Title

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Journal

The Journal of Sexual Medicine, 17(5)

ISSN

1743-6095

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Publication Date

2020-05-01

DOI

10.1016/j.jsxm.2020.01.022

Peer reviewed

THE JOURNAL OF
SEXUAL MEDICINE

ORIGINAL RESEARCH & REVIEWS

EPIDEMIOLOGY & RISK FACTORS

The Association Between Pelvic Discomfort and Erectile Dysfunction in Adult Male Bicyclists

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ABSTRACT

Background: Bicycle riding's impact on erectile function remains a topic of great interest given cycling's popularity as a mode of transportation and exercise.

Aim: We evaluated risk factors for sexual dysfunction in male cyclists with the primary intention of determining if genital/pelvic pain and numbness are associated with erectile dysfunction (ED).

Methods: We surveyed male cyclists using an online anonymous questionnaire. Cyclists were queried on their demographics, cycling experience, and sexual function using the Sexual Health Inventory for Men (SHIM). ED was diagnosed when a completed SHIM score was <22. Regression analysis was used to evaluate the risk of ED in men with genital/pelvic pain or numbness after riding. The survey was designed in the United States.

Outcomes: Quantitative characterization of cycling habits, onset and timing of genital pain and numbness, and SHIM score.

Results: A total of 1635 participants completed the survey. A majority of men were over the age of 50 (58%, 934/1,607), Caucasian (88%, 1,437/1,635), had been active cyclists for over 10 years (63%, 1,025/1,635) and used road bikes (97%, 1,578/1,635). Overall, 22%, 30%, and 57% of men reported ED, genital pain, and genital numbness, respectively. While controlling for cohort demographics, body mass index, cycling intensity and equipment, and medical comorbidities, no saddle characteristics were associated with the risk of developing genital numbness. However, men reporting penile numbness were at higher risk of reporting ED (odds ratio [OR] = 1.453, $P = .048$). In addition, quicker onset of numbness and resolution of numbness within a day was associated with impaired erectile function. For example, numbness occurring less than 1 hour after cycling had greater odds of leading to ED than numbness after 5 hours (OR = 2.002, $P = .032$). Similarly, genital pain occurring less than 1 hour (OR = 2.466, $P = .031$) after cycling was associated with higher ED risk.

Strengths & Limitations: Strengths include a large sample size of high-intensity cyclists and validated questionnaire use. Limitations include reliance on anonymous self-reported survey data and minimal inquiry into the riding preferences and terrain traversed by cyclists.

Conclusions: Pelvic pain and numbness are common complaints among male riders in the United States. Men with such complaints are more likely to also report ED especially if it occurs earlier in the ride. Although direction of causality and temporality are uncertain, alleviation of factors resulting in pelvic discomfort may reduce cycling's impact on sexual function. Such interventions are critical given that cycling for both active travel and aerobic exercise confers numerous health benefits. **Balasubramanian A, Yu J, Breyer BN, et al. The Association Between Pelvic Discomfort and Erectile Dysfunction in Adult Male Bicyclists. J Sex Med 2020;17:919–929.**

Key Words: Cycling; Erectile Dysfunction; Pelvic Discomfort; Adult Male; Bicycling

Received September 18, 2019. Accepted January 23, 2020.

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https://doi.org/10.1016/j.jsxm.2020.01.022

INTRODUCTION

Cycling remains a popular activity for leisure, sport, transportation, and fitness in the United States and across the globe.[1,2] Cycling adoption is projected to increase as urban planners expand bicycle infrastructure to reduce vehicle congestion and promote public health.[3] Cycling is considered a safe, low-impact activity that improves cardiovascular and metabolic health.[4–6] Cycling and aerobic exercise in general confer numerous health benefits including decreased blood pressure, regulation of blood sugar, and strengthening of the immune system.[7–9] Cycling has also been affiliated with mental health benefits including improvements in executive function and neuroplasticity.[10–12]

