CLINICAL RESEARCH STUDY

THE AMERICAN JOURNAL of MEDICINE®

Regular Intercourse Protects Against Erectile Dysfunction: Tampere Aging Male Urologic Study

Juha Koskimäki, MD, PhD,[a] Rahman Shiri, MD, PhD,[b] Teuvo Tammela, MD, PhD,[a] Jukka Häkkinen, MD, PhD,[a] Matti Hakama, ScD,[b] Anssi Auvinen, MD, PhD[b]

[a]Tampere University Hospital, Department of Urology, Tampere, Finland; [b]University of Tampere, School of Public Health, Tampere, Finland.

ABSTRACT

BACKGROUND: Erectile dysfunction is common among men aged more than 60 years. Its cause involves both physiologic and psychosocial factors.

METHODS: To evaluate the effects of coital frequency on subsequent risk of erectile dysfunction, data were analyzed from a population-based 5-year follow-up study that was conducted in Pirkanmaa, Finland, using postal questionnaires. Assessment was based on the 5-item version of the validated International Index of Erectile Function. Men with erectile dysfunction at entry were excluded from the analysis. The study sample consisted of 989 men aged 55 to 75 years (mean 59.2 years). The most common comorbidities were hypertension (32%), heart disease (12%), depression (7%), diabetes (4%,) and cerebrovascular disorder (4%).

RESULTS: The overall incidence of moderate or complete erectile dysfunction was 32 cases per 1000 person-years (95% confidence interval [CI], 27-38). After adjustment for comorbidity and other major risk factors, men reporting intercourse less than once per week at baseline had twice the incidence of erectile dysfunction compared with those reporting intercourse once per week (79 vs 33/1000, incidence rate ratio 2.2, 95% CI, 1.3-3.8). The risk of erectile dysfunction was inversely related to the frequency of intercourse. No relationship between morning erections and incidence of moderate or severe erectile dysfunction was found.

CONCLUSION: Regular intercourse protects against the development of erectile dysfunction among men aged 55 to 75 years. This may have an impact on general health and quality of life; therefore, doctors should support patients' sexual activity.

 • *The American Journal of Medicine (2008) 121, 592-596*

KEYWORDS: Cohort studies; Impotence; Incidence; Sexual behavior

Erectile function is dependent on maintaining normal physiology, including both vascular and endocrine components. In the development of erectile dysfunction, psychosocial factors, such as depression, anxiety, low self-esteem, and problems in relationships, are involved, in addition to specific diseases, including those related to atherosclerosis (eg, diabetes, hypertension, and cardiovascular diseases).[1]

Male sexual function has a tendency to wane with age. The frequency of nocturnal erections and intercourse decrease, whereas the prevalence of erectile dysfunction increases with age.[2,3] It has been estimated that three quarters of men aged 50 to 70 years have some degree of erectile dysfunction and that the proportion of men with any erectile dysfunction increases with age.[4] The incidence of moderate erectile dysfunction (onset of new cases) has been reported to range from 12 to 66 per 1000 in different populations.[5-7] In prevalence studies, erectile dysfunction has shown a strong effect on sexual activity, especially on coital frequency.[4,8,9] However, no previous studies have evaluated the effect of sexual activity on the subsequent development of erectile dysfunction.

We report the results of a longitudinal study with questionnaire data in a population-based cohort of 989 men who were aged 55 to 75 years at baseline and initially free from erectile dysfunction. The aim of this prospective study was

Dr Shiri is currently at the Finnish Institute of Occupational Health, Helsinki, Finland. Dr Auvinen is currently at the Finnish Cancer Institute, Helsinki, Finland.

Requests for reprints should be addressed to Juha Koskimäki, MD, PhD, Tampere University Hospital, Department of Urology, Box 2000, FIN-33521 Tampere.

E-mail address: juha.koskimaki@sarment.fi

0002-9343/$ -see front matter
doi:10.1016/j.amjmed.2008.02.042

to determine whether the frequency of intercourse or morning erection predicts the development of erectile dysfunction in a population-based cohort of 989 men who were aged 55 to 75 years at baseline and initially free from erectile dysfunction.

