Journal of Andrological Sciences 2008;15:170-176

Prevalence of erectile dysfunction and lower urinary tract symptoms in cyclists

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Summary

Objective. To verify the presence of erectile dysfunction (ED) and lower urinary tract symptoms (LUTS) in a population of cyclists. We also assessed the possible presence of prospective factors predictive of impairment in sexual and urinary functioning in cyclists.
Materials and methods. The data collected in a study population consisting of 404 cyclists were compared with those of a control population of 408 men. All the subjects enrolled in the study were invited to fill in a specific questionnaire designed for the purpose of collecting information on their general characteristics. For assessment of the LUTS the IPSS (International Prostate Symptom Score) was used, while sexual functioning was assessed by means of the IIEF (International Index Erectile Function). The characteristics of all the recruited subjects were correlated with the IPSS and IIEF scores. Subsequently the characteristics and results recorded for the cyclist population were compared with those of the control group. Multiple logistic regression was used for the multivariate analysis of the data. In the group of cyclists, the same analysis was used to see whether, and to what extent, the severity of each symptom reported by the athletes examined could be attributed to the characteristics of the subjects enrolled.
Results. Of the whole sample of 812 subjects studied, the IPSS, QL AND IIEF-5 showed to be significantly correlated ($p < 0.001$). The IPSS, QL, and IIEF-5 revealed significantly worse scores in the population of cyclists ($p < 0.001$). Moreover, in the multivariate analysis, age and amount of cycling practised showed to be the most predictive risk factors of a worsening of the urinary and erectile functioning. Considering solely the group of cyclists, the symptoms of compression of the perineal cavernous spaces when seated on the bicycle saddle showed to be significantly correlated with age and level of intensity of cycling.
Conclusions. The population of cyclists presents a higher prevalence of ED and/or LUTS compared to that found in the control group of non-cyclists. The most important predictive factors capable of interacting with sexual and urinary functioning were age and cycling, as well as the intensity of cycling within the cyclist group.

Introduction

The presence and intensity of the lower urinary tract symptoms (LUTS) secondary to cervico-urethral obstruction is significantly correlated

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to an increase of the prevalence of sexual dysfunctions [1], including erectile dysfunction (ED), ejaculatory dysfunctions (Dej) and loss of libido. There are multiple physiopathological hypotheses at the basis of this correlation (Table I), suggesting a cause-effect relation that to date has still not been exhaustively explained. Clearly the relation between LUTS and sexual dysfunctions may have a significant impact on the quality of life of those affected.

An increase in incidence of the sexual dysfunctions has been observed above all in cyclists who cover large distances [11 12] in particular erectile dysfunction, that may be attributed to compression of the neurovascular structures of the genito-perineal region [13]. For this reason technological research in recent years has focused on realizing a model of saddle that is capable of preventing excessive compression in the perineal region [14 15] while at the same time limiting possible repercussions regarding the sexual functions and also reducing the incidence of LUTS. In particular, Leibovitch et al. underlined the fact that the lower urinary tract symptoms seem to present more frequently in the cyclist population in comparison with the control group [16].

The aim of this study is to carry out a large-scale epidemiological investigation in order to examine the actual incidence of ED/LUTS in a population of cyclists and in a comparative group of non-cyclists, considering also the possibility of determining factors capable of predicting worsening of sexual and urinary functioning.

Materials and methods

We enrolled 404 amateur cyclists who covered average to long distances on their bicycles. Recruitment was carried out through distribution of invitations in cycling-gear shops or sport/recreational clubs. The control group for comparison consisted of 408 volunteers from various work environments who participated spontaneously in the project. Some of these subjects reported practising sports other than cycling at an amateur level, while others referred no physical activity at all. All participants in the study filled in a specific questionnaire prepared by the authors for the purpose of collecting general information (Table II). Also the IPSS (International Prostate Symptom Score) and the IIEF-5 (Index Erectile Function) were completed for assessment of the presence of LUTS and of sexual functioning. Subjects were classified according to age ((≤ 39 years; 40-49 years; ≥ 50 years) and severity of symptoms: mild-moderate LUTS (IPSS ≤ 19) or severe (IPSS ≥ 20); QoL (normal = 0-3; pathological = 4-6); moderate erectile dysfunction (IIEF ≥ 11) or severe (IIEF ≤ 10). The results obtained in the population of cyclists were then compared to those of the control group. A sample of about 400 subjects per group, in the case of prevalences around 50% (worst case), permits us to identify differences of 10% between cyclists and non-cyclists as being 95% significant (evaluation obtained with the Fleiss method) [17].