Despite its overall health benefits, increasing attention has been drawn to the sexual side effects including erectile dysfunction (ED) and perineal numbness that are associated with cycling.[13,14] Several vascular and neurogenic mechanisms have been thought to contribute to these sexual health outcomes of interest namely penile blood flow compromise and pudendal nerve compression.[15,16] As cycling is increasingly adopted across age groups for both exercise and recreation, further research is required to understand whether bicycle riders are at heightened risk for sexual dysfunction. A recent systematic review of physical activity interventions to improve erectile function showcased that cycling is frequently used as a modality to combat ED.[17] Owing to the fact cycling maybe increasingly pursued to improve overall health and reduce ED, it is vital to understand whether certain equipment choices or habits may worsen certain sexual health outcomes.

The proportion of cyclists reporting these symptoms has been identified to be a function of biking intensity and duration.[13,14] Various investigators have aimed to optimize the interface between rider and bicycle saddle to mitigate associated ED and genital numbness symptoms. Bicycle saddles are conventionally designed as narrow devices composed of a seat and elongated nose that enable the rider to bear bodyweight while riding. Breda et al highlighted that redesigned geometric saddles can more uniformly distribute compression pressures across the gluteus, ischiatic tuberosity, and ischial muscles and can thereby appreciably improve perineal perfusion.[18] Munnariz et al evaluated saddles designed without front nose extensions and demonstrated that this design improves penile hemodynamics.[19] Sanford et al incorporated seat post shock absorbers into traditional saddles and established that this modification can alleviate microtrauma to genital structures.[20]

Despite increasing research to improve bicycle design, few studies have characterized saddle preferences, associated symptoms, and cycling habits among the broader cycling community. It is critical to understand adoption trends among cyclists given that cycling for both active travel and aerobic exercise confers numerous health benefits. In this study, we sought to evaluate risk factors for sexual dysfunction in male cyclists from around the world with the primary intention of determining if genital/pelvic pain and numbness are associated with ED. Our hypothesis is that certain cycling habits and equipment preferences are more likely to be associated with increased rates of ED and genital numbness among male cyclists.

METHODS

Survey Recruitment

Cyclists were invited to complete an online, Stanford University School of Medicine Institutional Review Board—approved anonymous survey overviewing cycling habits and sexual health. Recruitment was targeted at individuals aged 18 years or older. Surveys were created and administered using the Qualtrics survey platform (Provo, UT). The electronic survey was distributed via various online cycling forums and social media. Several (>6) cycling publications based in the United States were contacted to help publicize the survey. Several cycling groups located in Northern California disseminated the survey via their email listservs. The survey was published on Facebook, and presentations were also published on websites affiliated with US cycling groups. Data were collected across a 2-year period from October 2016 through October 2018. Respondents to the survey were provided a formal consent form through the Qualtrics platform and were required to authorize their information for use in this study.

Survey Design

The survey collected demographic information including age, body mass index, race/ethnicity, and marital status. Participants were asked to report pertinent medical history such as hypertension, depression, hyperlipidemia, arthritis, and tobacco or alcohol use. Participants were asked to report cycling habits including preferred type of riding (road, mountain, triathlon), hours spent during each type of riding, distance cycled per week, number of years cycling, and preferred rider position on the saddle. Cycling equipment choices including bike type, saddle shape, cycling shorts padding/size, handlebar height, and saddle lubrication were also assessed. Survey participants were provided with multiple choice options to indicate their bicycle type, cycling short use, padding type, handlebar height, and saddle lubrication preferences. Survey participants could identify the saddle shape they used through both multiple-choice options and a series of images depicting whether a saddle was shaped as a dome, semi-dome, or flat.

