Prevalence of Self-Reported Erectile Dysfunction in People With Long-Term IDDM

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OBJECTIVE — The purpose of this report is to examine the prevalence of erectile dysfunction and relationships to other characteristics in men with younger-onset diabetes.

RESEARCH DESIGN AND METHODS — In a population-based cohort study in southern Wisconsin, prevalence of erectile dysfunction was measured based on self reports in men who were 21 years of age or older, were <30 years of age at diagnosis of diabetes, had 10 or more years of diabetes, and were taking insulin (n = 365).

RESULTS — Of the study group, 20% reported a history of erectile dysfunction. The prevalence of erectile dysfunction increased with increasing age (from 1.1% in those 21–30 years of age to 47.1% in those 43 years of age or older, P for trend <0.0001) and with increasing duration of diabetes (P for trend <0.0001). Erectile dysfunction was associated with presence of severe diabetic retinopathy, a history of peripheral neuropathy, amputation, cardiovascular disease, a higher glycosylated hemoglobin, use of antihypertensive medications, and higher BMI.

CONCLUSIONS — These data suggest that tighter glycemic control and careful selection of antihypertensive medications might prove beneficial.

Erectile dysfunction is an important cause of decreased quality of life in men with diabetes (1). Its frequency has been reported to be higher in people with diabetes compared with those without in some but not all studies (2–9). Erectile dysfunction in men with diabetes has been associated with increased age (6,10), poor glycemic control (6,10), smoking (11), increased alcohol intake (10), depression (12), use of specific types of medications (13–15), and microvascular diabetic complications, such as retinopathy and nephropathy (6,10). The purpose of this report is to describe the prevalence of self-reported erectile dysfunction and its association with risk factors in a large population-based study of men with younger-onset diabetes.

RESEARCH DESIGN AND METHODS

Population

Case identification methods and descriptions of the population have appeared in previous reports (16–18). Briefly, the study area is comprised of 11 counties in southern Wisconsin. During the period from 1 July 1979 to 30 June 1980, lists of diabetic patients were kept by 452 of the 457 primary care physicians in the area. In this manner, 10,135 people with diabetes were identified. A two-part sample of 2,990 of these people was invited to participate in the baseline examination from 1980 to 1982. The first part consisted of the entire population of insulin-taking people diagnosed as having diabetes before 30 years of age (n = 1210) and is referred to as younger-onset. The analyses will be limited to this group.

A total of 996 people (82.3%) participated in the baseline examination. Reasons for nonparticipation and comparisons between participants and nonparticipants have been presented elsewhere (16). Surviving people were invited to participate in 4- (1984–1986) (17) and 10-year (1990–1992) (18) follow-up examinations. At the 4-year examination, 891 people were examined, and at the 10-year examination, 765 people were examined. Only men participating in the 10-year examination who were 21 years of age or older (n = 365) were included in this evaluation.

Procedures

All examinations followed a similar protocol that was approved by the institutional human subjects committee. The pertinent parts of the examination consisted of obtaining informed consent; measuring blood pressure (19), height, and weight; dilating the pupils; administering a medical history questionnaire; taking stereoscopic fundus photographs of seven standard fields (20); and determining urine protein level, serum total and HDL cholesterol, and glycosylated hemoglobin levels (normal range 4.6–7.9%) (21).

At the 1990–1992 examination, all male participants ≥21 years of age were asked the following question for the first time: Has diabetes caused impotence, that is, the inability to achieve a normal erection? In addition, they were also asked questions regarding a history of diabetic neuropathy, loss of sensation or temperature perception in their hands or feet, sores or ulcers on the feet or ankles, pain in the legs on ambulation not due to arthritis, amputation of a lower extremity, a history of cardiovascular disease, medications used to lower blood pressure, and hypoglycemic agents taken at the time of the examination.

