health in women with SCI [41]. Women should be mindful of changes in mobility, making adjustments with the assistance of physiotherapy. Issues such as accessibility and social support are frequently lacking and deserve more attention [40].

### Conclusions

The findings of a literature review on the sexual and reproductive health of women with SCIs have been enlightening. To begin, it is indisputable that sexual function and pleasure are drastically altered in women with SCI. Spinal cord injury-related neurological deficits can alter genital sensation, lubrication, and the orgasmic response, all of which make it more difficult to attain orgasm. Nonetheless, sexual fulfillment is still attainable through imaginative planning and open communication between partners.

New research dispels long-held beliefs about the infertility of women with spinal cord injuries, demonstrating that such women can conceive and deliver healthy children. Researchers discovered that SCI did not significantly influence fertility rates in women and that pregnancy rates were comparable to those of the general population regardless of injury severity, degree of incompleteness, or duration since injury. Nevertheless, impaired sexual function and altered uterine contractility may necessitate the use of ART.

For women with SCI, maternal and fetal health are of the utmost importance. Obstacles and problems unique to pregnancy require specialized care and the collaboration of professionals from other fields. UTIs, AD, pressure lesions, and respiratory issues are all conditions that require close monitoring and treatment. Preconception counseling, prenatal care, and access to appropriate rehabilitative treatments are essential for optimal pregnancy outcomes and the health of the mother and expectant child.

Epidemiological data indicate that the preponderance of SCIs occurs in young adult males. SCI may be the result of a car accident, a fall, an act of violence, or even sports participation. A large proportion of males with SCI (90%) are sterile and unable to naturally conceive a child due to erectile dysfunction and infertility. However, the pregnancy success rate for women with SCI is comparable to that of the general population. The ability to engage in sexual and reproductive activities is regarded as a crucial factor in determining the quality of life for individuals with SCI.

Assisted reproductive procedures offer SCI patients, particularly men, a viable reproductive option. In addition to ART, males with SCI who cannot produce ejaculate during sexual interaction require assisted ejaculation treatments. It is simple and affordable to perform IVI at home. Consultation with reproductive professionals is necessary for couples to select the most suitable technique, as success rates vary depending on the method used.

This literature review uncovered a bounty of new information regarding the sexual and reproductive health of women with spinal cord injuries. Despite the difficulties brought on by the neurological abnormalities caused by SCI, women with the condition can still find erotic fulfillment through creative problem-solving and open communication. It has been demonstrated that women with SCI are able to conceive and deliver healthy infants at rates comparable to the general population, disproving long-held beliefs about their incapacity to do so. To conceive a child when sexual function is diminished, IVF or another ART may be required. Women with SCI must have access to specialized care and multidisciplinary collaboration in order to enhance pregnancy outcomes and maternal health.

### Conflict of interest

The authors declare no conflicts of interest.