For the statistical analysis we studied the bivariate relations between the characteristics of the subjects being examined and the IPSS, QoL and IIEF-5 scores. In particular, the parametrical or non-parametrical correlations, and any dependencies, between general characteristics and results of the questionnaires were assessed by means of the chi-

Table I. Physiopathological hypotheses LUTS/sexual dysfunctions.

Theory of autonomous hyperactivity [2-3]
Theory of endothelial dysfunction [4-5]
Theory of activation of the Rho kinase system [6]
Theory of the metabolic syndrome [7]
Theory of atherosclerosis and of associated chronic ischemia [8]
Theory of anatomical factors for volumetric increase of the prostate and of the detrusor urinae muscle [9]
Hormone theory [10]

Table II. Questionnaire for data-collection filled in by participants.

Age (< 39; 40-49; > 50)
Weight
Smoking
Sports practised
Concomitant illnesses
Previous surgical operations
Drugs taken
Cyclist
Cyclist for 10 years
Hours on bike/week (< 3; 3-6; > 6)
Urinary infections
Tingling sensation in perineal region
Perineal pain
Perineal nodules
Haematuria
IPSS-QL
IIEF-5

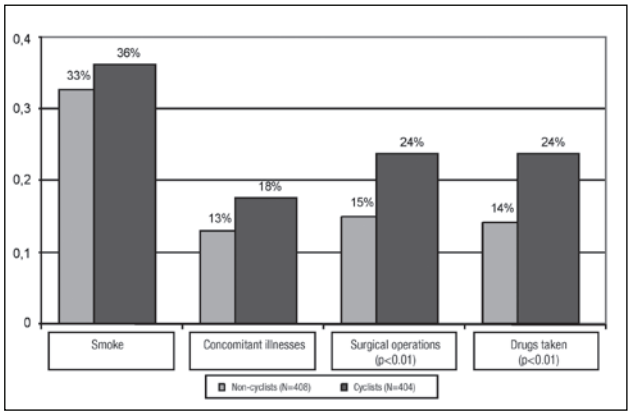
squared test. Differences between the two groups in terms of IPSS, QoL and IIEF-5 were analysed using Student's t-test. The multivariate analysis was performed through application of multiple logistic regression. Solely in the group of cyclists, the multivariate analysis was carried out to see whether and to what extent the presence and severity of each symptom (urinary infections, tingling sensation in the perineal area, perineal pain, perineal nodules, haematuria) could depend on the characteristics of the subjects recruited. The results of the logistic regression were expressed as odds ratio (OR) and confidence intervals (CI) at 95%. The statistical significance was considered for two-tailed values of $p < 0.05$. Statistical analysis of the data was performed with SPSS 12.0.21 for Windows, SPSS INC., Chicago, Illinois.

Results

The descriptive characteristics of the sample are shown in Table III. The average age of the 812 subjects was 46.4 years (± 11.5 SD) (standard deviation) and the average weight was 74.8 kg ± 6.9. There were some smokers among the subjects in the sample (non-cyclists 32.7%, cyclists 36.1%); others were affected by concomitant pathologies (non-cyclists 13%, cyclists 17.6%), or had already undergone abdomen-pelvic surgery (non-cyclists 15%, cyclists 23.8%).

