Published in final edited form as:
J Sex Med. 2014 August ; 11(8): 2039–2047. doi:10.1111/jsm.12606.

Les Lanternes Rouges: The Race for Information About Cycling Related Female Sexual Dysfunction

Sarah N. Partin, MSPH[*], **Kathleen A. Connell, MD**[†], **Steven Schrader, PhD**[‡], and **Marsha K. Guess, MD**[§]

[*]Department of Epidemiology and Biostatistics, School of Rural Public Health, Texas A&M Health Science Center, College Station, TX

[†]Department of Obstetrics and Gynecology, University of Colorado School of Medicine, Aurora, CO

[§]Department of Obstetrics, Gynecology and Reproductive Sciences, Yale University School of Medicine, New Haven, CT

[‡]National Institute for Occupational Safety and Health—Reproductive Health Assessment, Cincinnati, OH, USA

Keywords

Female sexual dysfunction; genital injuries; bicycling; pudendal nerve; cycling related neuropathy

Introduction

Cycling is a popular sport among women and men, serving as a source of recreation and exercise. It provides an excellent moderate intensity, low-impact form of physical activity. It, also, imparts all of the health benefits associated with this class of exertion, such as improved cardiovascular fitness, better weight control and alleviated symptoms of chronic disease [1–4].

The Outdoor Foundation listed bicycling as the second most popular activity by participation in the US [5] and between 2000 and 2010, US women riding enthusiasts increased by 8% [6, 7]. Recent reports suggest that nearly half of cyclists are women and for the first time in US history, women between the ages 29–48 are driving the US bicycling

Author for Correspondence: Marsha K. Guess, MD, Section of Urogynecology & Reconstructive Pelvic Surgery, Department of Obstetrics, Gynecology & Reproductive Sciences, Yale University School of Medicine, New Haven, CT 06511. Phone: (203) 785-4880; Fax: (203) 785-2909; marsha.guess@yale.edu.

Statement of Contribution
Conception and design: SNP, MKG Acquisition of data: SNP, SS, KAC, MKG; Analysis and interpretation of data: SNP, SS, KAC, MKG; Drafting the manuscript: SNP, MKG; Critical revision of the manuscript: SNP, SS, KAC, MKG; Statistical analysis: Not applicable

market [7]. While increased popularity in riding among females carries many benefits, cycling-related injuries in female cyclists are not uncommon.

Aims

Women's sexual health in relation to bicycling has concerned society since bicycles popularization in the late 1800's. At that time, the medical community primarily focused on protecting female sexual purity from the undue stimulation believed to be caused by the saddle [8]. Physicians advocated and recommended that females adopt an erect siting position on the bike and a crotch-less saddle design in order to avoid any prurient arousal [8]. In the more than a century that has since transpired, increasing evidence supports a possible correlation between cycling and abnormal sexual function in women. The purpose of this article is to provide an overview of the current body of evidence addressing pelvic floor injuries and female sexual dysfunction (FSD) in women cyclists.

Methods

Search Scope

Literature searches were performed on Pubmed, Medline, Google Scholar, Academic Search Complete, EBSCO databases, as well as MasterFILE. Premier using the key terms: cycling, female pelvic floor, female sexual dysfunction, pudendal nerve, cycling nerves, cycling blood supply, saddle pressures and cycling related neuropathies. The bibliographies of all papers identified using the defined search terms were reviewed and any articles that were full articles of manuscripts deemed relevant based on the abstract or title, were also obtained and reviewed for eligibility.

Inclusion Criteria

In 1998, the Sexual Function Health Council of the American Foundation of Urologic Disease convoked 19 sex experts from 5 countries in order to evaluate and revise the definition for FSD [9]. These experts developed a consensus approach to improve treatment efforts for women, and to address the paucity of research on FSD. This resulted in an expanded definition of FSD including classifications into psychogenic and organic causes, as well as an addition of personal distress criterion in the American Psychiatric Association's Diagnostic and Statistical Manual of Mental Disorders IV and the World Health Organization's International Classification of Diseases-10 [9,10]. Their results were published in the Journal of Urology [9]. In order to adequately and fully compile all articles relevant to the progression of knowledge involving pelvic floor injuries and sexual dysfunction in female cyclists, articles dating from 1998 and onward are included in this review. All manuscripts that evaluated the impact of cycling on genital injuries or sexual function in women that were published in or translated into English during the designated time period were considered eligible articles and reviewed in this manuscript. Table 1 provides an overview of all of the studies included in this review. The overall level of evidence supporting the various bicycle modifications was determined using the US Preventative Services Task Force's defined levels of clinical and observations studies (see Table 2) [11].