All fundus photographs were graded using a modification of the Early

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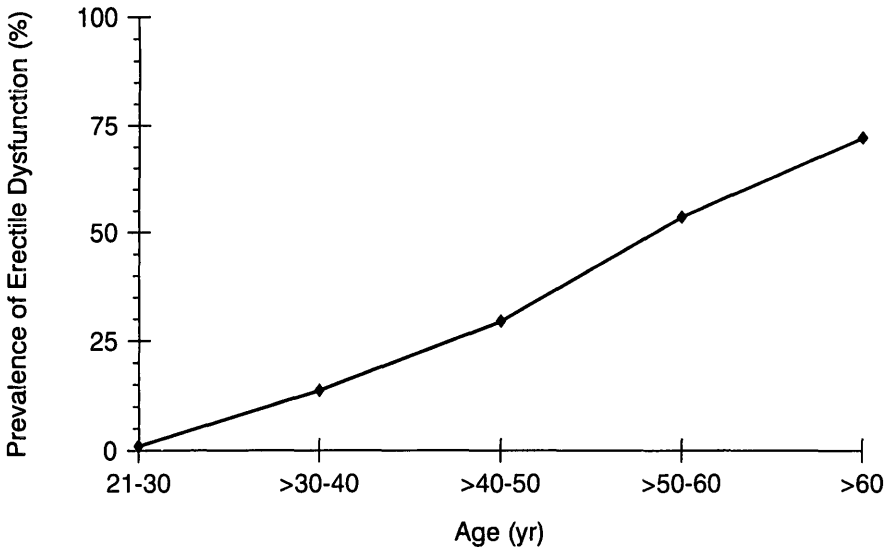

Figure 1—*Relationship of age to the prevalence of erectile dysfunction in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (1990–1992).*

Treatment Diabetic Retinopathy Study classification scheme adapted for the Wisconsin Epidemiologic Study of Diabetic Retinopathy (18). Briefly, level 10 represents no retinopathy; levels 21, 31, 37, 43, 47, and 53 represent increasing nonproliferative retinopathy; and levels 60–85 represent increasing severity of proliferative retinopathy. For purposes of analysis, the retinopathy level for a person was based on the worst eye. For univariate analyses, the levels were grouped as follows: level 10 (no retinopathy), levels 21–37 (mild retinopathy), levels 43–53 (moderate retinopathy), and levels 60–85 (proliferative diabetic retinopathy).

Definitions

All data and results pertain only to the 1990–1992 examination. The current age was defined as the age at the time of the 1990–1992 examination. Duration of diabetes was the time interval between diagnosis of diabetes and the 1990–1992 examination. Glycemic control was measured by glycosylated hemoglobin using a microcolumn technique on a rinsed venous blood sample. Urine protein was considered present if the concentration was ≥0.3 g/l. Hypertension was defined as a mean systolic blood pressure ≥160 mmHg, a mean diastolic blood pressure ≥95 mmHg, and/or a history of hypertension with use of a hypertensive medication. A person was considered to be a nonsmoker if he had smoked <100 cigarettes in his life, an exsmoker if he had smoked >100 cigarettes but had stopped before the examination, and a current smoker if he had not stopped. Pack-years smoked at baseline was defined as the number of cigarettes smoked per day divided by 20 multiplied by the number of years smoking. A nondrinker was defined as a person who had never consumed alcoholic beverages, an exdrinker as a person who had not consumed alcoholic beverages in the previous year, and a current drinker as a person who had consumed alcoholic beverages in the previous year.

Marital status was determined in response to the following question: Are you married, separated, divorced, or widowed now, or have you never been married?

Statistical analysis

SAS, a statistical analysis system, was used to compute means, proportions, and χ^2 tests (22). Tests for trends in proportions were performed with the Mantel-Haenszel procedure (23). Multivariate analyses of factors associated with presence of erectile dysfunction were performed with logistic regression. Models were determined by stepwise selection based on satisfying two of the following three criteria: Wald χ^2 test of individual terms ($P \leq 0.05$), comparison of −2 log likelihood ($P \leq 0.05$), and percent change in odds ratio for any other terms (≥20% change) (24).

RESULTS — Data are given as means ± SD. The age of the group was 37.6 ± 11.0 years (range 21–76), duration of diabetes 22.5 ± 8.8 years, BMI 25.7 ± 3.3 kg/m^2, systolic blood pressure 129.2 ± 17.3 mmHg, mean diastolic blood pressure 78.9 ± 11.3 mmHg, mean glycosylated hemoglobin 10.0 ± 1.7%, mean total cholesterol 199.1 ± 45.6 mg/dl, and mean HDL cholesterol 48.5 ± 14.4 mg/dl.

Of the 365 men who participated in the examination, 6 (1.6%) reported they did not know if they had erectile dysfunction. They were excluded from the analyses. Of the population, 20% (71 of 359) reported a history of erectile dysfunction.