Cyclists were asked to rate their sexual health using the validated Sexual Health Inventory for Men (SHIM) questionnaire.[21] Participants were classified with ED when their reported SHIM scores were less than 22. Moderate ED was defined as SHIM scores less than 17. Genital numbness and/or genital pain were other primary outcomes assessed by this survey. If a participant reported any of these symptoms, he was asked to specify the

Table 1. Demographic and clinical characteristics of male cyclists in study

Variable	Total cohort	Quartile 1	Quartile 2	Quartile 3	Quartile 4	*P* value
Number of participants	1,635	387	336	475	437	
Age distribution						
Less than 30	154	28.6%	24.7%	22.1%	24.7%	.1694
30 to 39	221	24.9%	16.3%	32.1%	26.7%	
40 to 49	298	21.1%	20.8%	31.9%	26.2%	
50 to 59	402	19.9%	23.1%	27.9%	29.1%	
60 and older	532	25.6%	19.0%	29.5%	25.9%	
Median BMI (IQR)	24.4 (22.6-27.0)	25.34 (23.5-28.1)	24.8 (22.8-27.0)	24.3 (22.3-26.6)	24.0 (22.3-26.3)	
Race/ethnicity						
African American	15	20.0%	20.0%	26.7%	33.3%	.2465
American Indian or Alaska Native	1	100.0%	0.0%	0.0%	0.0%	
Asian	59	37.3%	25.4%	22.0%	15.3%	
Caucasian	1,437	23.8%	20.5%	28.7%	27.0%	
Hispanic or Latino	40	10.0%	17.5%	37.5%	35.0%	
Native Hawaiian	3	0.0%	33.3%	33.3%	33.3%	
Other	72	18.1%	18.1%	36.1%	27.8%	
Marital status						
Dating (same partner for <6 months)	30	16.7%	23.3%	23.3%	36.7%	**.005802**
Dating (same partner for >6 months)	123	21.1%	21.1%	20.3%	37.4%	
Divorced	65	13.8%	9.2%	36.9%	40.0%	
Married or living as married	1,244	24.2%	21.5%	29.3%	25.0%	
Separated	12	25.0%	16.7%	8.3%	50.0%	
Single	140	27.9%	15.7%	32.1%	24.3%	
Widowed	14	14.3%	21.4%	50.0%	14.3%	
Medical history						
Arthritis	205	24.4%	17.1%	30.2%	28.3%	.4129
Depression	136	25.7%	16.2%	27.9%	30.1%	
High cholesterol	282	26.6%	20.9%	30.1%	22.3%	
Hypertension	194	23.7%	24.2%	23.7%	28.4%	
Alcohol use						
Yes	1,058	23.4%	20.6%	30.1%	25.9%	**.03124**
No	286	20.3%	19.6%	25.5%	34.6%	
Median number of drinks in past month	4 (2-7)	4 (1-8)	4 (2-7)	4 (2-8)	4 (1-7)	
Current smoker						
Yes	22	22.7%	9.1%	31.8%	36.4%	.5629
No	1,322	22.8%	20.6%	29.0%	27.7%	

(continued)

Table 1. Continued

Variable	Total cohort	Quartile 1	Quartile 2	Quartile 3	Quartile 4	*P* value
Median number of cigarettes/day (IQR)	10 (5.25-14.25)	15 (8-15)	10 (10-10)	10 (10-15)	3.5 (2-7.5)	
Former smoker						
Yes	337	22.8%	22.6%	33.2%	21.4%	**.01448**
No	1,007	22.7%	19.7%	27.6%	30.0%	
Number of years cycling						
Less than 2	77	51.9%	19.5%	15.6%	13.0%	**<.001**
2 to 5	244	23.8%	22.5%	32.4%	21.3%	
6 to 10	281	18.1%	23.8%	30.6%	27.4%	
Greater than 10	1,025	22.8%	19.4%	28.9%	28.9%	
Median days cycled						
Median kilometers (Km) per week	160 (96.6-221.3)	80.5 (48.3-98.3)	128.7 (96.6-160.9)	160.9 (128.7-209.2)	250 (193.1-321.9)	
Cycling type						
Road	1,578	22.8%	20.6%	29.2%	27.4%	**.004748**
Mountain	577	17.0%	22.0%	31.0%	30.0%	
Triathlon	72	12.5%	23.6%	25.0%	38.9%	
Spin/trainer	350	15.7%	22.0%	27.4%	34.9%	
Self-reported cycling preferences						**<.001**
Commuter	130	31.5%	20.8%	33.8%	13.8%	
Enthusiast	1,216	18.1%	21.1%	31.0%	29.9%	
Professional	37	0.0%	2.7%	2.7%	94.6%	
Recreational	249	50.6%	20.1%	21.3%	8.0%	

Bold values indicate statistically significant differences between quartiles.
BMI = body mass index; IQR = interquartile range.