Results

Potential Mechanisms of Pelvic Floor Injuries and FSD Resulting from Cycling

Current evidence suggests that central and peripheral neurological responses and vascular modifications play an essential role in the normal sexual response [2, 12–17]. Altered nerve conduction and reduced blood flow to the vagina and clitoris can result in delayed vaginal engorgement, pain or discomfort with intercourse, as well as diminished vaginal lubrication, reduced vaginal and clitoral sensation and anorgasmia [16, 18–20]. While this is usually associated with atherosclerotic vascular disease, factors unique to cycling can also predispose women to neurovascular injuries and may lead to FSD [16, 20].

Prevailing evidence suggests that neurovascular damage occurs during cycling as a result of chronic compression of the genitals against the saddle [13, 22]. In 1987, pudendal nerve entrapment was first described in a male cyclist who reported transient genital and perianal paresthesia and hypoesthesia. At the time, the symptoms were attributed to compression of the pudendal nerve in Alcock's canal [22]. However, newer studies have emerged suggesting that pudendal nerve injury results from stretching of the nerve during pedaling, as it spans between the sacrospinous and sacrotuberous ligaments, as well as compression of the nerve against the saddle where it innervates the perineum and symphysis [23].

Unfortunately, one cannot adequately infer etiology or treatments for pelvic floor injuries or altered sexual function in women based on male studies since literature indicates that there are significant gender-specific anatomical differences that affect how the bodies of females and males interact with the bicycle [24]. Specifically, women have a wider pelvis, a lower center of gravity and demonstrate a greater pelvic tilt when riding [25, 26]. In novel work, Potter et al. also identified substantial differences in saddle pressure distribution between male and female riders [25].

While cycling may not impart the same effects on women as on men, owing to the dramatic differences in pelvic anatomy and overall physique, several studies have identified pathology resulting from neurovascular compromise in the pelvic floor of female cyclists. In 2002, Baeyens et al., reported on an observation that they described as "bicyclist's vulva." This was characterized by permanent, unilateral swelling of the labium major that was associated with chafing, folliculitis and nodules in six professional female cyclists. The symptoms were more pronounced after longer training sessions and thought to result from impaired lymphatic drainage in the genital region [27]. To further explore the relationship between riding and neurovascular compromise, a study by the Brugmann University Hospital in Brussels, Belgium assessed more than 60 competitive female cyclists and found that 1 in 6 of the women suffered from lymphatic swelling and 70% of the remaining participants reported other groin related issues including chafing, folliculitis, nodules and temporary insensitivity of the clitoris [28]. In addition, Humphries reported that unilateral vulval hypertrophy is more common among competitive female cyclists than in the non-cycling population [29]. Finally, in the first comparative study of female cyclists a global decrease in genital sensation was identified at 8 sites along the perineum in competitive cyclists when compared to a control group of competitive runners [2]. In this study, however, none of the cyclists or runners reported sexual dysfunction.

Work by Munarriz et al., also suggests that pudendal nerve insults may occur following an incidental trauma during cycling [30]. These authors reported that 77% of bicycle injury cases were caused by incidental pelvic floor trauma most commonly involving the crossbar. They studied 26 women exhibiting FSD with and without a history of blunt perineal trauma; they concluded that blunt perineal trauma leads to a marked decrease in genital sensation [30]. Owing to the fact that all of the women in this study had sexual dysfunction, an assessment of the contributory effect of altered genital sensation on FSD in the cyclists could not be determined. While it is conceivable that sustained increases in genital pressure and altered genital sensation could result in altered sexual function, the level of evidence to substantiate this supposition is currently a grade C.

Evidence Supporting the role of Bicycle Accoutrements Affecting Pelvic Floor injuries and FSD in Women

The ergonomics of the traditional cycling position and typical saddle designs results in the female and male perineum being tasked with bearing the weight of the rider [2, 3, 31–34, 43, 45]. Owing to their differing anatomy, women experience dramatic changes in the positioning of and pressure on their perineum when riding [25]. As such, several riding related practices, including the configuration of the saddle and the positioning of the handlebars, have been implicated as factors contributing to female pelvic floor injuries during riding.

Saddle Design

Newer innovations have brought numerous saddle designs developed specifically to alleviate saddle-related chronic injuries in female riders [25, 33, 35, 36]. This includes increasing the width of the posterior aspect of the saddle to accommodate females' greater ischial tuberosity (IT) widths, adding gel to cushion the saddle, as well as removing sections of the saddle that come in contact with the perineum. Despite the many advances, limited research has been published supporting the effectiveness of many of these modernizations in protecting the female pelvic floor.

