Sexuality Among Middle-Aged and Older Adults With Diagnosed and Undiagnosed Diabetes

A national, population-based study

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OBJECTIVE — To describe sexual activity, behavior, and problems among middle-age and older adults by diabetes status.

RESEARCH DESIGN AND METHODS — This was a substudy of 1,993 community-residing adults, aged 57–85 years, from a cross-sectional, nationally representative sample ($N = 3,005$). In-home interviews, observed medications, and A1C were used to stratify by diagnosed diabetes, undiagnosed diabetes, or no diabetes. Logistic regression was used to model associations between diabetes conditions and sexual characteristics, separately by gender.

RESULTS — The survey response rate was 75.5%. More than 60% of partnered individuals with diagnosed diabetes were sexually active. Women with diagnosed diabetes were less likely than men with diagnosed diabetes (adjusted odds ratio 0.28 [95% CI 0.16–0.49]) and other women (0.63 [0.45–0.87]) to be sexually active. Partnered sexual behaviors did not differ by gender or diabetes status. The prevalence of orgasm problems was similarly elevated among men with diagnosed and undiagnosed diabetes compared with that for other men, but erectile difficulties were elevated only among men with diagnosed diabetes (2.51 [1.53 to 4.14]). Women with undiagnosed diabetes were less likely to have discussed sex with a physician (11%) than women with diagnosed diabetes (19%) and men with undiagnosed (28%) or diagnosed (47%) diabetes.

CONCLUSIONS — Many middle-age and older adults with diabetes are sexually active and engage in sexual behaviors similarly to individuals without diabetes. Women with diabetes were more likely than men to cease all sexual activity. Older women with diabetes are as likely to have sexual problems but are significantly less likely than men to discuss them.

Advances in treatment for diabetes have prolonged and improved quality of life for many of the ~12 million affected individuals aged ≥60 years in the U.S. Clinical guidelines for diabetes care include assessment and treatment of erectile problems in men (1). Sexual problems may be a warning sign of diabetes or a consequence that can lead to depression, lack of adherence to treat-

ment, and strained intimate relationships. In contrast, older women's sexual issues have been largely overlooked in screening for and treating diabetes (1,2). Failure to recognize and address sexual issues among middle-aged and older adults with diabetes may impair quality of life and adaptation to the disease.

Some adults with diabetes maintain sexual relationships throughout their lives (3). Prior studies have focused on the pathophysiological effects of diabetes on male sexual function, primarily erection and sexual desire. The effects of diabetes on women's sexual functioning are poorly understood and probably multifactorial (2). Sexual problems in adults with diabetes have been associated with age, disease duration, and comorbidity (1). The effects of chronic hyperglycemia, degree of diabetes control, or use of glucose-lowering drugs are less clear (4), in part because individuals with undiagnosed or preclinical diabetes are typically aggregated with control subjects in other studies (1). Psychosocial correlates of sexual problems in individuals with diagnosed diabetes have been found in younger adults. Studies including older adults find associations with depression (1), vulnerability, lifestyle restrictions due to disease management (5), and marital conflict (6).

Prior data on sexuality in individuals with diabetes were derived primarily from studies that are small, have not included very old individuals or aggregated individuals ≥65 years, lacked a comparison group, and relied on convenience or other nongeneralizable samples (1,2). Comprehensive, population-based data are needed to further physicians' understanding of the sexual norms and problems of older adults with diagnosed and undiagnosed diabetes. Virtually nothing is known about sexual function among individuals with undiagnosed diabetes; this information could be relevant for diagnosis, motivation to engage in treatment, and prevention of sexual and nonsexual diabetes-related complications. The National Social Life, Health

and Aging Project (NSHAP) provides disease-specific data on the sexual activity, behaviors, and problems of middle-aged and older adults affected by diabetes.

RESEARCH DESIGN AND METHODS

NSHAP involved a nationally representative probability sample of community-dwelling adults aged 57–84 years (at the time of screening), generated from U.S. households screened in 2004, described in detail elsewhere (7). Of 4,017 eligible subjects in the sample, 3,005 (1,455 men and 1,550 women) were interviewed at home between July 2005 and March 2006, yielding a weighted response rate of 75.5% (unweighted 74.8%). The protocol was approved by the University of Chicago and NORC institutional review boards; all respondents gave written informed consent.