Figure 1 shows the distribution of the main characteristics of the cyclists and non-cyclists, highlighting that the percentages of surgical operations undergone and drugs taken were significantly different in the two groups ($p < 0.01$). The cyclists and the control group had an average age of 47.8 and 45 years respectively; statistical analysis also considered the subjects of each single group classified in three age-groups as follows: ≤ 39 years; 40-49 years; ≥ 50 years.

Figure 1. Characteristics of the population studied.



The median scores on the IPSS (non-cyclists: 5.6 ± 5,1; cyclists: 13.9 ± 7,3), on the IIEF-5 (non-cyclists: 22.4 ± 2,6; cyclists: 18.5 ± 3,7) and on the QoL (non-cyclists: 1.2 ± 0,9; cyclists: 3.0 ± 1,3) were signifi-

Table III. Descriptive characteristics of the sample.

	TOTAL	NON-CYCLISTS	CYCLISTS
No. of patients	812	408	404
Average age	46,4	45,0	47,8
± SD	11,5	12,1	10,6
-39	27%	33%	22%
40-49	26%	26%	25%
50+	47%	42%	52%
Average weight	74,8	75,2	74,4
± SD	6,9	7,1	6,7
Smoking	279	133	146
%	34,4%	32,7%	36,1%
Sport	549	154	404
%	67,6%	37,7%	100%
Concomitant illnesses	124	53	71
%	15,3%	13,0%	17,6%
Surgical operations	157	61	96
%	19,3%	15,0%	23,8%
Drugs taken	154	58	96
%	19,0%	14,2%	23,8%
IPSS	9,7	5,6	13,9
± SD	7,5	5,1	7,3
IIEF-5	20,5	22,4	18,5
± SD	3,8	2,6	3,7
QL	2,1	1,2	3,0
± SD	1,4	0,9	1,3
Cyclist for			
-10 years			128
%			31,7%
+10 years			276
%			68,3%
Hours on bike			
-3 hours/wk			48
%			11,9%
3-6 hours/wk			241
%			59,7%
+6 hours/wk			115
%			28,5%

cantly different between the two groups ($p < 0.001$). Graphs 2-4 show the distribution of the subjective evaluations of state of health (IPSS, QL, IIEF-5) in the two groups in question and in relation to the three age-groups considered.

In the total sample of subjects recruited, the IPSS, QoL and IIEF-5 showed to be significantly correlated ($p < 0.001$) with regard to almost all of the characteristics of the participants: age, concomitant illnesses, surgical operations, drugs administered, sport practised in general, cycling ($p < 0.001$).

Table IV illustrates how much the characteristics of the subjects initially assessed significantly influence the scores of the IPSS and QoL. With regard to the IIEF-5, the test is mainly non-significant or not applicable due to the low number of severe cases recorded, all of whom were cyclists (Tab IV). In the multivariate analysis, age and cycling emerged as the most significant risk factors for worsening of erectile and urinary functioning. The probability that cyclists have high scores on the IPSS was ten times greater (Confidence Interval at 95%: 5.3-20.7) compared to the non-cyclists. QoL is correlated to urinary symptoms and the probability of scoring between 4-6 is almost 27 times greater for cyclists (CI 12.8-56.7). The probability of having moderate or severe scores on the IIEF-5 is 15 times greater for cyclists (CI 7.8-30.1). As for age, subjects in the age-groups of 40-49 years and over 50 years present a probability of having severe scores on the IPSS respectively more than 20 times (CI 2.9-164.3) and more than 30 times (CI 4.3-235.6) greater when compared to subjects younger than 40 years.

When analyzing solely the group of cyclists, the presence of urinary infections, tingling sensation in the perineal area, perineal pain and haematuria emerged as being statistically correlated to severity of LUTS and to the presence of erectile dysfunction (Tab. VI). The multivariate analysis illustrates how the urinary infections, tingling sensation and perineal pain depend significantly on age and on intensity of cycling (intended as number of hours per week), while only occasionally on smoking (urinary infections) or number of years spent cycling (perineal pain). The probability that cyclists over 40 years old present urinary infections or perineal nodules is respectively 2.4 (CI 1.4-4.2) and 2.9 (CI 1.6-5.1) times greater than those younger than 40 years old. For the same symptoms the probability is more than 4 times greater for those who do more than 6 hours of cycling a week (more than 3 hours for the urinary infections), compared to those who do less than 3 hours/week. The presence of haematuria does not appear to significantly depend on any of the predictors considered.