While several studies have reported that narrow saddles lead to perineal injuries in men [24, 35, 37, 38, 39] the supposition that, like males, females would benefit from using a wider saddle has only been supported in a few cross-sectional studies [25, 33]. In a subgroup analysis of competitive female cyclists, narrower saddles were associated with increased peak perineal and mean total saddle pressures when compared to traditional saddles, after adjusting for age, body mass index and saddle design [33]. However, in the aforementioned study, saddle width was not associated with changes in neurologic function in the genitalia or FSD [33]. Potter et al., assessed the influence of gender, power, hand position and IT width on saddle pressures in 22 experienced cyclists (11 men and 11 women) [25]. All of the riders were evaluated on a traditional saddle while 9 of the 11 female riders were also tested on an alternate saddle that was marketed as a traditional saddle designed specifically for females. The saddle was wider in the rear and transition region and had increased compliance in the perineal region. When riding the "female-specific" saddle, notable reductions (32%) in the normalized anterior maximum pressure were recorded. This encouraged the notion that wider saddles that also offer more perineal compliance design elements are better for women with the authors positing that they provided better bony support owing to their ability to accommodate females' greater IT widths [25]. Further research is needed to determine the correlation between wider saddles and perianal compliance elements in relation to saddle pressures. Unfortunately, this study was very small and exposures were different for men and women. Thus, while evidence appears to indicate that a wider saddle is effective in relieving compression of the pudendal nerve, the short and long-term effects of wider saddles on nerve function and FSD have not been confirmed.

Forbrose et al., assessed the effects of two saddle types on perineal pressure in women, comparing, a gel-cushioned saddle design with intact nose, and a partial cut-out saddle design (the anterior-medial section of the saddle is removed) [28]. They reported that the gel saddle distributed pressure over a larger surface area. They also noted that the majority of women found the gel cushion saddle more comfortable compared to the cut-out saddle design. As this study was limited to the cross-sectional evaluation of 12 women, more research is needed to fully evaluate the effectiveness of gel-saddles in alleviating pain, pressure or neuropathies, and protecting against FSD.

Bressel and Larson evaluated the effect of a traditional, a partial cut-out and a noseless saddle (the entire nose of the saddle is removed) saddle on pelvic floor pressure in women in both the tops (i.e. hands rest on top of the handlebars) and drops (i.e. hands rest in the bottom of the handlebars) hand positions [40]. They reported that while both saddle designs allowed for increased anterior pelvic tilt angles, the cyclists found the partial cut-out to be the most comfortable. Although the nose-less saddle favorably increased trunk flexion angles, which should potentially decrease stress on the lumbar spine, it was reported as being the least comfortable by the riders [40]. The investigators speculated that cyclists might find the nose-less saddle uncomfortable due to a perceived insecurity from the inability to rely on the anterior region of the saddle for stability and steering. They opine that the partial cut-out saddle is a compromise as it increases anterior tilt; yet, it is very similar in shape to the traditional saddle [40].

Interestingly, Frobose et al., found that the partial cut-out saddle did not alleviate or change the pressure applied to the central part of the saddle. In fact, they noted that the highest saddle pressures were found in the central aspect of the saddle, around the edges of the hole, when women rode in the racing position on partial cut-out saddles (40 degrees from the horizontal) [28]. Researchers speculate that in the bent over position, the edges of the cut-out portion of the saddle cause higher pressure to the outer genitalia, leading to increased discomfort [28]. Previous work by our group also suggests that higher pressures are distributed along the hole of partial cut-out saddles. Additionally, our work showed that mean and peak perianal pressures were significantly higher in partial cut-out saddles when compared to traditional saddles [33]. It is important to note, however, that our study was unable to elucidate a significant relationship between saddle design and neurological or sexual function among our participants. The current body of evidence strongly suggests that partial cutout saddles do not confer a protective effect on the female perineum.

Amid these studies evaluating the effects of cut-out saddle designs on pelvic floor support, cycling equipment designers and researchers are experimenting with modifying the nose of the saddle. The Murray Orthoped bicycle saddle as well as shortened, absent and downward deviating [31, 35, 40] nosed saddles are among the newest saddles designed to try to relieve pressure in the perineum. In a study evaluating saddle design, Buller reported that a sample of female cyclists (n=52) experienced relief from genital pain, numbness and discomfort by using the study's experimental, ergonomically designed saddle [41]. While these new saddles sound promising, studies assessing their effects on the perineum are very small [35] or only include male subjects [31, 42]. It is important to understand how these saddles influence genital pressures, genital sensation, and pelvic floor symptoms in order to fully understand any protective factor they may provide.

