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L Marceau

Kenneth Kleinman

I Goldstein

J McKinlay



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# Does bicycling contribute to the risk of erectile dysfunction? Results from the Massachusetts Male Aging Study (MMAS)

L Marceau, K Kleinman, I Goldstein and J McKinlay

An association between bicycling and erectile dysfunction (ED) has been described previously, but there are limited data examining this association in a random population of men. Such data would incorporate bicyclists with varied types of riding and other factors. Data from the Massachusetts Male Aging Study (MMAS) were utilized to examine the association between bicycling and ED. Logistic regression was used to test for an association, controlling for age, energy expenditure, smoking, depression and chronic illness. Bicycling less than 3 h per week was not associated with ED and may be somewhat protective. Bicycling 3 h or more per week may be associated with ED. Data revealed that there may be a reduced probability of ED in those who ride less than 3 h per week and ED may be more likely in bikers who ride more than 3 h per week. More population-based research is needed to better define this relationship.

**Keywords:** bicycling; erectile dysfunction; epidemiology; aging; men

## Introduction

> *'The constant jolting on their horses unfits them for intercourse … the great majority among the Scythians become impotent … this affliction affects the rich Scythians because of their riding, not the lower classes .. . the poor, who do not ride, suffer less.'* [1]

Erectile dysfunction (ED) has affected men since as early as the eighth century BC when the Scythians traveled throughout the region by horseback. ED has been well-documented but not well understood and continues to be stigmatizing for men. It was not until recently that scientists understood the pathophysiology of ED. Prior to recent clinical research, ED was largely considered psychogenic and treated with psychotherapy, or simply dismissed as an inevitable consequence of aging. Recent work[2 - 6] shows that it often has a physiologic component, which varies in severity and based on a subject' s perceptions of how ED is related to quality of life. Epidemiologic studies and randomized clinical trials have better defined ED and its associated risk factors.[3] In the 800s BC, Scythians identified their form of transportation (horseback riding) as a possible cause of impotence. Today, there is growing literature on the possible association of another form of transportation with ED — bicycle riding.

Bicycling has been a common form of transportation and recreation for centuries with roots as far back as ancient China, Egypt and India.[7] Today, individuals use bicycles for transportation, relaxation, exercise and weight loss.[7,8] Aerobic exercise such as biking is known to reduce disease risk (diabetes, high blood pressure) and has pronounced cardiovascular benefits.

Coinciding with the advantages of bicycling, however, is growing attention to the possible negative consequence of bicycling — ED. Erectile potency in the general population of cyclists is of particular interest because cyclists are typically a healthy, athletic population, often without the accepted risk factors for ED.[3,9] While population-based studies of randomly sampled men have not yet been done to specifically investigate the association between bicycling and ED, some data (case reports, observational, case - control and pathophysiologic studies) support this association and are briefly discussed here.

Case reports and case series[10 - 12] have documented bicyclists with erectile and=or perineal nerve sensory dysfunction symptoms which resolved with rest, altering cycling technique, softer saddle resolved symptoms, or either after ceasing bicycling. Small observational studies and case series have also supported an association between cycling and ED, showing a relatively high prevalence of ED

among elite cyclists,[13] and that among members of a Boston-area bicycling club and running club, bicyclists were more likely to have ED, penile numbness, sensation changes with ejaculation, and difficulty urinating than runners without biking exposure.[14] Pathophysiologic investigations of cyclists have described compression-based alterations of critical perineal structures. Studies have demonstrated that penile blood flow decreases significantly during 3 min stationary, but returns to values higher than baseline after 1 min of cycling in a standing position,[15] perineal compression reduces penile blood pressure by an average of 50 mmHg, cavernosal artery peak systolic velocity is diminished in impotent men who sat on narrow *vs* wide bike seats, chairs or who lay supine,[16,17] and that arteriographic compressed common penile, proximal cavernosal arteries in impotent men who had a narrow straddle-type seat placed in their perineum during selective internal pudendal arteriography.[16]