Discussion

Our epidemiological study, carried out on a vast sample of subjects, has revealed a greater incidence of erectile dysfunction and LUTS in the population of cyclists compared to the control group of subjects not practising this sport. Moreover, the results obtained in our study demonstrate that when considering solely the group of cyclists, age and intensity of cycling (hours/week) are the two factors that prevalently influence urinary and erectile function in a negative sense. These data, which refer to an Italian population, are in line with what has already emerged in international literature. In cyclists, prevalently in those who cover long distances[11,12], an increase has been observed in the incidence of pathologies that may be attributed to direct compression of the structures of the genito-perineal region. This compression is responsible for the manifesting of various clinical

Table IV. Impact of the principal characteristics of the population studied on IPSS,
IEF-5 and QoL (chi-squared).

	IPSS	IIEF-5	QOL
Age	< 0,001	NA	< 0,001
Weight	= 0,019	NA	= 0,047
Smoking	< 0,001	NS	< 0,001
Sports practised	< 0,001	= 0,036	< 0,001
Concomitant illnesses	< 0,001	NS	< 0,001
Surgical operations	< 0,001	NS	< 0,001
Drugs taken	< 0,001	NS	< 0,001
Cyclist	< 0,001	= 0,002*	< 0,001

* Fisher's exact test.

Figure 2. IPSS: comparison between cyclists and non-cyclists.

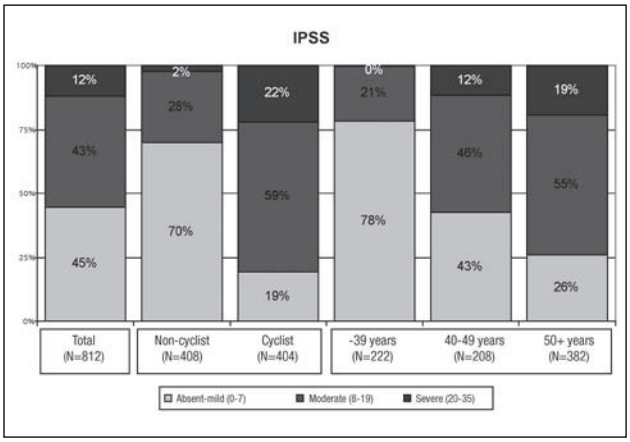


Table V. Multivariate analysis on whole population studied. Multiple logistic regression.