The prevalence of erectile dysfunction increased from 1.1% in those 21–30 years of age to 47.1% in those ≥43 years of age (test of trend, $P < 0.0001$, Fig. 1). The frequency of erectile dysfunction also increased with increasing duration of diabetes (test for trend, $P < 0.0001$; Fig. 2). Men with 35 or more years of diabetes were 7.2 times (95% CI 3.0–17.3) as likely to report erectile dysfunction as men with 10–14 years of diabetes. After controlling for age, the relation of duration to history of erectile dysfunction was no longer significant.

Erectile dysfunction was related to higher glycosylated hemoglobin (Table 1). Men with glycosylated hemoglobin in the fourth quartile were 2.8 times (95% CI 1.3–6.1) as likely to report a history of erectile dysfunction as those with glycosylated hemoglobin in the first quartile. Erectile dysfunction was not related to either total cholesterol or HDL cholesterol (data not shown).

Greater BMI and higher systolic but not diastolic blood pressure were associated with increased prevalence of erectile dysfunction (Table 1). Medically treated hypertension was also associated with increased frequency of erectile dysfunction. A history of current use of diuretics was significantly associated with a higher prevalence of erectile dysfunction (relative risk 3.15, 95% CI 2.13–4.65).

Frequency of erectile dysfunction increased with the increasing number of pack-years smoked (Table 1). Exsmokers were 2.4 times as likely (95% CI 1.52–3.88) and current smokers were 1.4 times as likely (95% CI 0.79–2.57) to report erectile dysfunction as nonsmokers. Erectile dysfunction was not significantly related to history of alcohol consumption in the past year. Few men (6.0%, 22 of 359) reported current consumption of one or

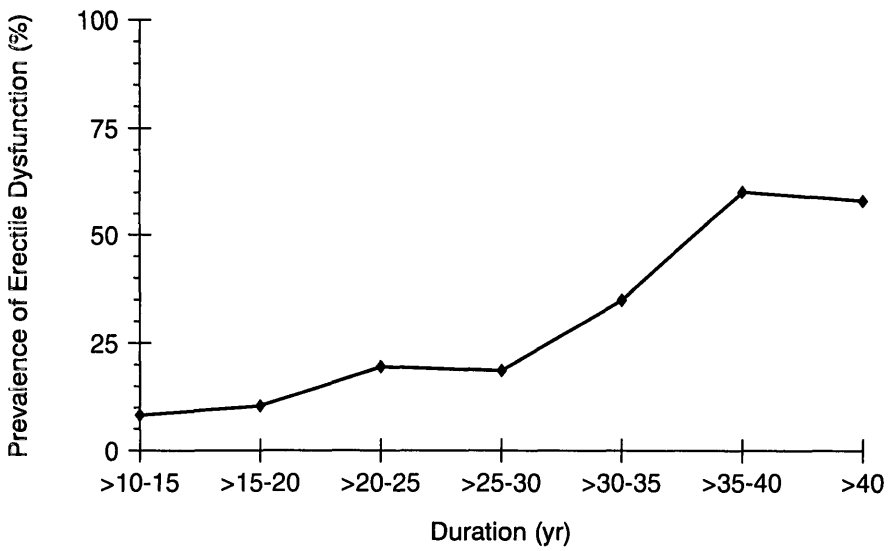

Figure 2—*Relationship of duration of diabetes to the prevalence of erectile dysfunction in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (1990–1992).*

more alcoholic beverages per day. Those that consumed one or more drinks a day were 1.8 times as likely (95% CI 1.0–3.6) to report erectile dysfunction as those who drank less frequently. Frequencies of erectile dysfunction were inversely associated with education (Table 1).

A logistic regression model was developed that included potential causal and modifiable factors found to be related to erectile impotence in univariate analyses, including duration of diabetes, glycosylated hemoglobin, systolic blood pressure, BMI, pack-years smoked, alcohol consumption in past years, and use of specific antihypertensive medications. After controlling for age, higher glycosylated hemoglobin, greater BMI, and use of diuretics were significantly related to erectile dysfunction (Table 2).

Erectile dysfunction was significantly associated with a history of diabetic neuropathy; lower-extremity pain while walking; loss of sensation; sores, ulcers, or amputation of lower extremity; a history of cardiovascular disease; and the presence of more severe retinopathy (Table 3). Men with proliferative retinopathy were 5.3 times as likely (95% CI 2.6–10.8) to report erectile dysfunction as men with no or mild nonproliferative retinopathy. The relationship of erectile dysfunction to gross proteinuria was of borderline statistical significance. Except for gross proteinuria, these relationships remained significant after controlling for duration of diabetes (Fig. 3), age, or glycosylated hemoglobin (data not shown).