Table 2. Relationship between cycling intensity, cycling equipment, and cycling habits

Variable		Total cohort	Quartile 1	Quartile 2	Quartile 3	Quartile 4	*P* value
Aero bar	Aero bars						
	Yes	190	20.0%	21.1%	23.2%	35.8%	.01589
	No	1,421	24.1%	20.8%	29.7%	25.5%	
Shorts	Shorts use						
	Yes	1,496	22.6%	20.9%	29.1%	27.3%	**.003526**
	No	116	37.1%	19.0%	25.9%	18.1%	
	Shorts size						
	Extra small (XS)	11	0.0%	18.2%	36.4%	45.5%	**.007744**
	Small (S)	117	20.5%	17.1%	30.8%	31.6%	
	Medium (M)	623	18.9%	19.4%	30.8%	30.8%	
	Large (L)	465	27.3%	22.4%	25.6%	24.7%	
	Extra large (XL)	238	23.1%	21.8%	31.9%	23.1%	
	Extra extra large (XXL)	38	34.2%	28.9%	23.7%	13.2%	
	Extra extra extra large (XXXL)	3	33.3%	66.7%	0.0%	0.0%	
	Presence of padding						
	Yes	1,474	22.2%	20.9%	29.4%	27.5%	**.004587**
	No	18	55.6%	22.2%	5.6%	16.7%	
	Lubrication use						
	Yes	675	16.6%	19.7%	31.9%	31.9%	**<.001**
	No	937	28.7%	21.6%	26.7%	23.1%	
Bike fit	Bike fit undertaken						
	Yes	898	19.5%	19.5%	30.6%	30.4%	**<.001**
	No	721	28.8%	22.3%	26.6%	22.2%	
	Measurement of ischial tuberosities (sit bones)						
	Yes	367	14.7%	20.2%	31.6%	33.5%	**.01383**
	No	202	24.3%	23.3%	26.2%	26.2%	
Saddle	Saddle length						
	Less than 250 mm	413	22.3%	19.4%	30.0%	28.3%	.752
	Greater than 250 mm	862	21.7%	22.0%	29.1%	27.1%	
	Different saddle widths available						
	Yes	658	18.8%	20.8%	29.6%	30.7%	**.003901**
	No	743	26.4%	20.6%	28.3%	24.8%	
	Saddle shape						
	Flat	620	22.4%	20.2%	29.7%	27.7%	.1677
	Semi-dome	685	22.0%	21.9%	29.6%	26.4%	
	Dome	144	31.9%	15.3%	25.0%	27.8%	
	Padding level						
	Minimal	774	20.5%	21.2%	30.5%	27.8%	**.02298**
	Moderate	545	27.2%	19.8%	28.6%	24.4%	

(continued)

Table 2. Continued

Variable		Total cohort	Quartile 1	Quartile 2	Quartile 3	Quartile 4	*P* value
	Heavy	17	47.1%	17.6%	17.6%	17.6%	
	None	172	21.5%	18.6%	25.0%	34.9%	
	Influenced by manufacturer marketing						
	Yes	438	25.6%	17.1%	29.7%	27.6%	.1871
	No	1,071	22.5%	21.8%	28.7%	27.0%	
Cycling habits	Ride on rough terrain (pot holes, curbs)						
	Yes	437	21.3%	16.2%	32.0%	30.4%	**.005802**
	No	1,175	24.5%	22.5%	27.7%	25.4%	

Bold values indicate statistically significant differences between quartiles.

anatomic location (penis, scrotum, perineal, buttocks), duration, and timing of onset after cycling. The survey was designed by authors of this study through a combination of expert opinion and literature review. The survey was pilot tested by authors and several local cycling groups to assess its clarity and adequacy before distribution.