PREDICTORS	IPSS MILD-MODERATE (697) *VS.* SEVERE (87)		IIEF-5 ABSENT-MILD (684) *VS.* MODERATE-SEVERE (126)		QOL 0-3 (631) *VS.* 4-6 (103)	
	Severe/total (%)	OR (CI at 95%)	Moderate-severe/total (%)	OR (CI at 95%)	[0-3]/total (%)	OR (CI at 95%)
Age						
-39	1/222 (0)	Reference	8/222 (4)	Reference	2/222 (1)	Reference
40-49	24/208 (12)	21,7 (2,9-164,3)**	42/208 (20)	5,8 (2,5-13,1)**	38/208 (18)	21,57 (5-93,0)**
50+	74/382 (19)	31,8 (4,3-235,6)**	77/382 (20)	4,2 (1,87-9,3)**	107/382 (28)	29,7 (7,0-125,4)**
Weight						
-69	8/142 (6)	Reference	18/142 (13)	Reference	16/142 (11)	Reference
70-79	74/519 (14)	2,5 (1,1-5,6)*	81/519 (16)	1,3 (0,7-2,4)	98/519 (19)	1,7 (0,9-3,3)
80+	17/151 (11)	1,7 (0,7-4,3)	28/151 (19)	1,7 (0,8-3,5)	33/151 (22)	2,1 (1,0-4,6)
Smoking						
No	49/532 (9)	Reference	76/532 (14)	Reference	76/532 (14)	Reference
Yes	50/279 (18)	1,5 (0,9-2,4)	51/279 (18)	1,0 (0,6-1,6)	71/279 (25)	1,6 (1,0-2,6)*
Cyclist						
No	10/408 (2)	Reference	10/408 (2)	Reference	8/408 (2)	Reference
Yes	89/404 (22)	10,4 (5,3-20,7)**	117/404 (29)	15,4 (7,8-30,1)**	139/404 (34)	26,9 (12,8-56,7)**
Concomitant illnesses						
No	65/688 (9)	Reference	96/688 (14)	Reference	104/688 (15)	Reference
Yes	34/124 (27)	1,8 (0,9-3,5)	31/124 (25)	1,0 (0,5-1,9)	43/124 (35)	1,5 (0,8-2,9)
Surgical operations						
No	60/655 (9)	Reference	83/655 (13)	Reference	92/655 (14)	Reference
Yes	39/157 (25)	1,2 (0,7-2,2)	44/157 (28)	1,6 (0,9-2,7)	55/157 (35)	1,5 (0,8-2,5)
Drugs taken						
No	59/658 (9)	Reference	84/658 (13)	Reference	94/658 (14)	Reference
Yes	40/154 (26)	1,1 (0,6-2,2)	43/154 (28)	1,4 (0,7-2,6)	53/154 (34)	1,0 (0,5-1,8)

** $p \leq 0.001$; * $p \leq 0.05$.

symptoms such as tingling sensation in the perineal area, sexual dysfunctions, erectile deficit, prostatitis, LUTS, priapism, haematuria, perineal nodular lesions, infertility etc., all of which may exert a negative influence on the sexual and urinary functions of the cyclist.

It is commonly known that cycling has become increasingly popular in recent years, which has lead to the development of new technical potential and sporting gear. The data of our study support the need for progress in this field to advance in the realization of specific models of bicycle saddles that are designed to prevent excessive compression of the perineal region[14,15]. With this sort of technological progress, the possible repercussions on sexual functioning due to compression of the neuro-vascular structures may be limited, thus permitting also a reduction of the incidence of lower urinary tract symptoms which seem to be more frequently found in the cycling population compared to those who do not practise this sport[16].

Research has thus moved in the direction of realizing bicycle saddles that are capable of avoiding excessive perineal compression. An important contribution has been that of identifying a product which limited the compression of the neuro-vascular structures while at the same time presenting a conformation compatible with the exigencies of cyclists.

The SMP [15] saddle seems to have many of the tar-

Table VI. Impact of the principal symptoms registered in the population of cyclists on IPSS, IIEF and QoL.

	IPSS	IIEF-5	QOL
Urinary infections	< 0,001	NS	< 0,001
Tingling in perineal area	< 0,001	< 0,05	<0,001
Perineal pain	< 0,001	< 0,005	< 0,001
Perineal nodules	< 0,1	< 0,005	NS
Ematuria	< 0,01	< 0,05	< 0,005

Figure 3. QoL: comparison between cyclists and non-cyclists.