## References

1. Courtois F, Alexander M, McLain ABJ. Women's Sexual Health and Reproductive Function After SCI. *Top Spinal Cord Inj Rehabil.* 2017; 23:20-30.
2. Lysberg K, Severinsson E. Spinal cord injured women's views of sexuality: A Norwegian survey. *Rehabil Nurs* 2003; 28:23-26
3. Biering-Sørensen I, Hansen RB, Biering-Sørensen F. Sexual function in a traumatic spinal cord injured population 10-45 years after injury. *J Rehabil Med.* 2012; 44:926-31.
4. Ferreiro-Velasco ME, Barca-Buyo A, de la Barrera SS et al. Sexual issues in a sample of women with spinal cord injury. *Spinal Cord* 2005; 43:51-55.
5. Sipski ML, Rosen RC, Alexander CJ et al. Sexual responsiveness in women with spinal cord injuries: differential effect of anxiety-eliciting stimulation. *Arch Sex Behav* 2004; 33:295-302.
6. Komisaruk BR, Whipple B, Crawford A et al. Brain activation during vaginocervical self-stimulation and orgasm in women with complete spinal cord injury: fMRI evidence of mediation by the vagus nerves. *Brain Res* 2004; 1024:77-88.
7. Alexander MS, Rosen RC, Steinberg S et al. Sildenafil in women with sexual arousal disorder following spinal cord injury. *Spinal Cord* 2011; 49:273-279.
8. Stoffel JT, Van der Aa F, Wittmann D et al. Fertility and sexuality in the spinal cord injury patient. *World J Urol.* 2018; 36:1577-1585.
9. Iezzoni LI, Chen Y, Jackson McLain AB. Current pregnancy among women with spinal cord injury: findings from the US national spinal cord injury database. *Spinal Cord.* 2015; 53:821- 826.
10. Kathiresan ASQ, Ibrahim E, Aballa TC et al. Pregnancy outcomes by intravaginal and intrauterine insemination in 82 couples with male factor infertility due to spinal cord injuries. *Fertility and Sterility* 2011; 96:328-331.
11. Anderson D, Borisoff JF, Johnson RD et al. Spinal cord injury influences psychogenic as well as physical components of female sexual ability. *Spinal Cord* 2007; 349-359.
12. Pavese C, Kessler TM. Prediction of Lower Urinary Tract, Sexual, and Bowel Function, and Autonomic Dysreflexia after Spinal Cord Injury. *Biomedicines.* 2023; 11:1644.
13. Ahuja CS, Wilson JR, Nori S et al. Traumatic spinal cord injury. *Nat Rev Dis Prim.* 2017; 3:17018.
14. Salomon J, Schnitzler A, Ville Y et al Prevention of urinary tract infection in six spinal cord-injured pregnant women who gave birth to seven children under a weekly oral cyclic antibiotic program. *Int J Infect Dis.* 2009; 13:399-402.
15. Hentzen C, Musco S, Amarengo G et al. Approach and management to patients with neurological disorders reporting sexual dysfunction. *Lancet Neurol.* 2022; 21:551-562.
16. Kreuter M, Taft C, Siösteen A et al. Women's sexual functioning and sex life after spinal cord injury. *Spinal Cord.* 2011; 49:154-60.
17. Deforge D, Blackmer J, Moher D et al. Sexuality and reproductive health following spinal cord injury. *Evid Rep Technol Assess (Summ)* 2004; 109:1-8.
18. Maasoumi R, Zarei F, Merghati-Khoei E et al. Development of a Sexual Needs Rehabilitation Framework in Women Post-Spinal Cord Injury: A Study From Iran. *Arch Phys Med Rehabil.* 2018; 99:548-554.
19. Merghati-Khoei E, Emami-Razavi SH, Bakhtiyari M et al. Spinal cord injury and women's sexual life: case-control study. *Spinal Cord* 2017; 55:269-273.
20. Barrett OEC, Mattacola E, Finlay KA. "You feel a bit unsexy sometimes": The psychosocial impact of a spinal cord injury on sexual function and sexual satisfaction. *Spinal Cord.* 2023; 61:51-56.
21. Otero-Villaverde S, Ferreiro-Velasco ME, Montoto-Marqués A et al. Sexual satisfaction in women with spinal cord injuries. *Spinal Cord* 2015; 53:557-560.
22. Andrei Krassioukov, Stacy Elliott. Neural Control and Physiology of Sexual Function: Effect of Spinal Cord Injury. *Top Spinal Cord Inj Rehabil* 2017; 23: 1-10.
23. Hess MJ, Hough S. Impact of spinal cord injury on sexuality: broad-based clinical practice intervention and practical application. *J Spinal Cord Med.* 2012; 35:211-218.
24. Parker, M.G., Yau, M.K. Sexuality, Identity and Women with Spinal Cord Injury. *Sex Disabil* 2012; 30:15-27.
25. Sipski ML, Arenas A. Female sexual function after spinal cord injury. *Prog Brain Res* 2006; 152:441-447.
26. Stacy Elliott, Gaya Jeyathevan, Shea Hocaloski et al. Conception and development of Sexual Health indicators to advance the quality of spinal cord injury rehabilitation: SCI-High Project, *J Spinal Cord Med.* 2019; 42:68-84