Data Analysis

Respondents were classified into quartiles of cycling intensity based on the number of weekly hours ridden. Hours ridden was correlated to total distance using a Pearson correlation coefficient. Patient demographic and medical history were coded as categorical variables and are presented in Table 1. A chi-squared test for these categorical variables was performed to determine whether cycling intensity was independent of patient demographics and cycling habits. Microsoft Excel version 16.11 (Redmond, WA) was used for this analysis.

Multivariate logistic regression analysis was performed on this retrospective database to determine the association of cycling habits on sexual health while controlling for patient demographics and comorbidities. Cycling equipment including bike type, saddle characteristics, cycling shorts padding/size, and terrain were coded as categorical variables and used to predict the odds ratio (OR) of developing ED, genital pain, or genital numbness. Specific categorizations of bike type, saddle characteristics, and other variables are shown in Table 2. The anatomic location (ie, perineum, buttocks, penis, scrotum), duration, and time of onset after cycling of genital numbness and pain were correlated with developing ED using the SHIM score. All analyses were performed using SPSS version 24.0 (IBM Corporation, Armonk, NY). A Wald test was performed with 0.05 set as the threshold for significance.

RESULTS

A total of 1,635 participants completed the survey from the beginning to the end. Some survey participants elected to not respond to certain questions, and hence, the total number of responses may not total up to 1,635 for certain categories. Demographics and cycling habits for men included in this study are summarized in Table 1. A majority of men were over the age of 50 (58%, 934/1,607). Most participants were Caucasian (88%, 1,437/1,635) and married (77%, 1,244/1,607). A majority of men had been active cyclists for over 10 years (63%, 1,025/1,635). Nearly all participants (98%, 1595/1635) were from English-speaking countries.

Most men cycled using road bikes (97%, 1,578/1,635), followed by mountain bikes (35%, 577/1,635) and spin/trainer bikes (21%, 350/1,635). A total of 46% (760/1,635) of survey respondents used 2 or more cycle types. A list of auxiliary cycling equipment used by participants is presented in Table 2. Most respondents preferred riding using cycling shorts (93%, 1,496/1,612) with padding (99%, 1,474/1,492). Less than 57% of

Table 3. Multivariate regression for association between genital pain, numbness, and ED with cycling equipment

Variable	OR for ED (SHIM < 22)*	*P* value	OR for moderate ED (SHIM < 17)*	*P* value	OR for genital numbness*	*P* value	OR for genital pain*	*P* value
Type of bike								
Road	1.263	.749	0.875	.91	0.77	.711	0.476	.24
Mountain	1.245	.407	1.588	.283	0.883	.6	0.984	.939
Triathlon	0.408	.183	0.175	.145	1.377	.561	1.884	.188
Spin or training	0.864	.603	0.995	.99	1.613	.071	1.343	.203
Position on saddle								
Back	Referent		Referent		Referent		Referent	
Center	0.792	.452	0.968	.948	0.808	.481	1.021	.94
Forward	0.821	.623	1.155	.818	1.207	.634	1.237	.545
Terrain								
Rough	1.082	.75	1.919	.082	0.936	.771	1.059	.786
Aero bars								
Yes	0.998	.996	2.064	.17	0.924	.822	0.855	.638
Shorts size								
Small	0.546	.549	0.264	.416	2.656	.209	1.733	.572
Medium	0.523	.45	0.271	.357	2.789	.137	1.74	.527
Large	0.856	.847	0.464	.568	3.881	**.05**	1.622	.567
XL	0.694	.639	0.596	.689	3.558	.076	1.592	.571
XXL	Referent		Referent		Referent		Referent	
Lubrication								
Yes	0.819	.397	0.531	.088	1.076	.736	0.784	.226
Saddle length								
>250 mm	0.615	**.05**	0.542	.112	1.145	.559	0.999	.995
Saddle shape								
Dome	Referent		Referent		Referent		Referent	
Flat	1.319	.514	0.413	.121	1.335	.423	0.8	.513
Semi-dome	1.513	.319	0.579	.313	1.671	.153	0.902	.762
Padding								
No padding	Referent		Referent		Referent		Referent	
Minimum	0.883	.781	0.619	.498	1.17	.711	0.815	.592
Moderate	0.974	.955	0.717	.644	0.978	.959	1.284	.521
Heavy	1.807	.602	2.538	.531	0.64	.682	1.207	.857