Bicycle Set-up

Cycling enthusiasts as well as researchers advocate proper bicycle fit [25, 28, 35, 43] and classic bike fit certifications and hardware set-up instructions ("fit kits") offer similar basic body position recommendations, modified for recreational and competitive cyclists. However, given the wide range of body types, body weight and weight distribution and influx of newer, faster and lighter bicycle designs, a precise definition of proper fit is continually evolving. While there are bike fits designed for each specific bicycle and its corresponding activity, such as mountain biking, track racing or cyclo-cross racing, the current body of literature chiefly addresses road cycling. Currently, there are two typical bicycle fits for cycling on roads, a competitive fit and a recreational fit. A competitive or racing fit is geared towards making the cyclist as aerodynamic as possible; the rider is bent over more and the handles bars tend to be lower than the saddle. A recreational fit accommodates the cyclist's comfort needs more than aerodynamic needs for speed; the rider sits-up more and the handlebars tend to be higher than the saddle. In a sub-analysis, our group examined the effect of bicycle set-up on genital sensation and saddle pressures in female cyclists. We showed that handlebars positioned lower than the saddle are associated with increased perineal pressures and decrease genital sensitivity [3]. Another study, reported that the female subjects were more comfortable when sitting in a more upright position. The researchers theorized that the upright position allowed their ITs to support more of their weight [28]. Ultimately, a bicycle set-up that encourages the rider to lean their pelvis forward, either by a lower placement of handlebars or by saddle design and orientation, forces the perineum to bear an increased load and suffer detrimental effects [3, 25, 40].

In addition to wider IT widths, females have additional gender-based pelvic differences [26]. Sauer et al. investigated the relationship between hand position (in the drops vs. on top) and power on pelvic motion between 12 male and 14 female experienced cyclists. Findings indicated that in female (but not male) riders the pelvis moves substantially when in the saddle and has a greater anterior tilt and non-sagittal pelvic rotation, resulting in increased anterior pelvic pressure when the hands are in the drops compared to the tops position [26]. Bressel and Cronin also confirmed that women (n=10) while riding stationary bikes, exhibit higher peak saddle pressure in the anterior region of the saddle when they moved from the tops to the drops compared to men [46]. The authors speculate that females' lower center of gravity may inhibit any load transfer to the handlebars. Interestingly, a study by Carpes et al. found that trunk position only influenced saddle pressures in the male riders (n=11) when shifting between a 90° position (relative to the handlebars) and a 60° position on traditional and partial cutout saddles [47]. Saddle pressures were unaffected by either trunk position or saddle type in the female sample (n=11). While these findings appear to contradict previous studies recommending cyclists take a more upright position in order to relieve pressure [3,23, 25, 28, 40], it nonetheless underscores the differences in male and female anatomy and how they bodies interact with the bicycle. These studies support the notion that bicycle position may play an important role in pelvic floor pathology and potentially affect sexual function in some women. However, none of the aforementioned manuscripts evaluated the effects of bicycle set-up on sexual function. More research is needed to fully elucidate recommendations for a specific bike fit that can help protect women from bicycle-related sexual issues.

Breakaway Remarks

Literature recommending bicycle modifications to decrease genital injury and prevent sexual dysfunction in women have gradually evolved [3, 24, 25, 33–36, 40, 42]. However, to date evidence suggests that most of these recommendations are without sound scientific merit. There is Level B evidence to suggest that wider saddles offer better protection than narrow saddles and that the partial-cut out saddles offer the least protection against high pressures in the perineal region when compared to traditional and wider saddles [25, 33]. Selecting an apropos saddle width is recommended; however, further evidence is needed in determining an effective method to ensure IT width is appropriately assessed and a well-suited saddle choice ensues. While the body of literature indicates the importance of perineal region compliance, it does not adequately elucidate the concept. Further research is needed to establish the optimal compliance needed to confer protection for women riders.

The nose-less saddle offers a novel strategy by removing the area of the saddle that would normally compress the genitalia. This design offers a bona fide construct to eliminate pressure in the perineum and can be beneficial for women who experience pain or numbness in the genitalia. It is important to note however, that no studies have identified a correlation between saddle design or genital pressure and sexual dysfunction in women. It is also premature to advocate the use of gel padding or a saddle with a modified nose, without female studies to support the theorized benefit.

