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The association of bicycle-related genital numbness and Sexual Health Inventory for Men (SHIM) score: results from a large, multinational, cross-sectional study

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Objective

To assess the association of genital numbness and erectile dysfunction in male cyclists.

Subjects and methods

Cyclists were recruited through Facebook advertisements and outreach to sporting clubs. This is a secondary analysis of a larger epidemiological population-based study that examined sexual and urinary wellness in athletes. We queried cycling habits and erectile function using Sexual Health Inventory for Men (SHIM).

Results

A total of 2 774 male cyclists were included in the analysis. Amongst cyclists, there was a statistically significant increase in the trend of genital numbness presence with more years of cycling ($P = 0.002$), more frequent weekly cycling ($P < 0.001$), and longer cycling distance at each ride ($P < 0.001$). Less frequent use of padded shorts (odds ratio [OR] 0.14, $P < 0.001$) and lower handlebar (OR 0.49, $P < 0.001$) were associated with numbness, but body mass index (BMI) (OR 1.1, $P = 0.33$) and age (OR 1.2, $P = 0.15$) were not. In a multivariate logistic regression model, after adjusting for age, BMI, and lifetime miles (calculated by average daily cycling mileage × cycling days/week × cycling years.), there were no statistically significant differences in mean SHIM score between cyclists with and cyclists without numbness (20.3 vs 20.2, $P = 0.83$). However, interestingly, the subset of cyclists who reported numbness in the buttock reported statistically significantly worse SHIM scores (20.3 vs 18.4, $P < 0.001$). This association was not present in cyclists who reported numbness in the scrotum, penis, or perineum and remained significant after adjusting for overall biking intensity.

Conclusion

Cyclists report genital numbness in proportion with biking intensity but numbness is not associated with worse sexual function in this cohort.

Keywords

erectile dysfunction, bicycling, lower urinary tract symptoms, genitalia, sexual dysfunction

Introduction

Cycling provides an efficient form of aerobic exercise and is on the rise globally [1,2]. Cycling has been postulated to cause urogenital disease second to perineal trauma. The association of perineal trauma with erectile dysfunction (ED) has ancient roots. Hippocrates, in the 4th century BC, wrote of the Sythians, a horse-riding tribe and their elite members who became impotent. Hippocrates attributed this to 'the constant jolting on their horses', which marks the first documented association between repeated perineal traumas and ED [3].

Genitourinary complaints such as genital numbness, priapism, infertility, elevated PSA, and prostatitis have been associated with cycling in the literature [4]. The research on *de novo* ED in association with genital numbness amongst cyclists has yielded controversial and conflicting results [5–8]. Sommer et al. [5] in a cross-sectional survey of 100 cyclists noted that ED invariably occurs in association with numbness. However,

not all participants with genital numbness complained of ED. However, multiple observational and population-based studies have questioned a causative relationship between recreational cycling and ED [5,8].

Recently our group studied the association of recreational cycling and urinary and sexual function in a large multinational, cross-sectional sample [9]. We found that cyclists had no worse sexual or urinary function than swimmers or runners. However, the rate of urethral stricture, genital numbness and saddle sores were significantly higher in cyclists than non-cyclists. In the present study, we aimed to examine whether genital numbness location and severity is associated with ED amongst cyclists. We hypothesised that genital numbness would be associated with ED in a dose-dependent relationship.

Subjects and Methods

Recruitment

This is a secondary data analysis of a large epidemiological population-based study that examined sexual and urinary wellness in athletes. The recruitment, population description, and survey development has been published in detail previously [9]. In brief, after Institutional Review Board approval, cyclists were recruited through a Facebook® advertisement and online outreach to English speaking sporting clubs with members aged ≥18 years in the USA, Canada, UK, Australia, and New Zealand. Study enrolment occurred from April 2016 to December 2016. For the present study, we selected adult male cyclists who had completed the sexual health survey with and without any degree of genital numbness. Swimmers and runners who also cycle were excluded.

Main Outcome

Sexual health was assessed using Sexual Health Inventory for Men (SHIM) and a score of ≤21 was considered to indicate ED [10].