Bold values indicate statistically significant OR following multivariate regression for association between genital pain, numbness, and ED with cycling equipment.
BMI = body mass index; ED = erectile dysfunction; HTN, hypertension; OR = odds ratio; SHIM = Sexual Health Inventory for Men.
*Adjusted for age, BMI, cycling intensity, partner status, HTN, arthritis, high cholesterol, depression.

Table 4. Multivariate regression between genital pain and numbness presentation with ED symptoms

Variable	OR for ED (SHIM < 22)*	*P* value	OR for moderate ED (SHIM < 17)*	*P* value
Anatomic location				
Penis numbness	1.453	**.048**	0.972	.915
Scrotum numbness	1.212	.341	1.061	.846
Perineal numbness	1.223	.273	1.501	.142
Buttocks numbness	1.229	.456	1.03	.941
Penis pain	0.842	.55	1.064	.887
Scrotal pain	1.324	.38	0.855	.767
Perineal pain	1.102	.726	2.973	**.014**
Buttocks pain	0.743	.305	1.002	.996
Duration				
Numbness resolves in few hours	Referent		Referent	
Numbness resolves in a day	2.787	**.017**	0.634	.567
Numbness resolves in several days	0.69	.568	n/a	n/a
Numbness resolves in a week	0.813	.864	n/a	n/a
Numbness resolves in several weeks	1.701	.583	n/a	n/a
Pain resolves in a few hours	Referent		Referent	
Pain resolves in a day	0.586	.09	0.561	.275
Pain resolves in a few days	0.465	.057	0.489	.276
Pain resolves in a week	0.336	.188	1.206	.836
Pain resolves in several weeks	0.846	.851	n/a	n/a
Time of onset after biking				
Numbness occurred < 1 hour	2.002	**.032**	2.817	**.041**
Numbness occurred between 1 to 5 hours	1.521	.106	1.855	.151
Numbness occurred > 5 hours	Referent		Referent	
Pain occurred < 1 hour	2.466	**.031**	5.075	**.015**
Pain occurred between 1 to 5 hours	2.893	**.002**	3.848	**.021**
Pain occurred > 5 hours	Referent		Referent	

Bold values indicate statistically significant OR following multivariate regression between genital pain and numbness presentation with ED symptoms.
BMI = body mass index; ED = erectile dysfunction; HTN, hypertension; OR = odds ratio; SHIM = Sexual Health Inventory for Men.
*Adjusted for age, BMI, cycling intensity, HTN, arthritis, high cholesterol, depression.

respondents (937/1,635) applied lubrication to further cushion the saddle surface. Approximately 55% (898/1,635) of men completed a bike fit. Most riders used saddles greater than 250 mm (53%, 862/1,635). Groove (33%, 545/1,635) and cut out (36%, 594/1,635) saddles were the most popular seat shapes. Twenty-seven percent (438/1,635) of cyclists considered manufacturer advertisement of health/safety benefits when purchasing their saddle. A total of 12% (190/1,611) of cyclists used Aero bars. Of these riders, 95% (180/190) used road bikes, 32% used (60/190) mountain bikes, 35% (66/190) used triathlon cycles, and 33% (62/190) rode on spin bikes/trainers. Among these survey respondents, 38% (73/190) rode exclusively on one form of biking modality. Road bikes (67/73) were the most common modality among riders riding on one bicycle type.