Changing handlebar height may be one of the most immediate sources of relief. This modification is supported by level B evidence that handlebars placed above the saddle reduce perineal pressures and protect against reduced genital sensation when compared to riding with hands in the drops position. Unfortunately, riding in a more upright position does not provide the aerodynamic efficiency sought by most competitive riders and thus, may not be a suitable option for all riders. It is important to note that most studies to date have been very small and several lack standardized interventions that allow for gender-stratified intragroup comparisons. Before strong recommendations can be made about the best bicycle set-up and saddle design for all women, there is a strong need to utilize appropriate selection strategies that will yield representative samples for both recreational and professional female cyclists.

Conclusion

The present body of literature underscores the importance of staying alert to the details when designing saddles and devising fits to accommodate the female anatomy and cycling biomechanics. Undoubtedly, women have fallen to the back in the race in terms of elucidating cycling's effects on sexual health. Research involving larger study populations of both recreational and professional female cyclists is essential to gaining a better understanding of these potential associations. The medical community, through an evidence-based approach to understanding potential short and long-term effects of cycling on female sexual health, can make an important impact on FSD and change women's sexual health from the lanterne rouge to the *maillot jaune*.

References

1. Oja P, Titze S, Bauman A, de Geus B, Krenn P, Reger-Nash B, Kohlberger T. Health benefits of cycling: a systematic review. Scand J Med Sci Sports. 2011; 21:496–509. [PubMed: 21496106]
2. Guess MK, Connell K, Schrader S, Reutman S, Wang A, LaCombe J, Toennis C, Lowe B, Melman A, Mikhail M. Genital sensation and sexual function in women bicyclists and runners: Are your feet safer than your seat? J Sex Med. 2006; 3:1018–27. [PubMed: 17100935]
3. Partin SN, Connell KA, Schrader S, LaCombe J, Lowe B, Sweeney A, Reutman S, Wang A, Toennis C, Melman A, Mikhail M, Guess MK. The bar sinister: Does handlebar level damage the pelvic floor in female cyclists? J Sex Med. 2012; 9:1367–73. [PubMed: 22390173]
4. Gerrard J. Healthy revolutions: Promoting cycling among women. Health Promot J Aust. 2003; 14:213–5.
5. 2011 Outdoor recreation participation topline report [Internet]. Washington, DC: The Outdoor Foundation; 2011. [cited 2013 Dec 1]. 10p. Available from: http://www.outdoorfoundation.org/research.participation.2011.topline.html
6. Edmondson, B. The US bicycling market: A trend overview [Internet]. Allentown, PA: Gluskin Townley Group, LLC; 2011. [cited 2013 Dec 1]. 10p. Available from: http://www.gluskintownleygroup.com/downloads/The US Bicycle Market – A Trend Overview Report.pdf
7. The League of American Bicyclists [Internet]. Washington, DC: League of American Wheelman Inc; c2000–2013. Fewer Men, More Women Riding?; 2013 Sep 3 [cited 2013 Dec 1]; [abut 2 screens]. Available from: http://bikeleague.org/content/fewer-men-more-women-riding
8. Garvey, EG. The adman in the parlor: magazines and the gendering of consumer culture, 1880s to 1910s. Oxford University Press; New York: 1996. p. 240
9. Basson R, Berman J, Burnett A, Derogatis L, Ferguson D, Fourcroy J, Goldstein I, Graziottin A, Heiman J, Laan E, Leiblum S, Padma-Nathan H, Rosen R, Segraves K, Segraves RT, Shabsigh R, Sipski M, Wagner G, Whipple B. Report of the international consensus development conference on female sexual dysfunction: Definitions and classifications. J Urol. 2000; 163(3):888–893. [PubMed: 10688001]
10. Goldstein, I.; Meston, CM.; Traish, AM.; Davis, SR. Future directions. In: Goldstein, I.; Meston, CM.; Davis, SR.; Traish, AM., editors. Women's sexual function and dysfunction: Study, diagnosis and treatment. Taylor & Francis; United Kingdom: 2006. p. 745-748.
11. Battaglia C, Nappi RE, Mancini F, Cianciosi A, Persico N, Busacchi P. Ultrasonographic and doppler findings of subclinical clitoral microtraumatisms in mountain bikers and horseback riders. J Sex Med. 2009; 6:464–8. [PubMed: 19138367]