Genital Numbness

Respondents were queried about their history of UTIs, urethral strictures, genital numbness, pain levels, and genital saddle sores (Appendix S1). Genital numbness was self-reported and participants were asked about their frequency ('always', 'randomly', 'after intercourse', 'after biking'), severity (range 1–10), location (perineum, penis, scrotum, buttocks, other), duration of numbness (<1, 1–60, 1–24, >24 h), and temporal association with cycling.

Other Survey Variables

The survey included demographic variables such as age, weight, height, race/ethnicity, and marital status (Appendix S1). We assessed the presence of the following conditions: diabetes mellitus, hypertension, ischaemic heart disease, BPH (yes/no), and current tobacco use.

Participants were queried regarding the cycling intensity including duration, regularity, average mileage, and speed. Saddle descriptions, use of padded shorts, and riding characteristics (sitting vs standing) were also queried (Appendix S1).

Statistical Analysis

Demographic and medical variables were analysed using the Pearson chi-squared test for categorical variables and *t*-test for continuous variables. Univariate and multivariable linear regression were used for SHIM score as a continuous outcome and logistic regression was used for SHIM score as a dichotomised outcome. Confounding variables were chosen *a priori* for each analysis and included in the multivariable model. The final model included: age, body mass index (BMI) and lifetime miles ridden (calculated by average daily cycling mileage × cycling days/week × cycling years). All tests were two-sided and a $P \leq 0.05$ was considered statistically significant. Data were analysed using STATA version 14 (College Station, TX, USA).

Results

A total of 14 333 people participated in our survey. Of the 8 480 men, 5 488 (65%) completed all survey items and 2 774 (33%) were cyclists who comprised the cohort selected for final analysis. The comparisons of demographic and clinical characteristics of cyclists who have ever experienced genital numbness ($n = 1\ 217$) vs not ($n = 1\ 557$) are summarised in Table 1. Cyclists with any degree of genital numbness have higher rate of diabetes and current smoking. Table 2 summarises cycling characteristics of the participants with and without genital numbness. Figure 1 shows the association of genital numbness with years of cycling, weekly cycling, average daily distance, and longest distance ridden in last 6 months.

Genital Numbness Characteristics

Numbness was most commonly reported in the penis (44%), followed by the perineum (31%), scrotum (19%), and buttocks (6%). The mean level of numbness (range 1–10) experienced by cyclists was 4 [interquartile range (IQR) 3–6], and there was no significant difference in severity with regard to location of genital numbness. The duration of numbness was <1, 1–59, 1–24, and >24 h in 28%, 62%, 8% and 2%, respectively.

Genital Numbness and Sexual Function

The average SHIM score was not significantly different between cyclists with or without numbness (20.3 vs 20.2, $P =$

Table 1 Comparison of demographic and clinical characteristics of cyclists with and without genital numbness.

Variable Number of participants	Numbness 1 557	No numbness 1 217	*P*
N (%)			
Age, years			
18–30	313 (20.1)	230 (18.9)	0.003
31–50	688 (44.2)	575 (47.3)	
51–65	454 (29.2)	369 (30.3)	
>65	101 (6.5)	43 (3.5)	
Hypertension	176 (11.3)	136 (11.2)	0.26
Diabetes	51 (3.3)	14 (1.2)	0.001
Heart attack	31 (2)	11 (0.9)	0.02
Cigarettes	56 (3.6)	22 (1.8)	0.005
Alcohol	1 118 (72.1)	914 (75.3)	0.06
BMI, kg/m^2, mean (SD)	25.5 (4)	25.8 (3.9)	0.02

0.83). Figure 2 shows the average SHIM scores in patients with and without genital numbness according to age. In particular, 80.6% of participants with genital numbness and 79.4% of the ones without numbness reported having satisfactory intercourse 'always' or 'most of the time' on the SHIM questionnaire (question 5). On multivariate logistic regression model, after adjusting for age, BMI, and lifetime miles there were no statistically significant differences in mean SHIM score between cyclists with and without history of numbness (β-coefficient 0.45, 95% CI: −0.4 to 0.5, P = 0.8). This association was not statistically significant even after dichotomising SHIM score to >21 vs <21 as a sensitivity analysis after controlling for age, BMI, and lifetime miles [odds ratio (OR) 1, 95% CI: 0.89–1.2, P = 0.6). Neither numbness duration nor severity was significantly associated with SHIM score as well. Table 3 summarises the association of different characteristics of genital numbness and SHIM score in a multivariate regression model before and after adjusting for age, BMI, and lifetime miles ridden. The subset of cyclists who reported numbness in the buttock reported statistically significantly worse SHIM scores (β-coefficient −2, 95% CI: −3 to −1). Numbness reported at other locations, and numbness duration or severity were not significantly associated with SHIM score (Table 3).