The prevalence of erectile dysfunction was similar in men who were married (25.5%) and men who reported being separated or divorced (31.3%, Table 1). Both prevalences were higher than in men who had never married (4.5%) at the time of the examination. Because erectile dysfunction may affect marital status, the latter was defined as the dependent variable and erectile dysfunction as an independent variable controlling for age. Men with erectile dysfunction were 1.7 times as likely (95% CI 0.8–3.8) to report a history of divorce compared with those who did not report a history of erectile dysfunction.

CONCLUSIONS — The self-reported history of erectile dysfunction is 20% in men ≥21 years of age with 10 or more years of diabetes. Self-reported erectile dysfunction was present in 13% of IDDM men participating in the Rochester Diabetic Neuropathy Study (25). Differences in rates of erectile dysfunction in our population compared with rates reported in other studies may be due to differences in definitions and methods used to ascertain history of this complication. Other reports of the frequency of erectile dysfunction in men with IDDM come from specialty clinics, and estimates have ranged from 18 to 71% (2–9). It is possible that the higher frequencies result from overrepresentation of those with severe disease at such clinics. The rates of erectile dysfunction in our study appear higher than those reported in the general population of the U.S., where estimates of erectile dysfunction are estimated to vary from ~5% in those at 40 years of age (28% = 7 of 25 in our study) to ~15–25% in men ≥65 years of age (83% = 10 of 12 in our study) (1).

The positive relationship between glycosylated hemoglobin and the history of erectile dysfunction found in our study is consistent with previous studies. McCulloch et al. (10) found a positive association of poor glycemic control and the 5-year incidence of erectile dysfunction in diabetic men. In the recently completed Diabetes Control and Complications Trial (26), there was a 60% reduction in risk of developing diabetic neuropathy, an important cause of erectile dysfunction in diabetes, in those in the intensive insulin treatment group compared with those in the conventional treatment group. These data suggest a possible benefit of tight glycemic control in the prevention of erectile dysfunction.

The relationship between hypertension and erectile dysfunction is complex (13,14,27,28). In our study, men with medically treated hypertension were 2.0 times as likely (95% CI 1.3–3.1) to report erectile dysfunction as those who were not hypertensive. However, after controlling for age and other factors, this relationship was no longer significant. However, significant associations between specific antihypertensive medications, such as diuretics, and erectile dysfunction were present. This is consistent with previous reports of sexual dysfunction in men taking these and other antihypertensive medications (13). Objective data from the study by Muller et al. (14) suggest that the direct effect of thiazide diuretics, in combination or alone, on the neuroregulation of the erectile tissue was more important as a cause of erectile dysfunction than was secondary arteriosclerosis as a result of hypertension. These data suggest the need for careful choice of antihypertensive agents because 42% (30 of 71) of the men in our study who reported erectile dysfunction were taking diuretics and other antihypertensive medications associated with erectile dysfunction. Other medications, such as α1-adrenergic blocking agents, have been suggested as first-step therapy in treatment of hypertension in diabetic patients to minimize the impact of erectile dysfunction as well as other problems associated with the use of diuretic agents (13).

Table 1—*The relationship of various characteristics to the prevalence of erectile dysfunction in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (1990–1992)*