12. U.S. Preventive Services Task Force [Internet]. Rockville, MD: U.S. Preventive Services Task Force; c2008–2014. Grade Definitions: May 2008 [cited 2014 Feb 12]; [about 2 screens]. Available from: http://www.uspreventiveservicestaskforce.org/uspstf/grades.htm
13. Guiliano F, Rampin O, Allard J. Neruophysiology and pharmacology of the female sexual genital response. J Sex Marital Ther. 2002; 28(Suppl 1):101–21. [PubMed: 11898692]
14. Connell K, Guess MK, La Combe J, Wang A, Powers K, Lazarou G, Mikhail M. Evaluation of the role of pudendal nerve integrity in female sexual function using noninvasive techniques. Am J Ob Gyn. 2005; 192:1712–7.
15. Romanzi LJ, Groutz A, Feroz F, Blavais J. Evaluation of female external genitalia sensitivity to pressure/touch: a preliminary prospective study using Semmes-Weinstien monofilaments. Urology. 2001; 57:1145–50. [PubMed: 11377329]
16. Tajkarimi K, Burnett AL. The role of genital nerve afferents in the physiology of the sexual response and pelvic floor function. J Sex Med. 2011; 8:1299–1312. [PubMed: 21324089]
17. Goldstein I, Berman JR. Vasculogenic female sexual dysfunction: vaginal engorgement and clitoral erectile insufficiency syndromes. Int J Impot Res. 1998; 10(Suppl 2):S84–90. discussion S98–101. [PubMed: 9647967]
18. Salonia A, Giraldi A, Chivers ML, Georgiadis JR, Levin R, Maravilla KR, McCarthy MM. Physiology of women's sexual function: Basic knowledge and new findings. J Sex Med. 2010; 7:2637–60. [PubMed: 20487242]
19. Handa VL, Cundiff G, Chang HH, Helzlsouer KJ. Female sexual function and pelvic floor disorders. Obstet Gynecol. 2008; 111:1045–52. [PubMed: 18448734]
20. IsHak WW, Bokarius A, Jeffrey JK, Davis MC, Bakhta Y. Disorders of orgasm in women: A literature review of etiology and current treatments. J Sex Med. 2010; 7:3254–68. [PubMed: 20584112]
21. Nehme-Schuster H, Youssef C, Roy C, Brettes JP, Martin T, Pasquali JL, Korganow AS. Alcock's canal syndrome revealing endometriosis. Lancet. 2005; 366:1238. [PubMed: 16198773]
22. Kennedy J. Neurologic injuries in cycling and bike riding. Phys Med Rehabil Clin N Am. 2009; 20:241–8. [PubMed: 19084774]
23. Dettori NJ, Norvell DC. Non-traumatic bicycle injuries: A review of literature. Sports Med. 2006; 36:7–18. [PubMed: 16445308]
24. Potter JJ, Sauer JL, Weisshaar CL, Thelen DG, Ploeg HL. Gender differences in bicycling saddle pressure distribution during seated cycling. Med Sci Sports Exerc. 2008; 40:1126–34. [PubMed: 18460992]
25. Sauer JL, Potter JJ, Weisshaar CL, Ploeg H, Thelen DG. Influence of gender, power, and hand position on pelvic motion during seated cycling. Med Sci Sports Exerc. 2007; 39:2204–11. [PubMed: 18046192]
26. Baeyens L, Vermeesche Bourgeois B. Bicyclists' vulva: Observational study. BMJ. 2002; 325:138–9. [PubMed: 12130610]
27. Frobose I, Baeyens L, Tofaute K. Ergonomics of 2 bicycle saddles—pressure at the pudendal area in women of a normal saddle with gel and of a saddle with a hole. The Bicycle Saddle Report 2003. 2003:1–15.
28. Humphries D. Unilateral vulval hypertrophy in competitive female cyclists. Br J Sports Med. 2002; 36:463–464. [PubMed: 12453843]
29. Munarriz R, Talakoub L, Somekh NN, Lehrfeld T, Chudnovsky A, Flaherty E, Goldstein I. Characteristics of female patients with sexual dysfunction who also had a history of blunt perineal trauma. J Sex Marital Ther. 2002; 28:175–179. [PubMed: 11898700]
30. Lowe BD, Schrader SM, Breitenstein MJ. Effect of bicycle saddle designs on the pressure to the perineum of the bicyclist. Med Sci Sports Exerc. 2004; 36:1055–62. [PubMed: 15179177]
31. Schrader SM, Breitenstein MJ, Lowe BD. Cutting off the nose to save the penis. J Sex Med. 2008; 5:1932–40. [PubMed: 18466268]
32. Guess MK, Partin SN, Schrader S, Lowe B, LaCombe J, Reutman S, Wang A, Toennis C, Melman A, Mikhail M, Connell KA. Women's bicycle seats: A pressing matter. J Sex Med. 2011; 8:3144–53. [PubMed: 21834869]

33. Weiss BD. Nontraumatic injuries in amateur long distance bicyclists. Am J Sports Med. 1995; 13:187–92. [PubMed: 4014534]

34. Mellion MB. Common cycling injuries: Management and prevention. Sports Medicine. 1991; 11:52–70. [PubMed: 2011683]

35. Keytel LR, Noakes TD. Effects of a novel bicycle saddle on symptoms and comfort in cyclists. S Afri Med J. 2002; 92:295–8.