27. Fritz HA, Dillaway H, Lysack C. "Don't think paralysis takes away your womanhood": Sexual intimacy after spinal cord injury. 2015; 69:1-10.
28. Lombardi G, Del Popolo G, Macchiarella A et al. Sexual rehabilitation in women with spinal cord injury: a critical review of the literature. *Spinal Cord* 2010; 48:842-849.
29. Zizzo J, Gater DR, Hough S et al. Sexuality, Intimacy, and Reproductive Health after Spinal Cord Injury. *Journal of Personalized Medicine*. 2022; 12:1985.
30. Marcalee Alexander, Frédérique Courtois, Stacy Elliott et al. Improving Sexual Satisfaction in Persons with Spinal Cord Injuries: Collective Wisdom. *Top Spinal Cord Inj Rehabil* 2017; 23: 57-70.
31. Thrussell H, Coggrave M, Graham A et al. Women's experiences of sexuality after spinal cord injury: a UK perspective. *Spinal Cord* 2018; 56:1084-1094
32. Khalili M, Berlin M, Pettersson K et al. Pregnancy, delivery, and neonatal outcomes among women with spinal cord injury in Sweden 1997-2015: A population-based cohort study. *Acta Obstet Gynecol Scand*. 2022; 101: 1282-1290.
33. Van den Borne K, Brands I, Spijkerman D. et al. Prevalence of parenthood in wheelchair-dependent persons with long-term spinal cord injury in the Netherlands. *Spinal Cord* 2018; 56:607-613
34. Deforge D, Blackmer J, Garritty C et al. Fertility following spinal cord injury: A systematic review. *Spinal Cord* 2005; 43:693-703.
35. Leduc BE. Treatment of infertility in 31 men with spinal cord injury. *Can J Urol*. 2012; 19:6432-6.
36. Sonksen J, Fode M, Lochner-Ernst D et al. Vibratory ejaculation in 140 spinal cord injured men and home insemination of their partners. *Spinal Cord* 2012;50:63-66.
37. Kathiresan AS, Ibrahim E, Aballa TC et al. Comparison of in vitro fertilization/intracytoplasmic sperm injection outcomes in male factor infertility patients with and without spinal cord injuries. *Fertil Steril*. 2011; 96:562-566.
38. Bertschy S, Schmidt M, Fiebag K. et al. Guideline for the management of pre-, intra-, and postpartum care of women with a spinal cord injury. *Spinal Cord* 2020; 58: 449-458
39. Smeltzer, Suzanne & Wetzel-Effinger, Lisa. Pregnancy in Women with Spinal Cord Injury. *Topics in Spinal Cord Injury Rehabilitation* 2009;15:29-42.
40. Sterling L, Keunen J, Wigdor E et al. Pregnancy outcomes in women with spinal cord lesions. *J Obstet Gynaecol Can*. 2013; 35:39-43.
41. Le Liepvre H, Dinh A, Idiard-Chamois B. et al. Pregnancy in spinal cord-injured women, a cohort study of 37 pregnancies in 25 women. *Spinal Cord* 2017; 55:167-171
42. Ghidini A, Healey A, Antreany M. and Simonson M.R. Pregnancy and women with spinal cord injuries. *Acta Obstetrica et Gynecologica Scandinavica* 2008; 87: 1006-1010
43. Pannek J., Bertschy S. Mission impossible? Urological management of patients with spinal cord injury during pregnancy: a systematic review. *Spinal Cord* 2011; 49: 1028-1032.
44. Robertson K, Ashworth F. Spinal cord injury and pregnancy. *Obstet Med*. 2022; 15:99-103.
45. Cabahug, P.G. Managing Spasticity in a Pregnant Woman with Spinal Cord Injury: a Review. *Curr Phys Med Rehabil*, 2018; 6:245-256.
46. Robertson K, Dawood R, Ashworth F. Vaginal delivery is safely achieved in pregnancies complicated by spinal cord injury: a retrospective 25-year observational study of pregnancy outcomes in a national spinal injuries centre. *BMC Pregnancy Childbirth*. 2020 29; 20:56.
47. Pebdani RN, Johnson KL, Amtmann D. Personal experiences of pregnancy and fertility in individuals with spinal cord injury. *Sexuality and Disability* 2014; 32:65-74.

Cite this paper as



Petropoulou A, Evangelopoulos DS, Vlamis J, Evangelopoulos ME. Sexual and reproductive health of patients with spinal cord injuries - Orientation to female fertility and pregnancy. *Acta Orthop Trauma Hell* 2024; 75(1): 74-83.