Characteristic	Number at risk	% with erectile dysfunction	Relative risk	95% CI	*P* value
Glycosylated hemoglobin (%)					
<8.8	77	9.1	1.00	—	0.002
8.8 to <9.8	85	15.3	1.68	0.71–3.99	—
9.8 to <10.9	87	28.7	3.15	1.45–6.88	—
≥10.9	87	25.3	2.78	1.26–6.14	—
BMI (kg/m^2)					
<26	189	14.8	1.00	—	0.004
26 to <27.8	70	20.0	1.35	0.76–2.41	—
27.8 to <31.1	51	27.5	1.86	1.06–3.26	—
≥31.1	16	43.8	2.96	1.54–5.68	—
Systolic blood pressure (mmHg)					
<117	78	15.4	1.00	—	0.026
117 to <127	83	14.5	0.94	0.45–1.97	—
127 to <140	84	22.6	1.47	0.76–2.82	—
≥140	80	27.5	1.79	0.95–3.35	—
Hypertension status					
None	219	16.0	1.00	—	0.003
Yes, untreated	32	18.8	1.18	0.54–2.57	—
Yes, treated	81	32.1	2.01	1.29–3.11	—
Diuretics and antihypertensive medications					
None	266	13.5	1.00	—	<0.0001
ACE inhibitors without diuretics	28	17.9	1.32	0.56–3.09	—
Diuretics without ACE inhibitors	27	44.4	3.29	1.95–5.52	—
ACE inhibitors with diuretics	23	52.2	3.86	2.35–6.33	—
Other without ACE inhibitors or diuretics	14	42.9	3.17	1.61–6.23	—
Pack-years smoked					
Never	217	12.4	1.00	—	<0.0001
0 to <5	43	16.3	1.32	0.61–2.82	—
5 to <16	47	27.7	2.23	1.25–4.00	—
≥16	45	46.7	3.77	2.35–6.04	—
History of alcohol consumption					
Never drinks	8	12.5	1.00	—	0.25
Exdrinker	46	30.4	2.43	0.37–16.02	—
Current drinker	305	18.4	1.47	0.23–9.35	—
Current alcohol consumption					
Not daily	283	17.3	1.00	—	0.09
Daily	22	31.8	1.84	0.95–3.57	—
Education (years)					
≤12	130	26.2	1.00	—	0.02
13+	229	16.2	0.62	0.41–0.93	—
Marital status					
Never married	111	4.5	1.00	—	<0.0001
Currently married	200	25.5	5.67	2.33–13.79	—
Separated/divorced	48	31.3	6.96	2.68–18.06	—

Mantel-Haenszel was used to find *P* value for trend.

Severity of hypertension and desirable levels of blood pressure must be balanced against the undesirable side effects of the specific antihypertensive medication(s) chosen.

The number of pack-years smoked was related to higher frequency of erectile dysfunction in our study. This relationship may be due to the positive association of cigarette smoking and atherosclerosis, which itself is thought to be an important cause of early erectile dysfunction in people with diabetes (29–31). Smoking has been shown to result in erectile dysfunction in some studies (11) as a result of inhibition of neurovascular mediators or smooth muscle function. However, we found a nonsignificant relation-

Table 2—*Odds ratios and 95% CIs for characteristics significantly associated with erectile dysfunction in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (1990–1992)*

Variable	Younger-onset
Age (per year)	1.17 (1.12–1.22)
Glycosylated hemoglobin (%)	
<8.8	1.00
8.8 to <9.8	0.96 (0.24–3.80)
9.8 to <10.9	5.12 (1.36–19.26)
≥10.9	6.25 (1.61–24.15)
BMI (kg/m^2)	
<26	1.00
26 to <27.8	1.15 (0.43–3.09)
27.8 to <31.1	2.47 (0.91–6.76)
≥31.1	2.10 (0.37–11.92)
Antihypertension medication	
None	1.00
ACE inhibitors without diuretics	0.80 (0.21–3.07)
Diuretics without ACE inhibitors	3.50 (1.01–12.14)
ACE inhibitors with diuretics	16.29 (2.97–35.65)
Others without ACE inhibitors or diuretics	7.40 (1.54–35.51)

Data are odds ratios (95% CIs).

ship with current smoking in our study. It is possible that men who had erectile dysfunction and other complications of diabetes gave up smoking as a result of these problems.

One other modifiable variable, current alcohol consumption, was not significantly associated with higher frequency of erectile dysfunction in the cohort, although in our study, those reporting consumption of one or more alcoholic beverages a day were nearly twice as likely to report erectile dysfunction as those consuming alcoholic beverages less frequently. McCulloch et al. (10) reported that those who were heavy drinkers were more than twice as likely to develop erectile dysfunction compared with those who were teetotalers or moderate consumers of alcohol. The inability to find a significant relationship in our study may be due to the infrequency of heavy alcohol consumption in our cohort or because men with erectile dysfunction stopped drinking alcohol.

The frequency of erectile dysfunction was related both to increasing duration of diabetes and to age. McCulloch et al. (6) showed comparable age- and duration-specific frequencies of erectile dysfunction with reported rates of 79% in men who had 15–29 years of diabetes and who were 50–59 years of age.

The relationships between self-reported diabetic neuropathy, a history of cardiovascular disease, lower-extremity pain on ambulation, and erectile dysfunction are not surprising because both neuropathy and atherosclerotic vascular disease are important causes of erectile dysfunction (1,4). The relationships of these chronic complications as well as diabetic retinopathy with erectile dysfunction have been previously reported (4,6,10,15). Patients with erectile dysfunction may not be asked about or discuss this problem with their physicians (1). The presence of other chronic micro- and macrovascular complications associated with diabetes should alert the primary care physician of the need to discuss the presence of erectile dysfunction and to evaluate whether possible changes in antihypertensive drug therapy associated with erectile dysfunction and other interventions are necessary.