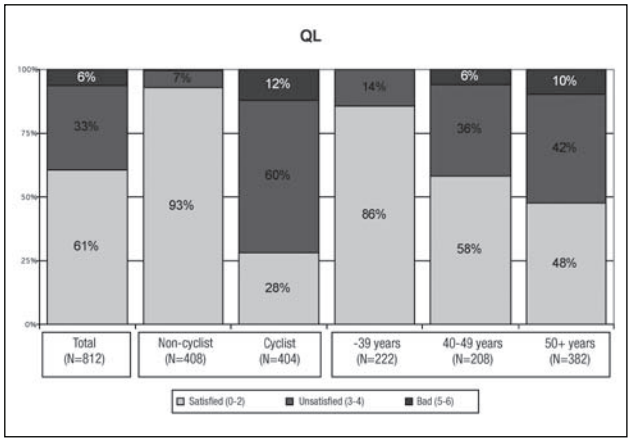
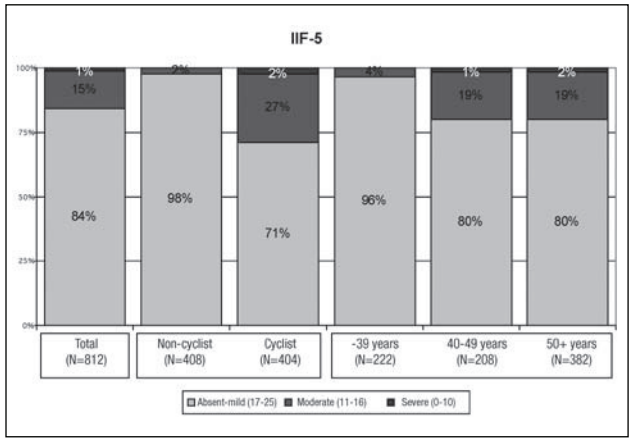


Figure 4. IIEF-5: comparison between cyclists and non-cyclists. SMP saddle



geted requisites, presenting a sitting position that is uniformly distributed over the gluteal muscles, the ischial tuberosity and the ischium while leaving the perineal region clear. Moreover, the inclined 'beak' of the saddle leaves the external genitalia completely free of compression. These advantages have been acquired in consideration of the dimensions preferred by cyclists. In fact, this model presents a posterior width of 140 mm and an anterior width of 45 mm where the structure has an inclination of 60°. The central width is 75 mm, while the geometry of the saddle conforms to the musculature of the thighs, the specific purpose being to avoid rubbing or friction of the gracilis and adductor muscles which can subsequently provoke irritation in the lower limbs during the action of pedalling. In actual fact, it is typical of professional cyclists to pedal with knees turned in towards the frame of the bike in order to increase strength and output.

In line with what has been widely reported in many

Table VII. Multivariate analysis in the cyclist population. Multiple logistic regression: cyclist population.

PREDICTORS	OR (CI AT 95%)				
	URINARY INFECTIONS	TINGLING SENSATION IN PERINEAL AREA	PERINEAL PAIN	PERINEAL NODULES	HAEMATURIA
Age					
-39	Reference	Reference	Reference	Reference	Reference
+40	2,4 (1,4-4,2)**	2,9 (1,6-5,1)**	1,8 (1,1-3,0)*	1,2 (0,5-2,5)	1,8 (0,6-5,5)
Weight					
-74	Reference	Reference	Reference	Reference	Reference
+75	1,1 (0,7-1,7)	1,7 (1,0-3,0)*	1,2 (0,7-1,9)	0,9 (0,5-1,6)	0,9 (0,4-1,9)
Smoking					
No	Reference	Reference	Reference	Reference	Reference
Sì	1,6 (1,0-2,5)*	1,2 (0,7-2,1)	1,3 (0,8-2,2)	2,5 (1,4-4,6)*	1,8 (0,8-3,9)
Cyclist for					
-10 years	Reference	Reference	Reference	Reference	Reference
+10 years	0,8 (0,5-1,2)	1,5 (0,9-2,6)	2 (1,2-3,3)*	1 (0,5-2,1)	2,2 (0,8-6,3)
Hours on bike					
-3 hours/wk	Reference	Reference	Reference	Reference	Reference
3-6 hours/wk	4,1 (1,8-9,5)**	1,5 (0,7-2,9)	2,8 (1,4-5,4)*	1,6 (0,5-4,8)	0,8 (0,2-3,0)
+6 hours/wk	4,5 (1,8-11,3)**	4,8 (1,9-12,2)**	2,6 (1,2-5,7)*	1,8 (0,5-6,0)	1 (0,2-4,2)

* $p \leq 0,05$; ** $p \leq 0,001$.

other studies, also our contribution has highlighted the prevalence of ED and LUTS in the cyclist population compared to a control group; as such, our findings confirm that cyclists undoubtedly represent a category which deserves monitoring with greater attention for its higher incidence of urological and andrological pathologies.