This body of research suggests a relationship between ED and bicycling. However, many of these studies have been conducted on atypical cyclist populations, often in a clinic and on quite small numbers. The association between cycling and ED has not yet been examined in a population-based random sample survey of men and thus is not generalizable to the whole population of cyclists. To our knowledge, this is the first epidemiologic study to investigate whether bicycling contributes to the risk of ED in a population of mid-aged men. Our central research aim was to elucidate whether an association exists between cycling and ED. The Massachusetts Male Aging Study (MMAS) offers several advantages compared with other previously collected data:

(1) It is a large cross-sectional survey of 1709 free-living men aged 40 – 70 y enabling generalizability to a similar population.
(2) The population was randomly sampled from the Boston Metropolitan area and is much larger than any other study on ED and bicycling.
(3) A multidisciplinary approach captured biophysiologic and psychologic data, unlike studies focusing primarily on the physiologic component.
(4) The sample does not exclusively focus on 'serious' cyclists (ie club members, long-distance racers) and the men in the MMAS sample rode for a broad range of reasons (ie recreation, sport=competition, transportation).

## Methods

The baseline MMAS was conducted in 11 randomly selected Boston communities with probabilities proportional to population within each of six strata defined by community size and median income. Men were drawn at random from the annual state census listings, with sampling fractions adjusted to produce a uniform distribution across this range.

Introductory letters were sent to 5287 men, followed by telephone recruitment. During the survey period, 1709 men (52% of those eligible) completed a baseline evaluation. This response rate is comparable to other epidemiologic studies, such as NHANES, involving early morning sampling. The MMAS participants were typically Caucasian (95%), employed (78%) and married (75%). The low (5%) proportion of non-Caucasians is consistent with the composition of the Massachusetts population at the time of the sampling.

Details of the field protocol for the MMAS have been previously described.[3,4,9] Trained interviewer phlebotomists visited subjects in-home and completed health and diet questionnaires, psychological instruments and physiological measurements. Weight, height and blood pressure were measured, and blood was drawn within 4 h of the subject's awakening for lipids and sex steroid hormones analysis.

Physical activity was assessed by activity recall, frequency and duration over the previous seven days. Erectile function was determined by a self-administered 23-item sexual activity questionnaire.[4] The questionnaire contained specific questions on erectile function (frequency and quality) and other aspects of sexual activity. Nine items were directly related to potency and were used to generate a direct assessment of ED.[3,18,19] An algorithm was derived in which each subject was assigned to one of four categories: No ED, minimal, moderate, or complete ED.

### *Statistical methods*

We used logistic regression to evaluate the association between bicycling and ED. ED is dichotomized as none or minimal ED *vs* moderate or complete ED. Bicycling is categorized by amount of time spent on a bicycle: no biking, less than 3 h per week (moderate cyclists), and 3 h or more per week (sport cyclists). We defined 3 h of cycling or less as moderate cycling based on average cycling times and distance from recent publications.[8,20,21] Three hours of cycling at an average speed is approximately 39 miles of cycling per week. This would be equivalent to nearly 6 half-hour sessions on a stationary bike, or a 15-min commute each way per day for a week. In the general population, only 15% of Americans participate in 20 or more minutes of physical activity three times per week[7] which is well within our cut-off point of 3 h or less. It is reasonable to assume that the moderate cyclists in the MMAS are more likely to represent the general

population of cyclists than 'elite' cyclists reported in other studies. Men in the sport cycling group would include the bicycling enthusiasts (eg touring, racing).

We included kilocalories expended in the logistic regressions to control for the effect of general physical activity. The effect of bicycling in these models is that of substituting bicycling for another activity while keeping kilocalories expended at a constant level. We transformed kilocalories expended per day by taking its natural logarithm in order to reduce skewness and the possibility of undue influence from observations with extremely high values.

We controlled statistically for cancer, diabetes, and high blood pressure (all determined by self-report) and depression by including them as covariates in the analysis. Depression was based on the Center for Epidemiologic Studies Depression Scale (CES-D)[22] score dichotomized at 16. Each of these factors might be related to ED and bicycling, and could confound the relationship. Since the measure of physical activity assessed activity level over the previous 7 days, men interviewed from December to February were omitted in these analyses. If men who had bicycling-related ED were interviewed but did not cycle in the winter months, including them might bias results.