Discussion

The findings of the present large population-based study support the previously known association between genital numbness with cycling. However, genital numbness does not appear to be associated with ED in male cyclists regardless of cycling intensity.

Association of Genital Numbness, Cycling, and ED

Most cycling-related injuries are trauma related, although chronic overuse injuries to ulnar, median, and tibial nerve have also been reported in the literature [7,11,12]. Low serum testosterone has been identified in up to 50% of elite aerobic male athletes participating in ultra-endurance events; however, the association with ED is unknown [13,14]. The association between genital numbness and cycling intensity is established with better evidence than the relationship of either condition with ED. Taylor et al. [15] studied erectile function using the SHIM questionnaire on 688 cyclists who were recruited via internet survey. Genital numbness was reported in up to 80% of participants and both the presence and duration of numbness were significantly associated with an International Index of Erectile Function (IIEF) score of <25 on univariate analysis. However, after adjusting for age, this correlation was no longer significant and the authors concluded that neither cycling nor numbness was an independent predictor of ED, which is consistent with our present findings. They also showed that ED was inversely associated with number of cycling years, agreeing with our previously published finding [9]. Other large observational studies have also not shown an association between ED and cycling [16–18].

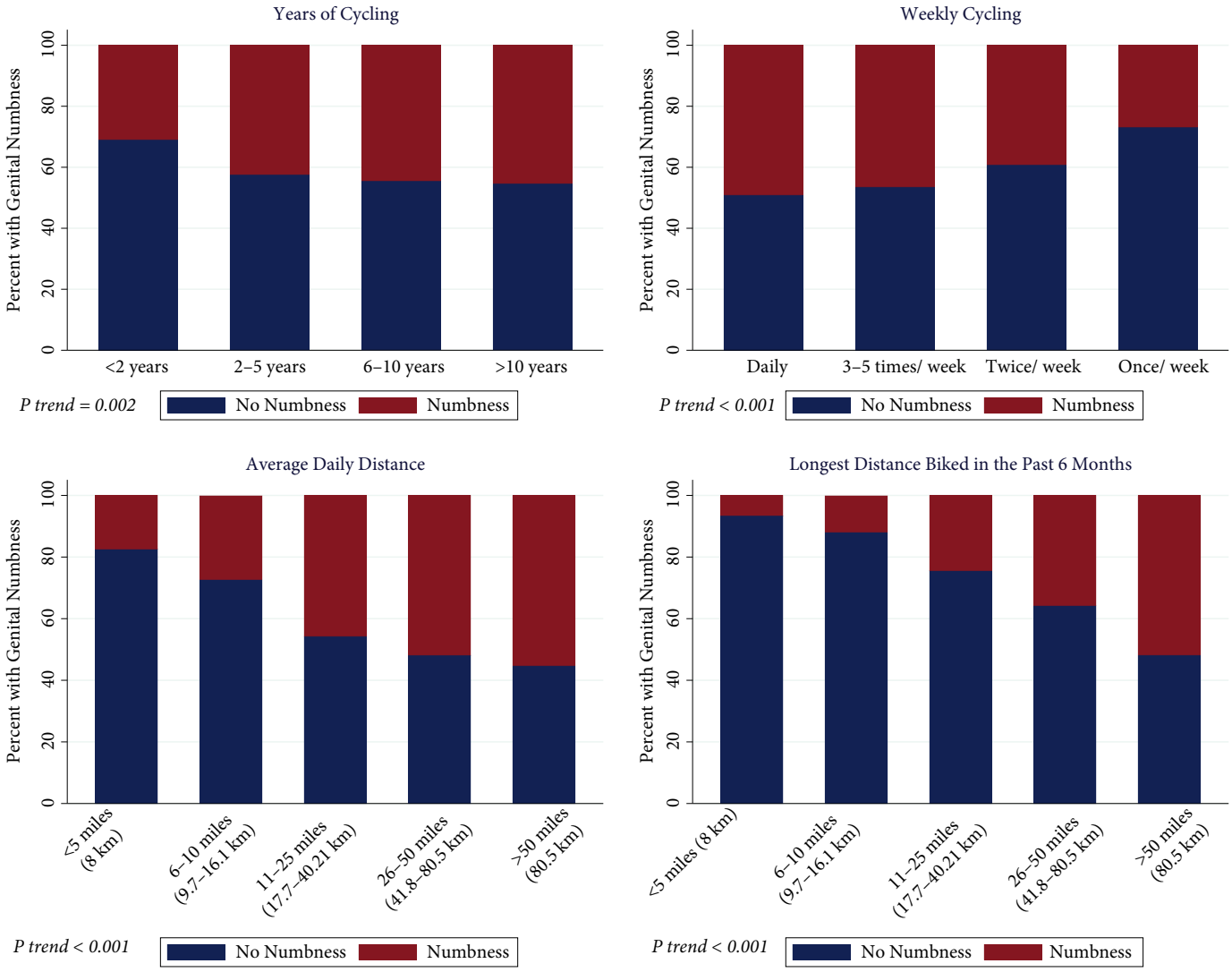
Few investigators have studied the association of genital numbness and ED [5,6,15–17]. Somner et al. [5] studied the vascular hypothesis of ED aetiology by measuring transcutaneous glans penis oxygen pressure in 40 cyclists in standing and sitting positions. They showed a significant decrease in penile blood flow when sitting. They also