Cyclists were classified into quartiles based on the number of weekly hours ridden. The low-intensity quartile was comprised of cyclists who rode less than 6 hours a week, followed by the moderate-intensity quartile who rode between 6 and 8 hours a week. The high-intensity quartile was defined as men who cycle between 8 and 11 hours a week, and the very-high-intensity quartile was comprised of men who cycled for greater than 11 hours a week. Low-intensity riders preferred using padded saddles while high-intensity cyclists preferred seats with less padding ($P = .023$).

A total of 27% (437/1,612) of riders indicated that they stayed in the saddle when riding on rough terrain. Among these riders, a majority rode on road bikes (97%, 426/437), followed by mountain bikes (34%, 134/437), triathlon cycles (5%, 22/437), and lastly by spin bike/trainers (19%, 85/437). Of these survey respondents, 58% (253/437) rode on only one form of biking modality. Road bikes (245/253) were the most common modality among riders exclusively using one type of bicycle.

Multivariate regression analysis was performed to determine associations between cycling equipment and genital pain, genital numbness, and ED (Table 3). Overall, there was no association between cycling intensity (as measured by hours of riding per week) and erectile function. Moreover, hours ridden per week were found to be positively correlated to miles ridden per week with a Pearson correlation coefficient of 0.23 ($P < .001$). While controlling for age, race, body mass index, cycling equipment and intensity, and other medical comorbidities, the saddle shapes included in this survey were found to have minimal impact on genitourinary dysfunction.

We also analyzed the influence of the location, duration, and onset of genital pain and numbness on ED symptoms (Table 4). Men who experienced penile numbness were at higher risk of reporting lower SHIM scores (OR = 1.453, CI = 1.003 to 2.105, $P = .048$). Earlier onset of symptoms was associated with increased risk of developing ED. Numbness occurring less than 1 hour after cycling had greater odds of leading to diminished erectile function than numbness after 5 hours (OR = 2.002, CI = 1.063 to 3.769, $P = .032$). Similarly, genital pain occurring less than 1 hour (OR = 2.466, CI = 1.085 to 5.606, $P = .031$) or between 1 and 5 hours (OR = 2.893, CI = 1.461 to 5.731, $P = .002$) after cycling was associated with higher risk of ED compared with pain that began >5 hours into a ride. The association with the duration of numbness or pain did not follow a clear temporal pattern.

DISCUSSION

Cycling is a physical activity governed by a rider's contact between the handlebar, saddle, and pedals.[22] A rider's comfort and overall performance is influenced by positioning at each of these points. As cycling becomes an increasingly popular activity among the general public for transportation and exercise, further attention has been drawn to the saddle's potential adverse impact on rider comfort, fatigue, pain, and overall genitourinary function.[23] Schwarzer highlighted that certain saddle types are more likely to induce perineal compression and decrease penile blood flow, thereby placing riders at an increased risk of developing ED.[15] Other potential mechanisms of injury that have been explored include pudendal nerve compression which may further predispose riders to ED.[16] Despite these proposed mechanisms of injury, recent work by Awad et al demonstrated that cyclists did not have worse sexual or urinary function when compared with swimmers or runners.[14] The authors did however discover that cycling may place riders at risk for other genitourinary issues such as urethral strictures and genital numbness. Ultimately the authors highlighted that further work was required to understand the cycling habits and equipment factors that may contribute to the development of genitourinary issues among cyclists. In this study, we assessed whether various risk factors including saddle preferences and cycling habits may predispose men to developing genital/pelvic pain, numbness, and ED.

We observed that there were notable differences in cycling habits and equipment preferences after stratifying riders into intensity quartiles. As expected, it was observed that cyclists who were stratified into the very-high-intensity quartile, as determined by time spent on the saddle, had the highest median kilometers cycled per week. In addition, we observed that there were distinct cycling type and equipment preferences between the different quartiles. Cyclists in the high-intensity quartiles were more likely to use auxiliary equipment including aero bars and cycling shorts. Physicians counseling riders about the impact of cycling on overall health and genitourinary function should be vigilant of the heterogeneity of equipment choices among cyclists across intensities. This variability highlights that health-care practitioners should assess not only if cyclists are participating for commuting, recreational, or exercise reasons but also the overall volume of cycling they engage in. However, there was no association between bike fit, sexual function, and genital pain/numbness in the current report, suggesting that cycle fit optimization may not equate to saddle safety.