## Results

Table 1 shows descriptive statistics for non-bicyclists, moderate and sport bicyclists. Sport cyclists were younger on average (50.9 y) than moderate cyclists (53.3 y), who were still younger than non-bicyclists (54.9 y). Bicyclists have proportionately less moderate or complete ED (17% and 10% for $>3$ and $<3$ respectively) than non-bicyclists (21%). Non-bicyclists expended slightly more energy on average (746.1 kcal=day) than moderate cyclists (584.3 kcal=day); sport cyclists expended more than non-bicyclists (927.8 kcal=day). A similar pattern was seen in the proportion of depression, high blood pressure and cancer. Diabetes was most common among non-bicyclists (8%), with similar proportions among moderate (3%) and sport cyclists (4%).

Table 2 represents the results of logistic regression to examine the associations between bicycling and moderate or complete ED among all subjects in the MMAS with complete data on ED, cycling and covariates. The second column (labeled 'Unadjusted') shows results for the effect of bicycling without adjustments for any covariates. Moderate cyclists were less likely than those who do not bicycle to have moderate or complete ED (odds ratio (OR) ¼ 0.48, 95% confidence interval 0.25 – 0.95). The same is true for sport cyclists (OR ¼ 0.82, 95% CI 0.28 – 2.42). The third column (labeled 'Adjusted') is adjusted for age, energy expenditure, BMI, cigarette smoking, depression, cancer, high blood pressure and diabetes. While moderate cyclists were still less likely to have moderate or complete ED (OR ¼ 0.61 CI 0.30 – 1.22), sport cyclists were more likely to have moderate or complete ED (OR ¼ 1.72), though the confidence interval is wide (0.55 – 5.40).

**Table 2** Unadjusted and adjusted association of baseline cycling with erectile dysfunction (ED) in respondents to the Massachusetts Male Aging Study (Boston, MA) interviewed between March and November (1987 – 1989) with complete data on ED, cycling and covariates ($n$ ¼ 1277)

| | *Erectile dysfunction (ED)* | |
|---|---|---|
| | *Unadjusted OR (95% CI)* | *Adjusted*[a] *OR (95% CI)* |
| Moderate cycling[b] | 0.48 (0.25, 0.95) | 0.61 (0.30, 1.22) |
| Sport cycling[c] | 0.82 (0.28, 2.42) | 1.72 (0.55, 5.40) |

[a]Controlled for age, log kcal=day, BMI, weight, cigarette smoking, depressive symptoms, cancer, high blood pressure and diabetes.
[b]Moderate cycling defined as cycling greater than 0 and less than 3 h per week.
[c]Sport cycling defined as cycling 3 h or more per week.

**Table 1** Selected characteristics of respondents to the Massachusetts Male Aging Study (Boston, MA) who were interviewed between March and November (1987 – 1989) with complete data on included variables ($n$ ¼ 1277)

| | *Non cyclists* | | *Moderate cyclists* | | *Sport cyclists* | |
|---|---|---|---|---|---|---|
| | n *(%)* | *Mean (s.d.)* | n *(%)* | *Mean (s.d.)* | n *(%)* | *Mean (s.d.)* |
| Subjects | 1164 (100%) | | 90 (100%) | | 23 (100%) | |
| Age | | 54.9 (8.9) | | 53.3 (8.7) | | 50.9 (7.0) |
| kcal=day expended | | 764.1 (1065.3) | | 584.3 (1022.0) | | 927.8 (835.7) |
| BMI | | 27.4 (4.5) | | 27.0 (3.7) | | 26.9 (4.5) |
| Cigarette smoker | 295 (25%) | | 10 (11%) | | 2 (9%) | |
| Depressed | 141 (12%) | | 15 (17%) | | 1 (4%) | |
| High blood pressure | 352 (30%) | | 31 (34%) | | 4 (17%) | |
| Cancer | 71 (6%) | | 7 (8%) | | 0 | |
| Diabetes | 88 (8%) | | 3 (3%) | | 1 (4%) | |
| Moderate=complete ED | 239 (21%) | | 10 (11%) | | 4 (17%) | |