Demographic and sexuality data

Details of demographic and sexuality measures have been reported previously (3). Sex was defined as "any mutually voluntary activity with another person that involves sexual contact, whether or not intercourse or orgasm occurs." Sexually active respondents were asked about the presence of sexual problems selected on the basis of diagnostic and clinical criteria for sexual dysfunction (3). All respondents who had not had sex in the previous 3 months were asked to indicate why from a list of reasons (3). A self-administered questionnaire completed during the in-home interview asked about the frequency of masturbation, defined as "stimulating your genitals (sex organs) for sexual pleasure, not with a sex partner," and ascertained whether orgasm occurred with masturbation. Questions about sexual activity and problems were refused by 2–7% of respondents; 12–13% declined to answer the questions regarding masturbation.

Diabetes status classification

Individuals were classified as having "diagnosed diabetes," regardless of their A1C value, if they responded that they had been told by a physician that they had diabetes or if they were using one or more diabetes medications. To identify individuals with "undiagnosed diabetes," we used an A1C cut point of 6.0% based on the correlation of A1C with the traditional fasting glucose criterion in older individuals. This A1C cut point for identifying undiagnosed diabetes was selected based on a sensitivity/specificity analysis of data from the 1999–2004 U.S. National Health and Nutrition Examination Survey for individuals aged 57–85 (8). By comparing different A1C cut points with diagnosis of diabetes based on fasting glucose levels, an A1C cut point of 6.0% maximized specificity of the assay for detecting undiagnosed diabetes without compromising sensitivity for all cut points examined between 5.0 and 7.0% (specificity 0.91 for men and 0.91 for women; sensitivity 0.68 for men and 0.69 for women) (supplementary Fig. 1, available in an online appendix at http://care.diabetesjournals.org/cgi/content/full/dc10-0524/DC1). Individuals who did not have diagnosed diabetes were classified as having "no diabetes" if their A1C value was <6.0% and were classified as having "undiagnosed diabetes" if their A1C value was ≥6.0% (supplementary Fig. 1A). In light of recent changes in international diabetes care guidelines, we also performed sensitivity analyses using the A1C 6.5% cut point criterion and summarize these in the DISCUSSION (9,10).

Details of medication data collection by direct observation and medication classification and coding have been described previously (11). Sixteen percent of all individuals and 26% of those in the analytic sample (17 and 24% weighted, respectively) were taking at least one medication classified as an antidiabetic agent "on a regular schedule, like every day or every week." These agents (and the weighted proportion of individuals in the analytic sample taking them) included biguanides (13.9%), sulfonylureas (12.5%), thiazolidinediones (7.2%), insulin (5%), antidiabetes combinations (2.6%), meglitinides (0.7%), α-glucosidase inhibitors (0.3%), and miscellaneous antidiabetes agents (0.1%). Of all the individuals using one or more diabetes medications, 95.1% also reported a diabetes diagnosis. Of individuals classified as having diagnosed diabetes, 3.9% were classified on the basis of medication data alone.

Measurement of A1C

Fingerstick dried blood specimens were sought from a random two-thirds of study respondents ($n = 2,494$), with a cooperation rate of 84.4% ($n = 2,105$) (supplementary Fig. 2B, available in an online appendix). A1C was obtained using well-validated dried blood spot methods described previously (12,13). Adequate specimens were obtained for analysis from 1,746 respondents.

Measurement of other health conditions and physician communication

Physical health was self-rated using the 5-point "excellent," "very good," "good," "fair," or "poor" scale. Comorbidities were assessed using the Katz modification of the Charlson index (14) (diabetes excluded), and activities of daily living were assessed using the Katz Activities of Daily Living Scale (15). Respondents were asked whether a medical doctor had ever told them they had any of several common diabetes-related complications (Table 1). Communication with a physician about sexual matters since age 50 was assessed as described previously (3). Depressive symptoms were assessed using the 11-item short form of the Center for Epidemiological Studies-Depression (CES-D) index (16), with response options 0–3; a score ≥9 was considered indicative of a clinically significant level of depressive symptoms, consistent with a threshold of 16 on the 20-item scale (17).