Men who were divorced or separated were more likely to report erectile dysfunction than those who were never married; however, these differences were

Table 3—*The relationship of diabetic complications to the prevalence of erectile dysfunction in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (1990–1992)*

Characteristic	Number at risk	% with erectile dysfunction	Relative risk	95% CI	*P* value
History of neuropathy					
None	253	8.7	1.00	—	<0.0001
Yes	105	46.7	5.37	3.43–8.41	—
Loss of sensation					
None	188	5.3	1.00	—	<0.0001
Yes	170	35.9	6.74	2.81–16.20	—
History of sores/ulcers					
None	280	12.5	1.00	—	<0.0001
Yes	79	45.6	3.65	2.46–5.40	—
History of pain on walking					
None	292	14.4	1.00	—	<0.0001
Yes	66	42.4	2.95	1.98–4.39	—
History of amputation					
None	331	16.6	1.00	—	<0.0001
Yes	28	57.1	3.44	2.30–5.14	—
Severity of retinopathy					
None or mild	133	6.0	1.00	—	<0.0001
Moderate	72	19.4	3.23	1.42–7.35	—
Severe	154	31.8	5.30	2.60–10.80	—
Gross proteinuria					
None	220	16.4	1.00	—	0.08
Yes	111	24.3	1.48	0.95–2.31	—
History of cardiovascular disease					
None	328	16.5	1.00	—	<0.0001
Yes	31	54.8	3.33	2.23–4.98	—

Mantel-Haenszel test used to find *P* value for trend.

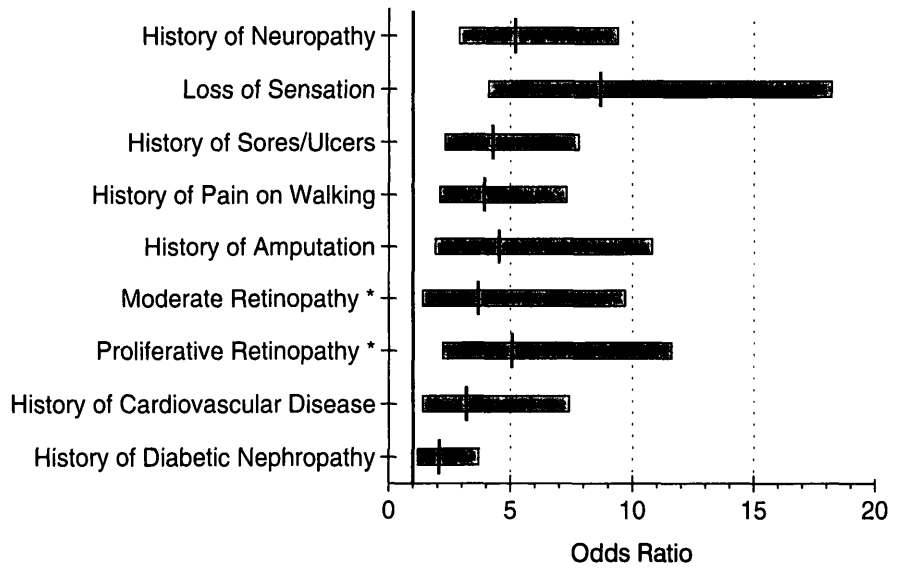

Figure 3—*Odds ratio (vertical lines), adjusted for duration of diabetes, and 95% CI (horizontal lines) for relationships of diabetic complications and erectile dysfunction in the Wisconsin Epidemiologic Study of Diabetic Retinopathy (1990–1992). *Relative to none/mild retinopathy.*

not statistically significant. Moreover, there were few differences in prevalence of erectile dysfunction in those who were currently married versus those who were divorced or separated at the time of the examination.

A potential influence on the findings may be methodological. The prevalence proportions are affected by the sensitivity and specificity of the question used to assess erectile dysfunction in the study. Other methods such as more detailed questionnaires and other more objective methods, such as nocturnal penile tumescence and rigidity testing, may provide different prevalence rates (32,33).

In conclusion, a high frequency of self-reported erectile dysfunction is reported in people with younger-onset diabetes. Relationships exist between erectile dysfunction and a number of factors that are subject to intervention. In particular, tighter glycemic control and careful selection of antihypertensive medications might prove beneficial.

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