36. Jeong SJ, Park K, Moon JD, Ryu SB, Correspondence SB. Bicycle saddle shape affects penile blood flow. Int J Impot Res. 2002; 14:513–17. [PubMed: 12494288]

37. Leibovitch I, Mor Y. The vicious cycling: Bicycling related urogenital disorders. Eur Urol. 2005; 47:277–87. discussion 286–7. [PubMed: 15716187]

38. Schwarzer U, Sommer F, Klotz T, Cremer C, Engelmann U. Cycling and penile oxygen pressure: the type of saddle matters. Eur Urol. 2002; 41:139–143. [PubMed: 12074400]

39. Bressel E, Larson BJ. Bicycle seat designs and their effect on pelvic angle, trunk angle, and comfort. Med Sci Sports Exerc. 2003; 35:327–32. [PubMed: 12569224]

40. Buller JC. Female cyclists and perineal symptoms: An experimental bicycle seat. Clin J Sport Med. 2001; 11:289–90.

41. Breda G, Piazza N, Bernardi V, Lunardon E, Caruso A. Development of a new geometric bicycle saddle for the maintenance of genital–perineal vascular perfusion. J Sex Med. 2005; 2:605–611. [PubMed: 16422817]

42. Thompson MJ, Rivara F. Bicycle-related injuries. Am Fam Physician. 2001; 63:2007–14. [PubMed: 11388717]

43. Carpes FP, Dagnese Francisco K, de Assis Martins E, Mota CB. Effects of workload on seat pressure while cycling with two different saddles. J Sex Med. 2009; 6:2728–35. [PubMed: 19627469]

44. Sommer F, Goldstein I, Korda JB. Bicycle riding and erectile dysfunction: A review. J Sex Med. 2010; 7:2346–58. [PubMed: 20102446]

45. Bressel E, Cronin J. Seat interface pressure: Reliability, validity, and influence of hand position and workload. J Biomech. 2005; 38:1325–31. [PubMed: 15863117]

46. Carpes FP, Dagnese Francisco K, de Assis Martins E, Mota CB. Bicycle saddle pressure: Effects of trunk position and saddle design on healthy subjects. Urol Int. 2009; 82:8–11. [PubMed: 19172089]

Table 1

Summary of eligible studies addressing pelvic floor issues and cycling

Study	Study Design	Study Population	Number of Subjects	Assessment	General Findings
[2] Guess 2006	Cross-sectional	Women Runners Cyclists	N=70 n= 22 n=48	Effect of riding on saddle pressures and genital sensation.	Bicycling is associated with increased perineal pressures and decreased genital sensation.
[3] Partin 2012	Cross-sectional Secondary analysis	Women Cyclists	N=48	Effects of bicycle setup and cyclists' attributes on saddle pressures and genital sensation.	Handlebars positioned in the drops is significantly associated with increased perineum pressures and decreased genital sensation.
[20] Battaglia 2009	Case series	Mountain Bikers Horseback Riders	N=6 n=4 n=2	Evaluates the clinical and sexual impact of chronic trauma on the clitoris.	Chronic trauma is associated with clitoral microhematomas, inflammation, and/or degenerative processes.
[25] Potter 2007	Cross-sectional	Cyclists Men Women	N=22 n=11 n=11	Influence of gender, power, hand position and ischial tuberosity width on saddle pressure during seated stationary cycling.	Significant gender-related differences occur in saddle loading, especially in the drops as more weight is supported by anterior pelvic structures.
[26] Sauer 2007	Cross-sectional	Cyclists Men Women	N=26 n=12 n=14	Effects of gender, power, and hand position on pelvic motion.	Pelvic motion occurs naturally in both genders, but females have greater average anterior tilt than males.
[27] Baeyens 2002	Case series	Cyclists Female	N=6	Cycling-related injuries to the labium major.	Lymphatic damage results from compression of the groin area and repetitive skin infections.
[28] Frobose 2003	Cross-sectional	Cyclists Female	N=12	Compared gel-cushioned traditional and particle cut-out saddles on pressure distribution in two cycling positions.	• Upright positioning is associated with increased comfort and decreased pressure in the gentalia, • the partial cut-out increases centeral pressure on the central part of the perineum
[29] Humphries 2002	Case series	Cyclists Female	N=4	Observes unilateral vulval hypertrophy in competitive female cyclists.	Unilateral vulval enlargement appears frequently in cyclists which result from biomechanical factors.
[30] Munarriz 2002	Cross-sectional	Women	N=13	Characteristics of sexual dysfunction resulting from blunt perineal trauma.	Exhibited decreased genital sensation implicates connection between pudendal nerve injury and sexual dysfunction.
[31] Lowe 2004	Cross-sectional	Police Cyclists Males Females	N=33 n=32 n=1	Compared saddle designs (complete-seat noseless, split-seat shorten-nose, split-seat noseless) to a traditional saddle, on seat, pedal and handlebar pressure.	• Noseless saddles significantly reduced pressure to the perineal area. • Higher pressure to perineal influenced by saddle geometry and shape.
[32] Schrader 2008	Interventional	Police Cyclists Males	N=121	Determines effectiveness of a noseless saddle design.	Noseless saddles effectively reduced pressure to the perineal area.
[33] Guess 2011	Cross-sectional Secondary analysis	Women Cyclists	N=48	Assesses correlations between saddle design, seat pressure, and genital nerve function.	Cutout and narrower saddles negatively affect saddle pressures.