MATERIALS AND METHODS

The target population comprised men born in 1924, 1934, or 1944 and residing in the Finnish city of Tampere or 11 adjacent municipalities in 1999. The study subjects were identified from the Finnish Population Register.[10] Self-administered postal questionnaires were used to collect information on sociodemographic status, lifestyle factors, medical conditions and medications, erectile capacity, frequency of intercourse, morning erection, and concern about erectile problems. The short form of the International Index of Erectile Function[11] was used for the assessment of subjects' erectile function and the severity of erectile dysfunction calculated by scoring the 5 questions as follows: score >20, no erectile dysfunction; score of 16 to 20, mild erectile dysfunction; score of 11 to 15, moderate erectile dysfunction; and score ≤10, complete erectile dysfunction.[12,13] Two analyses were made: In the first analysis, the outcome was moderate or complete erectile dysfunction, and included men reporting no or mild erectile dysfunction at baseline (because mild erectile dysfunction has no effect on frequency of intercourse[4]). In the second analysis, only complete erectile dysfunction was used as the end point, and all men free of it at entry were included.

CLINICAL SIGNIFICANCE

- Regular intercourse protects men from the development of erectile dysfunction.
- This may have an impact on general health and quality of life.
- Doctors should support patients' sexual activity.

The initial questionnaire was mailed to 2837 men in May of 1999, and a reminder was mailed to the 1162 men who did not respond to the first round. The overall response rate was 75% (2133 men). A similar questionnaire was mailed 5 years later to 2510 men in the last quarter of 2004, with a reminder to the 844 men who did not respond to the first inquiry. Between 1999 and 2004, a total of 318 men had died, 3 men had emigrated, and 6 men no longer had an address in the population registry, indicating that they were probably institutionalized. In total, 1905 questionnaires (76%) were returned.

A total of 1665 men (66%) responded to both the baseline and follow-up surveys. Of those, 361 men were excluded from the study because of incomplete information on erectile function, and 1304 men were included in the study material. In the first analysis, the men with moderate or complete erectile dysfunction (because men with outcome at baseline are not at risk of incidental erectile dysfunction during follow-up) and those reporting no sexual intercourse during the preceding 6 months (because erectile function cannot be assessed among men who are not sexually active) in either survey were excluded from the analyses. In the second analysis, the men with complete erectile dysfunction and those reporting no sexual intercourse during the preceding month in either survey were excluded from the analyses. The effect of morning erection and frequency of intercourse on the incidence of erectile dysfunction was assessed among 890 men in the first analysis and among 989 men in the second analysis.

Men without further follow-up were on average older than those with complete follow-up (mean age 65.8 vs 62.1 years, respectively). They were more often ever smokers (62.3% vs 52.1%) and more frequently reported erectile dysfunction (32.5% vs 20.5%) and chronic medical conditions (heart disease, hypertension, cerebrovascular disease, depression, or diabetes) (57.0% vs 48.3%).

Statistical Analysis

The incidence of erectile dysfunction was calculated in those free of erectile dysfunction (in the first analysis free of moderate or complete erectile dysfunction and in the second analysis free of complete erectile dysfunction) at entry by dividing the number of new cases of moderate or complete erectile dysfunction in the first analysis and of new cases of complete erectile dysfunction in the second analysis occurring between the baseline and the follow-up surveys by the number of person-years of follow-up. Person-years were estimated by multiplying the number of men who did not develop erectile dysfunction by 5 years and the number of men who developed erectile dysfunction by 2.5 years.

The statistical significance (defined as 2-tailed $P \leq .05$) of the relationship between morning erections and erectile dysfunction and the relationship between intercourse frequency and erectile dysfunction was assessed by a chi-square test. Poisson regression (with the number of events as the outcome and person-years at risk as an offset term) was used in the multivariable analyses, because it is suitable for analysis of incidence rates. Age, chronic medical conditions (diabetes, heart disease, hypertension, cerebrovascular disease, and depression), body mass index, and smoking were included in the multivariable models as covariates. Smoking was categorized as follows: Current smokers and ex-smokers were combined to be ever smokers and compared with never smokers. They were chosen as potential confounders, because they are known risk factors of erectile dysfunction; they differed in men with varying degrees of erectile dysfunction and may be correlated with the exposure of interest (frequency of intercourse).

Hypertension, coronary artery disease, and depression were based on self-report, regardless of medication. Diabetes included both men receiving oral diabetic medications or insulin. Cerebrovascular disease included stroke and transient ischemic attack.

The study protocol was approved by the Pirkanmaa Hospital District Committee for Research Ethics. A returned questionnaire was regarded as consent to participate in the study.

RESULTS

The mean age at baseline was 59.2 years, and more than 80% of the men were married or cohabiting (Table 1). Being overweight was common, and 45% reported at least 1 chronic disease. At baseline, the frequency of sexual intercourse was associated with the frequency of morning erections (of the men who had <1 intercourse per week, 49.4% had <1 morning erection per week) ($P < .001$) (Table 2).