Table 2 Cycling characteristics of the participants with and without genital numbness.

Variable Number of participants	Numbness 1 557	No numbness 1 217	*P*
N (%)			
No. years cycling			
<2	45 (3.7)	100 (6.5)	0.008
2–5	224 (18.5)	303 (19.6)	
6–10	225 (18.5)	280 (18.1)	
>10	720 (59.3)	865 (55.9)	
Days cycled/week, mean (SD)	4.2 (1.8)	3.8 (1.9)	<0.001
Lifetime miles ridden, median (IQR)*/km	37 620 (18 720–79 420)/ 60 543.5 (30 126.9–127 814.1)	27 797 (8 320–59 565)/ 44 734.9 (13 389.7–95 860.6)	<0.001

**Calculated by multiplying the average daily cycling mileage by cycling days/week and cycling years.*

Fig. 1 The association of genital numbness with years of cycling, weekly cycling, average daily distance, and longest distance ridden in last 6 months.

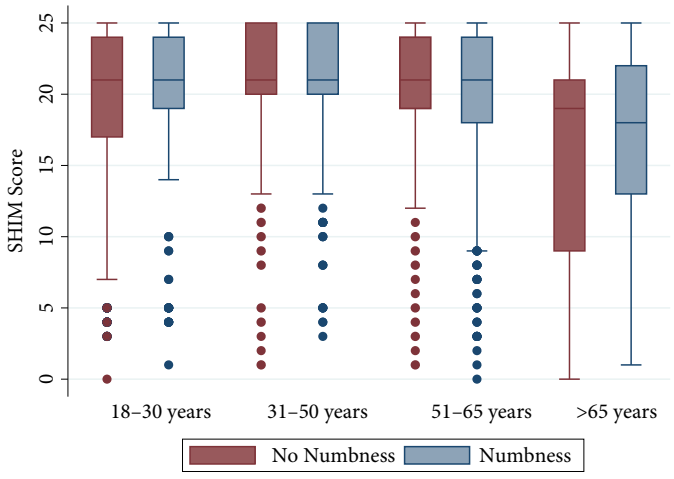


interviewed 100 separate cyclists who had a weekly training distance of >400 km and reported 61% reporting genital numbness and 19% ED. Pertinent to the present report; they observed that ED invariably occurred amongst cyclists who reported genital numbness but not vice versa. They did not perform any comparison of penile blood flow in participants with and without numbness or observed a dose-response relationship between cycling, numbness, and ED [5]. Case-control studies comparing the rate of ED and genital numbness in cyclists with other athletes have yielded conflicting results. Schrader et al. [8] compared 17 male cyclists to five non-cycling men (mean age 34.1 and 29.5 years, respectively) and observed poorer quality of erections and a high percentage of genital numbness amongst the cyclists; however, ED was not present in either group. In contrast, Kim et al. [18] compared 22 recreational cyclists to an age-matched group of 17 amateur marathon runners and found no significant difference in IIEF scores between the two groups with comparable comorbidities.