Conclusions

The data obtained from our epidemiological study have evidenced how cyclists present a very significant incidence of ED and LUTS in comparison with a non-cyclist population. The most important predictive factors that are capable of interacting with sexual and urinary functioning are age and cycling. Within the cyclist group, intensity of cycling (in terms of hours/week) seems to be the most important element for determining a worsening of erectile and urinary functions. The onset of symptoms such as tingling sensation and perineal pain, together with urinary infections in the cyclist population depends significantly on the age of the subject and on the intensity with which he practises cycling.

Bibliography

1 Casarico A, Pescatori ES. *LUTS/IPB and male sexual dysfunctions: evidence-based data*. GIMSeR 2006;13:19-36.

2 McVary KT, Razzaq A, Lee C, Venegas MF, Rademaker A, McKenna KE. *Growth of the rat prostate gland is facilitated by the autonomic nervous system*. Biol Reprod 1994;51:99-107.

3 Becker AJ, Uckert S, Stief CG, Scheller F, Knapp WH, Hartmann U, Jonas U. *Cavernous and systemic plasma levels of norepinephrine and epinephrine during different penile conditions in healthy men and patients with erectile dysfunction*. Urology 2002;59:281-6.

4 Takeda M, Tang R, Shapiro E, Burnett AL, Lepor H. *Effects of nitric oxide on human and canine prostates*. Urology 1995;45:440-6.

5 Steers WD, Clemow DB, Persson K, Sherer TB, Andersson KE, Tuttle JB. *The spontaneously hypertensive rat: insight into the pathogenesis of irritative symptoms in benign prostatic hyperplasia and young anxious males*. Exp Physiol 1999;84:137-47.

6 Bivalacqua TJ, Champion HC, Usta MF, Cellek S, Chitaley K, Webb RC, et al. *RhoA/Rho-kinase suppresses endothelial nitric oxide synthase in the penis: a mechanism for diabetes associated erectile dysfunction*. Proc Natl Acad Sci 2004;101:9121-6.

7 Mc Vary KT, McKenna KE. *The relationship between erectile dysfunction and LUTS: epidemiological, clinical and basic science evidence*. Curr Urol Rep 2004;5:251-7.

8 El-sakka A. *Lower urinary tract symptoms in patients with erectile dysfunction: is there a vascular association?* Eur Urol 2005;48:319-25.

9 Chang S, Hypolite JA, Zderic SA, Wein AJ, Chacko S, DiSanto ME. *Enhanced force generation by corpus cavernosum smooth muscle in rabbit with partial bladder outlet obstruction*. J Urol 2002;167: 2636-44.

10 Rosen RC, Giuliano F, Carson CC. *Sexual dysfunction and lower urinary tract symptoms (LUTS) associated with benign prostatic hyperplasia (BPH).* Eur. Urol 2005;47:824-37.

11 Taylor JA, Kao T, Albertsen P, Shabsigh R . *Bicycle riding and its relationship to the development of erectile dysfunction*. J Urol 2004;172:1028-31.

12 Marceau L, Kleinman K, Goldstein I, McKinlay J. *Does bicycling contribute to the risk of erectile dysfunction? Result from the Massachusetts Male Aging Study (MMAS).* Int J Impot Res 2001;13:298-302.

13 Mackinnon SE. *Pathophysiology of nerve compression*. Hand Clin 2002;18:231-41.

14 Schwarzer U, Sommer F, Klotz T, Cremer C, Engelmann U. *Cycling and penile oxygen pressure: the type of saddle matters*. Eur Urol 2002;41:139-43.

15 Breda G, Piazza N, Bernardi V, Lunardon E, Caruso Adara. *Development of a new geometric bicycle saddle for the maintenance of genital-perineal vascular perfusion*. J Sex Med 2005;2:605-11.

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

17 Fleiss JL. *Statistical methods for rates and proportions*. 1st ed. New York, NY: John Wiley & Sons Inc 1973, pp. 23-34.