Overall, the incidence of erectile dysfunction was 32 cases per 1000 person-years (95% confidence interval [CI], 27-38) (Table 3). Frequency of intercourse was associated with the incidence of erectile dysfunction ($P = .001$). Erectile dysfunction incidence was 79 cases per 1000 in men who had reported sexual intercourse less than once per week and reduced in relation to the number of weekly intercourses. Erectile dysfunction incidence was 32 cases per 1000 in men, with 1 and 16 in those reporting intercourse 3 or more times per week.

The incidence rate ratio of erectile dysfunction in men free of moderate or complete erectile dysfunction at baseline, adjusted for age, heart disease, diabetes, cerebrovascular disease, hypertension, depression, body mass index, and smoking, was statistically significantly increased in men who reported intercourse less than once per week and decreased (not statistically significantly) for men who reported intercourse twice per week and for men who reported intercourse 3 or more times per week compared with those who reported intercourse once per week (Table 3). Among men free of complete erectile dysfunction at baseline, the incidence rate ratio was statistically significantly increased among those with less than 1 intercourse per week and statistically significantly decreased among men with 2 or more intercourses per week compared with men who reported 1 intercourse per week (Table 4).

Frequency of morning erections was not associated with the incidence of moderate or complete erectile dysfunction ($P = .9$). The incidence of erectile dysfunction was 33 cases per 1000 among men with morning erections less than once per week and 31 cases in those with erections every morning. However, frequency of morning erections predicted the development of complete erectile dysfunction, with an approximate 2.5-fold risk among those with less than 1 morning erection per week compared with 2 to 3 morning erections per week (Table 4).

Table 1 Background Characteristics of 989 Men Free of Complete Erectile Dysfunction at Baseline, Tampere Aging Male Urologic Study, Finland, 1999-2004

Characteristic	N	%
Demographic Factors		
Age (y)		
55-64	629	63.6
65-74	307	31.0
>75	53	5.4
Marital Status		
Married or cohabiting	815	83.4
Medical Conditions		
Hypertension	312	31.5
Heart disease	123	12.4
Depression	70	7.1
Diabetes	42	4.3
Cerebrovascular disease	40	4.0
Lifestyle Factors		
BMI		
Normal (BMI 18.5-24.9 kg/m^2)	295	30.6
Overweight (BMI 25-29.9 kg/m^2)	522	54.1
Obese (BMI ≥ 30 kg/m^2)	148	15.3
Smoking History		
Ever smoker	518	52.9

BMI = body mass index.

Table 2 Relation Between the Frequency of Intercourse and the Frequency of Morning Erection Among Men Free of Complete Erectile Dysfunction at Entry

Frequency of Intercourse (No. per Week)	Frequency of Morning Erections (No. per Week)			
	<1	1	2-3	Daily
<1	45 (49.4)	15 (16.5)	25 (27.5)	6 (6.6)
1	182 (44.2)	81 (19.7)	122 (29.6)	27 (6.5)
2	71 (31.0)	48 (21.0)	88 (38.4)	22 (9.6)
≥3	43 (32.3)	16 (12.0)	46 (34.6)	28 (21.1)

DISCUSSION

Our findings indicate that intercourse at least once per week protects against the development of erectile dysfunction. Moreover, we found a dose-response with coital frequency. The incidence of erectile dysfunction was twice as high among men reporting intercourse less than once per week compared with those having intercourse once per week and more than 4 times higher than those having intercourse 3 times or more per week. The result indicates that regular sexual activity preserves potency in a similar fashion as physical exercise maintains functional capacity. We are not aware of any previously published studies on the topic.

The frequency of morning erection was not associated with the incidence of moderate erectile dysfunction, but it showed an effect on the development of complete erectile dysfunction. This suggests that morning erection does not preserve erectile function as effectively as intercourse among elderly men.