Theoretical Neurovascular Pathophysiology of Genital Numbness and ED

The pudendal nerve seems to be involved in genitourinary manifestations of cycling. It roots from sacral nerve S2–4 and passes through the Alcock's canal, adjacent to the sacrotuberous ligament deep in the pelvis. As it exits the Alcock's canal distally, it branches off to the deep perineal nerve under the pubic arch, as well as the dorsal penile/clitoral nerve and superficial perineal branches providing sensory fibres to the scrotum [7,19]. The forward tilting of the body during cycling can cause nerve entrapment against the pubic arc [5,7]. A more proximal compression within the Alcock's canal or at the sacrospinal ligament, can present

Fig. 2 The association of genital numbness and SHIM score according to age category.



with more severe symptoms and lead to penile, scrotum and/or perineal/buttock hypoaesthesia [7]. In addition, studies on post-prostatectomy ED have identified the role of cavernosal nerve as the main penile innervation pathway for normal erection [20,21]. The cavernosal nerve originates from hypogastric plexus and is located deeper within the pelvis compared to pudendal nerve. It is therefore less likely to be affected by body position during cycling.

The vascular supply to the penis and perineum can contribute to numbness symptoms. The arterial supply to the penis comes via the pudendal artery that also passes through the pudendal canal. Penile sensory nerves travel along the dorsal artery of the penis and temporary vascular insufficiency can explain penile numbness after long distance cycling [7]. However, it seems implausible that it can permanently affect the complex mechanism of erection in men. One interesting finding of our present study was that cyclists who reported numbness in the buttock alone reported significantly worse SHIM scores compared to any other location. We cannot explain this finding conclusively with any of the current ischaemic or nerve entrapment theories. Whether this is a variant of Alcock's canal syndrome needs further validation. Another interesting finding in the genitourinary manifestations of cycling is that pain in classic neuralgia, is a rare finding.

Despite our relatively large sample size, our present study is cross-sectional in design with known inherent biases. Cross-sectional sampling prohibits determination of causality. Genital numbness and its characteristics are self-reported and not objectively evaluated. Cyclists may be prone to attribute their ED to a change in genital sensation and have recall bias. In addition, some cyclists who have genital numbness or ED might have changed their riding habits or cycling saddles and this was not captured in our present data collection.

Table 3 Univariable and multivariable linear regression analyses for genital numbness association with sexual function.

	Unadjusted Coef. mean SHIM score (95% CI)	*P*-value	Adjusted Coef. mean SHIM score (95% CI)	*P*-value
Ever experienced genital numbness after biking				
Yes	0.75 (0.4–1.1)	<0.001	0.07 (−0.3 to 0.5)	0.73
Location of numbness				
Penis	0.54 (0.04–1)	0.03	−0.12 (−0.6 to 0.4)	0.65
Scrotum	0.67 (0.2–1.1)	0.002	−0.08 (−0.4 to 0.5)	0.74
Perineum	−0.01 (−0.6 to 0.6)	0.96	−0.3 (−0.9 to 0.3)	0.32
Buttocks	−1.6 (−2.6 to −0.6)	0.002	−2 (−3 to −1)	<0.001
Severity of numbness (range 1–10)	−0.03 (−0.1 to 0.1)	0.64	−0.1 (−0.2 to 0.05)	0.25
Duration of numbness				
Less than 1 min	(Referent)		(Referent)	
1–59 min	−0.4 (−1 to 0.3)	0.26	−0.15 (−0.8 to 0.5)	0.65
1–24 h	−0.8 (−1.9 to 0.3)	0.16	−0.7 (−1.8 to 0.5)	0.24
More than 24 h	−0.3 (−2.2 to 1.6)	0.74	0.01 (−1.9 to 2)	0.99

Adjusted for age, Body mass index, and lifetime miles ridden. CI, confidence interval; Coef, coefficient; SHIM, sexual health inventory for men.

Conclusions

Genital numbness is common amongst male cyclists and can be explained based on the neurovascular anatomy of the external genitalia and chronic saddle contact during riding. However, based on our large population-based study, genital numbness does not appear to be associated with ED.

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Conflict of Interest

None.