A multivariate analysis was performed to identify potential associations between genital pain, numbness, and ED with a rider's cycling equipment choice. After controlling for various demographic, medical history, and cycling intensity factors, it

was noted that saddle length greater than 250 mm was associated with lower risk of developing mild ED. This relationship between saddle length and ED development goes against prior studies that have proposed that minimizing saddle length or eliminating the saddle nose altogether may be an effective approach to reduce ED risk.[19,24] Our results therefore highlight that further work is required to identify whether certain subpopulations of riders may benefit from the presence of a nosed saddle.

Further analysis was performed to identify the relationship between genital pain, numbness, and ED. Indeed, genital numbness and pain were positively associated with ED. This finding highlights that riders should be vigilant about the development of numbness and pain, as well as the specific location where they are experiencing reduced sensation/discomfort. In addition, the onset of the numbness was related to the probability of developing ED, whereby men with rapid onset of numbness were at higher risk for reporting ED. Together, these features suggest that riders should be mindful of the context in which their numbness and pain presents and that these features are likely insightful into the eventual development of ED. The awareness of when these symptoms emerge has implications for both commuters as well as cyclists that participate recreationally in clubs.

Prior work by Baradaran et al did however conclude that genital numbness was not associated with worse sexual function among their study cohort.[13] Our results demonstrated parallel associations between genital pain and ED compared with their study. These differences underscore that further work is required to understand the impact of cycling on genitourinary symptoms across the spectrum of individuals who partake in the activity. An important consideration however is that participants in this study had lower rates of ED than a similar aged group from the general population.[25] The fact that certain subsets of cyclists may develop numbness and ED does not detract from the fact that cycling is largely protective against various ED risk factors including several components of metabolic syndrome.

Several limitations warrant mention. First, we used an anonymous self-reported survey to collect our data, which may be susceptible to recall bias or omission. Furthermore, our cross-sectional design does not permit the identification of causal pathways. Second, we sampled riders who visit cycling enthusiast websites and forums. Acquiring data from a population with higher cycling intensity may limit the generalizability of our findings to cyclists who do not ride a bicycle as often. In addition, 88% of our survey respondents were Caucasian. While cycling adoption has historically been concentrated among certain demographic categories, the broadening of the sport among different groups may temper the ability to translate our results across the evolving cycling landscape.[26] Third, our survey had limited inquiry into variables such as riding preferences and terrain that riders routinely cycle on. Then, we tested several cycling variables and identified associations that may have occurred by chance alone. As such, further research is required to characterize the impact that these cycling habits and environments have on the development of ED and other genitourinary symptoms. Similarly, we did not quantify the degree of pain and numbness which limited our ability to further investigate the influence of these variables of interest. Fourth, given the fact that many respondents used multiple types of bikes, it is possible that our conclusions about the relationship between equipment and ED may be less reliable. Furthermore, it is important to reiterate that the cardiovascular benefits experienced by cyclists will outweigh the impact of being on the saddle on sexual function and overall health.

CONCLUSIONS

In this study, we assessed the association of a range of risk factors on the development of sexual dysfunction in male cyclists. We first highlighted that there are considerable differences in cycling equipment choices among riders of differing cycling intensities. Moreover, we identified several features that may influence the development of ED and genital numbness. Specifically, we identified that saddle characteristics may be associated with rider comfort and sexual function. In addition, our study revealed that features such as the early onset of genitourinary pain and numbness may be more predictive of developing ED. Cyclists should be vigilant of pain or numbness in specific anatomic regions such as the penis or perineum as discomfort in these locations was associated with increased risk of ED. Future research further characterizing the development of genital numbness and pain may elucidate new opportunities to mitigate sexual side effects from cycling.

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Conflict of Interest: The authors have no disclosures pertaining to this article.

Funding: None.

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