A crucial issue is whether coital frequency is actually a determinant of the development of erectile dysfunction or merely a risk indicator. We assessed the frequency of intercourse before the occurrence of erectile dysfunction and

Table 3 Incidence Rate Ratio of Moderate or Complete Erectile Dysfunction by Frequency of Intercourse and Morning Erections in Men Free of Moderate or Complete Erectile Dysfunction at Baseline, Adjusted for Age, Diabetes, Heart Disease, Hypertension, Cerebrovascular Disease, Depression, Body Mass Index, and Smoking

Determinant	Baseline (No. of Men)	Cases (No. of Cases)	Incidence (per 1000, 95% CI)	Incidence Rate Ratio (95% CI)
Frequency of intercourse (No. per week)				
<1	73	24	79 (53-117)	2.20 (1.27-3.79)
1	375	55	32 (24-41)	1 (reference)
2	223	21	20 (13-30)	0.61 (0.35-1.07)
≥3	129	10	16 (9-30)	0.63 (0.31-1.29)
				$P_{trend} < .001$
Frequency of morning erections (No. per week)				
<1	351	54	33 (25-43)	0.88 (0.57-1.38)
1	161	22	29 (19-45)	0.96 (0.55-1.67)
2-3	289	41	31 (22-41)	1 (reference)
Daily	84	12	31 (17-54)	1.04 (0.53-2.06)
				$P_{trend} = .52$
Overall	890	131	32 (27-38)	

CI = confidence interval.

adjusted for the other major risk factors. Therefore, our results provide strong support for a causal role of coital frequency.

Our study was based on sexually active men free from erectile dysfunction at baseline. This ensures comparability between groups. We were able to adjust for major risk factors for erectile dysfunction, and therefore confounding is not likely to explain our results. In our study, nocturnal erections were self-reported. This approach may be prone to error, but the accuracy of reporting would have to be correlated with the risk of erectile dysfunction to bias our results (ie, to induce differential error).[11] The gold standard for the assessment of erectile capacity is cavernosometry, but this is not feasible in a large population-based study such as ours. On the other hand, it can be argued that self-assessed erectile problems provide a more relevant

Table 4 Incidence Rate Ratio of Complete Erectile Dysfunction by Frequency of Intercourse and Morning Erections in Men Free of Complete Erectile Dysfunction at Baseline, Adjusted for Age, Diabetes, Heart Disease, Cerebrovascular Disease, Hypertension, Depression, Body Mass Index, and Smoking

Determinant	Baseline (No. of Men)	Cases (No. of Cases)	Incidence (per 1000, 95% CI)	Incidence Rate Ratio (95% CI)
Frequency of intercourse (No. per week)				
<1	93	15	35 (21-58)	2.32 (1.18-4.53)
1	412	32	16 (11-23)	1 (reference)
2	230	7	6 (3-13)	0.41 (0.17-0.99)
≥3	134	1	1 (0.2-11)	0.14 (0.02-0.99)
				$P_{trend} < .001$
Frequency of morning erections (No. per week)				
<1	403	38	20 (14-27)	2.48 (1.23-5.05)
1	178	12	14 (8-25)	2.01 (0.85-4.76)
2-3	309	13	9 (5-15)	1 (reference)
Daily	89	1	2 (0.3-16)	0.37 (0.05-2.90)
				$P_{trend} = .002$
Overall	989	65	14 (11-17)	

CI = confidence interval.

measure of erectile dysfunction. Another limitation is that we evaluated only intercourse, not masturbation.

In the analysis of incidence, we used incidence as a measure of erectile dysfunction occurrence, estimated from the number of subjects reporting erectile dysfunction at 5 years of follow-up among those men who were free of it at baseline. In principle, incidence is primarily suitable for the assessment of irreversible events. Erectile dysfunction is a reversible state, with potential fluctuation toward either recovery or progression. To calculate the incidence rates, we had to classify the varying levels of erectile dysfunction as the presence or absence of defined criteria. This dichotomization resulted in the loss of information, diminishing impairing accuracy. This situation is analogous, for example, to studies on hypertension. Erectile dysfunction was assessed at 2 time points, and we had no information on the exact time of the onset of erectile dysfunction. We therefore assumed that, on average, the transitions occurred at the midpoint of the follow-up interval. This assumption is identical to that used in life-table analysis, although we used a 5-year period instead of the single year commonly used for constructing life-tables. It is possible (and consistent with our results) that the intensity of the transitions increases with age, which would lead to a skewed distribution of event times. This may cause a slight inaccuracy in incidence estimates.

The men without further follow-up were on average older and more frequently had a history of chronic diseases than the participants. Thus, they may be at greater risk of erectile dysfunction than the study sample. Therefore, our results may have underestimated the true incidence in the general population. However, the rate ratios are likely to be unbiased.