Study	Study Design	Study Population	Number of Subjects	Assessment	General Findings
[36] Keytel 2002	Cross-sectional	Cyclists Males Females	N=11 n=5 n=6	Compares a traditional saddle and a shorten nose—guttered-seat on comfort and cycling pelvic floor issues.	Non-traditional saddle is more comfortable and alleviated saddle-related issues.
[37] Jeong 2002	Cross-sectional	Males	N=20	Evaluates a wider and a narrower saddle's effect penile blood flow during cycling.	The narrower saddle is associated with significant reductions in penile blood flow and factors into vasculogenic impotence.
[39] Schwarzer 2002	Cross-sectional	Males	N=20	Evaluates the influence of a traditional narrow with liberal padding, a traditional narrow with middle groove, a wide unpadded seat, and a female noseless padded saddles on penile profusion.	• Saddles relieve encumbrances to penile blood flow by offering sufficient support to perineal area, • Saddle width is important factor in protecting penile perfusion, • Noseless saddle is an effective method to avoid decrease penile blood flow.
[40] Bressel 2003	Cross-sectional	Cyclists Female	N=20	Compares a traditional, partial and complete cutout's influence on pelvic angle, trunk angle, and comfort.	• Partial and complete cutout saddles increases anterior pelvic tilt, • Partial cutout design feels more comfortable than others, • Saddle width and complete cutout design increases trunk flexion angles.
[42] Breda 2005	Cross-sectional	Cyclists Males	N=29	Evaluates a modified-nose partial cutout and a partial cutout's maintenance of penile blood flow.	The modified-nose partial cutout saddle is protective penile perfusion.
[44] Carpes 2009	Cross-sectional	Cyclists Males Females	N=22 n=11 n=11	Investigates the effects of two different workloads and a traditional and partial cutout on saddle pressures.	• Saddle pressures increase with workload, • Partial cutout saddles may provide some protection for females under certain conditions.
[47] Carpes 2009	Cross-sectional	Cyclists Men Women	N=22 n=11 n=11	Determines trunk position's effect on saddle pressures using traditional and partial cutout saddles.	• Lower saddle pressures occurs when men are in a forward position on a partial cutout. • No relationship between trunk position and saddle pressures were found in women.
[46] Bressel 2005	Cross-sectional	Cyclists Men Women	N=19 n=10 n=9	Examines baseline pressure measurements and patterns during different work-loads and hand positions.	• Men and women respond differently to the influence of various work-loads and hand position conditions. • Specific trial pressure measurements are reliable and valid statically.
[41] Buller 2001	Cross-sectional	Cyclists Female	N=52	Evaluates the effectiveness of an ergonomically designed experimental bicycle seat.	Saddle design provided noticeable relief to perineal symptoms.

Table 2

Grade of Evidence

Level	Definition
A	The strength of evidence indicates a substantial benefit. Findings are based on consistent results derived from well-designed and well-conducted studies in appropriate cohorts that directly analyze effects on health outcomes.
B	The strength of evidence indicates a moderate benefit. Evidence is sufficient to identify effects on health outcomes; however, there are limitations on the amount, generalizability, quality and consistency of individual studies.
C	The strength of evidence does not clearly indicate a benefit. Evidence is unsatisfactory to identify effects on health outcomes and is limited by the power of the study, amount of studies, weakness in the support for underlying suppositions or lack of generalizability.