References

1 **Statista**. *Number of Cyclists/Bike Riders in the U.S.* The Statistics Portal. Available at: https://www.statista.com/statistics/227415/%0Anumber-of-cyclists-and-bike-riders-usa/. Accessed September 2017.

2 **Williams PT**. Changes in vigorous physical activity and incident diabetes in male runners. *Diabetes Care* 2007; 30: 2838–42

3 **Hippocrates**. *Airs, Waters, Places*; translation by W. H. S. Jones. London: William Heinemann Ltd., 1923.

4 **Leibovitch I**, **Mor Y**. The vicious cycling: bicycling related urogenital disorders. *Eur Urol* 2005; 47: 277–87

5 **Sommer F**, **König D**, **Graf C et al.** Impotence and genital numbness in cyclists. *Int J Sports Med* 2001; 22: 410–3

6 **Schwarzer U**, **Wiegand W**, **Bin-Saleh A et al.** Genital numbness and impotence rate in long distance cyclists. *J Urol* 1999; 161 (Suppl.): S178 (abstract 686).

7 **Andersen KV**, **Bovim G**. Impotence and nerve entrapment in long distance amateur cyclists. *Acta Neurol Scand* 1997; 117: 233–40

8 **Schrader SM**, **Breitenstein MJ**, **Clark JC**, **Lowe BD**, **Turner TW**. Nocturnal penile tumescence and rigidity testing in bicycling patrol officers. *J Androl* 2002; 23: 927–34

9 **Awad MA**, **Gaither TW**, **Murphy GP et al.** Cycling, and male sexual and urinary function: results from a large, multinational, cross-sectional study. *J Urol* 2018; 199: 798–804

10 **Rosen RC**, **Riley A**, **Wagner G**, **Osterloh IH**, **Kirkpatrick J**, **Mishra A**. The international index of erectile function (IIEF): a multidimensional scale for assessment of erectile dysfunction. *Urology* 1997; 49: 822–30

11 **Tasian GE**, **Appa AA**, **Bagga HS et al.** Bicycle-related genitourinary injuries in the USA from 2002–2010. *Inj Prev* 2014; 20: 350–3

12 **Weiss BD**. Nontraumatic injuries in amateur long distance bicyclists. *Am J Sports Med* 1985; 13: 187–92

13 **Kupchak BR**, **Kraemer WJ**, **Hoffman MD**, **Phinney SD**, **Volek JS**. The impact of an ultramarathon on hormonal and biochemical parameters in men. *Wilderness Environ Med* 2014; 25: 278–88

14 **Hooper DR**, **Kraemer WJ**, **Saenz C et al.** The presence of symptoms of testosterone deficiency in the exercise-hypogonadal male condition and the role of nutrition. *Eur J Appl Physiol* 2017; 117: 1349–57

15 **Taylor JA 3rd**, **Kao TC**, **Albertsen PC**, **Shabsigh R**. Bicycle riding and its relationship to the development of erectile dysfunction. *J Urol* 2004; 172: 1028–31

16 **Michiels M**, **Van der Aa F**. Bicycle riding and the bedroom: can riding a bicycle cause erectile dysfunction? *Urology* 2015; 85: 725–30

17 **Goldstein I**, **Lurie AL**, **Lubisich JP**. Bicycle riding, perineal trauma, and erectile dysfunction: data and solutions. *Curr Sex Health Rep* 2008; 5: 21–7

18 **Kim DG**, **Kim DW**, **Park JK**. Does bicycle riding impact the development of lower urinary tract symptoms and sexual dysfunction in men? *Korean J Urol* 2011; 52: 350–4

19 **Jünemann KP**, **Persson-Jünemann C**, **Tanagho EA**, **Alken P**. Neurophysiology of penile erection. *Urol Res* 1989; 17: 213–7

20 **Yiou R**, **De Laet K**, **Hisano M**, **Salomon L**, **Abbou CC**, **Lefaucheur JP**. Neurophysiological testing to assess penile sensory nerve damage after radical prostatectomy. *J Sex Med* 2012; 9: 2457–66

21 **Giuliano F**. Neurophysiology of erection and ejaculation. *J Sex Med* 2011; 8: 310–5

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Abbreviations: BMI, body mass index; ED, erectile dysfunction; IIEF, International Index of Erectile Function; OR, odds ratio; SHIM, Sexual Health Inventory for Men.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Appendix S1. Urinary & Sexual wellness among athletes.