Common causal factors affecting both the frequency of intercourse and the development of erectile dysfunction should be considered as a possible alternative explanation. High androgen levels could boost sexual drive and sexual performance,[13] and serum testosterone concentration decreases with age,[14] raising the possibility that coital frequency may be an indicator of androgen concentration. However, among men free of hypogonadism, serum testosterone concentration is associated with frequency of nocturnal erections but not with frequency of intercourse.[15] In the Massachusetts Male Aging Study, no association between serum testosterone and development of erectile dysfunction was observed.[16] The influence of androgens on both libido and erectile function is therefore unlikely to account for the results of our study.

Another possible influence is that some medications, such as antidepressants, may decrease both libido and erectile function. Yet, only a small proportion of subjects reported any psychotropic medication (4%), and their exclusion did not substantially alter the findings. The most likely mechanism for our observation is that sexual activity itself preserves vascular function through maintained cavernosal reactivity and prevents cavernous fibrosis.

CONCLUSIONS

Regular intercourse has an important role in preserving erectile function among elderly men, whereas morning erection does not exert a similar effect. Continued sexual activity decreases the incidence of erectile dysfunction in direct proportion to coital frequency.

References

1. Camacho ME, Reyes-Ortiz CA. Sexual dysfunction in the elderly: age or disease? *Int J Impot Res.* 2005;17(Suppl 1):S52-S56.
2. Foresta C, Caretta N, Garolla A, Rossato M. Erectile function in elderly: role of androgens. *J Endocrinol Invest.* 2003;26(Suppl 3):77-81.
3. Araujo AB, Mohr BA, McKinlay JB. Changes in sexual function in middle-aged and older men: longitudinal data from Massachusetts Male Ageing Study. *J Am Geriatr Soc.* 2004;52:1502-1509.
4. Koskimäki J, Hakama M, Huhtala H, Tammela TLJ. Effect of erectile dysfunction on frequency of intercourse: a population-based prevalence study in Finland. *J Urol.* 2000;164:367-370.
5. Johannes CB, Araujo AB, Feldman HA. Incidence of erectile dysfunction in men aged 40 to 69 years old: longitudinal results from the Massachusetts Male Ageing Study. *J Urol.* 2000;163:460-463.
6. Moreira ED Jr, Lobo CF, Diament A. Incidence of erectile dysfunction in men aged 40 to 69 years old: results from a population-based cohort study in Brazil. *Urology* 2003;61:431-436.
7. Shiri R, Koskimäki J, Hakama M, et al. Effect of chronic diseases on incidence of erectile dysfunction. *Urology* 2003;62:1097-1102.
8. Riley A, Beardsworth A, Kontodimas S, et al. Sexual intercourse frequency in men presenting for treatment of erectile dysfunction: results from the Pan-European Erectile Dysfunction Observational Study. *J Sex Marital Ther.* 2007;33:3-18.
9. Chen K-K, Chiang H-S, Jiann B-P, et al. Prevalence of erectile dysfunction and impacts on sexual activity and self-reported intercourse satisfaction in men older than 40 years in Taiwan. *Int J Impot Res.* 2004;16:249-255.
10. Available at: http://www.vaestorekisterikeskus.fi/vrk/home.nsf/pages/index_eng
11. Rosen RC, Cappelleri JC, Smith MD, et al. Development and evaluation of an abridged, 5-item version of the International Index of Erectile Function (IIEF-5) as a diagnostic tool for erectile dysfunction. *Int J Impot Res.* 1999;11:319-326.
12. McMahon CG, Touma K. Predictive value of patient history and correlation of nocturnal penile tumescence, colour duplex Doppler ultrasonography and dynamic cavernosometry and cavernosography in the evaluation of erectile dysfunction. *Int J Impot Res.* 1999;11:47-51.
13. Schiavi RC, White D, Mandeli J, Levine AC. Effect of testosterone administration on sexual behavior and mood in men with erectile dysfunction. *Arch Sex Behav.* 1997;26:231-241.
14. Deslypee JP, Vermeulen A. Leydig cell function in normal men: effect of age, lifestyle, residence, diet, and activity. *J Clin Endocrinol Metab.* 1984;59:955-962.
15. Kwan M, Greenleaf WJ, Mann J, et al. The nature of androgen action on male sexuality: a combined laboratory-self-report study on hypogonadal men. *J Clin Endocrinol Metab.* 1983;57:557-562.
16. Kupelian V, Shabsigh R, Travison TG, et al. Is there a relationship between sex hormones and erectile dysfunction? Results from the Massachusetts Male Aging Study *J Urol.* 2006;176:2584-2588.