## Conclusion and implications

Results suggest that without considering other associated factors, the proportion of men with ED is smaller both among moderate or sport cyclists when compared to non-cyclists. Controlling for age, energy expenditure, BMI, smoking and depression, moderate cyclists are less likely to have ED, but sport cyclists appear more likely to have ED. In both cases these associations have very wide CIs. However, a *post-hoc* power analysis shows that if the OR of ED in sport cyclists is 1.72, we would need a sample size of at least 6720 to attain 80% power to detect this difference at the 0.05 significance level. With the current sample size of 1277, the power is only 27%. Lack of a significant finding may be more reflective of the MMAS sample size than a lack of a true effect. The marginal finding of a reduced probability of ED in moderate cyclists is narrower, but since it does not account for associated covariates, it is not definitive.

Some study limitations merit discussion. Self-reported conditions, such as high blood pressure, cancer and diabetes may not be as accurate as medical records review or clinical diagnosis. This might lead to bias if an erroneous self-report were related to both bicycling and ED. If not related, the mostly likely effect of inaccurate self-reports would be to attenuate the estimated effect of bicycling on ED. Also, the MMAS includes a relatively small proportion of bicyclists and a smaller proportion of sport cyclists which may lead to wide confidence intervals for the effects of bicycling. However, this random population-based sample is representative of a similar population of men[23] and includes a variety of cyclists, unique among studies done on cycling and ED to date.

Because the logistic regression model included energy expenditure, it does not merely suggest that moderate cycling, when added to little or no exercise, has a beneficial effect on ED. It implies that substituting bicycling for another activity may protect against ED. We have reported previously that physical activity, known to have an inverse relation with heart disease,[24,25] is also associated with the probability of developing ED.[26] In the MMAS, the highest risk for ED was in men who remained sedentary, and the lowest levels of ED were in men who began exercising or continued exercising between baseline and follow-up.[26] Our analyses looking at cycling further support this finding. Even when controlling for a variety of factors, moderate cycling is not associated with moderate or complete ED in the MMAS. In fact, we found that moderate cyclists are less likely to have ED than those who do not cycle (although the 95% CI includes 1) and sport cyclists are more likely to have ED (although the CI is very broad).

The implications of these findings are important in the context of physical activity for aging populations similar to that of the MMAS. Physical *inactivity* is of major concern in the US: only about 15% of US adults engage in regular physical activity three times a week for 20 min.[27] Less active individuals are at 30 – 50% greater risk of developing high blood pressure (associated with chronic heart disease and ED).[26,27] Approximately 250 000 US deaths per year can be attributed to inactivity.[27] However, an estimated 131 million Americans cycle[21] because it: (1) is an uncomplicated form of exercise; (2) is often learned at a young age; (3) is accessible to all ages; (4) can be conducted on an individualized basis; and (5) can be accomplished both indoors and outside (year round). Bicycling may be the most feasible form of exercise or transportation for individuals[28] due to cost (many sports require extensive financial commitments), physical limitations (injuries may prohibit sports such as tennis, many team sports, or running), or time constraints (commuting may serve as exercise and transportation). Most significantly, cycling is one of the few forms of physical activity aging populations can do easily with low probability for injury, and thus may increase in prevalence as the population ages.

Finally, elite athletes suffer for their passion. Runners are plagued by joint disorders, football players by knee injuries, tennis players by rotator cuff tears, climbers by torn finger tendons. These athletes compete at a different level than the individuals likely to be in the MMAS sample. Elite riders are more likely to maintain competition level fitness, join cycling clubs and participate in long distance events. While ED may be a serious concern in an elite population of riders, it must be addressed in this context and should not be generalized to the average cyclist. Further research is needed to determine the precise association between sport cyclists and ED and between moderate cyclists and a reduced probability of ED.

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