Data analysis

The analytic sample consisted of the 1,993 participants for whom diabetes status could be determined based on A1C, medication data, and/or self-report (supplementary Fig. 2A).

Demographic and clinical characteristics were estimated separately within each of the three diabetes status groups by gender. Bivariate associations with diabetes status were tested using the Rao and Scott (18) correction to the χ^2 test to account for the survey design. Logistic regression was used to model associations between diabetes conditions and sexual activity, behavior, and problems separately by gender.

All models were adjusted for age-group (57–64, 65–74, and 75–85 years), depressive symptoms (CES-D scores <9 vs. ≥9), and the modified Charlson comorbidity index (0, 1–2, and ≥3) except for outcomes with too few individuals in either outcome category to support a fully adjusted model (19). Education and race were also evaluated as potential confounders of the effect of diabetes status. For outcomes with a small number of individuals in either outcome category, confounding effects of each covariate listed above were evaluated separately; unadjusted models are presented for these outcomes unless confounding, de-

Table 1—*Characteristics of the study population*

	Men					Women				
Characteristic	Overall	Diagnosed diabetes*	Undiagnosed diabetes†	No diabetes‡	P value	Overall	Diagnosed diabetes	Undiagnosed diabetes	No diabetes	P value
n		340	202	425			325	183	518	
Social and demographic										
Age					0.33					0.05
57–64 years	41.9 (38.0–45.8)	41.6 (35.5–48.1)	36.9 (29.0–45.6)	44 (39.6–48.6)		38.6 (34.6–42.7)	38.7 (31.4–46.6)	39 (29.3–49.8)	38.4 (33.8–43.2)	
65–74 years	36.4 (32.7–40.3)	37 (32.6–41.7)	36.6 (29.0–45.0)	35.9 (31.0–41.1)		37.3 (33.7–41.2)	39.1 (31.9–46.7)	27.4 (20.4–35.6)	39.5 (35.3–43.8)	
75–85 years	21.8 (19.0–24.8)	21.3 (17.1–26.3)	26.5 (21.2–32.6)	20.1 (16.5–24.2)		24.1 (21.4–27.0)	22.3 (17.8–27.5)	33.6 (26.7–41.3)	22.2 (19.2–25.5)	
Race or ethnic group§					<0.001					<0.001
White	81.1 (75.9–85.3)	74.4 (67.3–80.4)	76.1 (65.5–84.2)	87.7 (82.9–91.3)		80 (74.9–84.3)	68.5 (60.2–75.8)	68.1 (60.1–75.2)	89.9 (85.4–93.1)	
Black	8.8 (6.4–11.9)	15.8 (10.5–23.1)	8.4 (5.9–11.8)	4.1 (2.3–7.0)		10.8 (7.9–14.5)	18.3 (12.7–25.6)	17.3 (11.4–25.4)	4.7 (3.0–7.3)	
Hispanic	7.1 (3.9–12.6)	6.1 (2.6–13.6)	11.8 (5.2–24.5)	5.8 (3.4–9.8)		7.2 (3.9–13.1)	11.5 (5.4–23.0)	9.5 (5.2–16.7)	4.2 (2.2–7.9)	
Other	3.1 (2.0–4.8)	3.7 (1.7–7.9)	3.8 (1.5–9.2)	2.4 (1.0–5.4)		2 (1.0–4.1)	1.7 (0.6–4.9)	5.1 (2.0–12.8)	1.3 (0.5–3.0)	
Marital status					0.57					0.3
Married	77.5 (73.9–80.7)	78.4 (72.8–83.1)	77.9 (68.8–84.9)	76.7 (71.5–81.2)		52.4 (49.0–55.8)	48.6 (41.7–55.5)	46 (37.3–55.0)	56.4 (50.8–61.9)	
Living with a partner	2.1 (1.2–3.8)	2.4 (1.0–5.7)	1.5 (0.3–7.0)	2.2 (1.0–4.5)		2.2 (1.1–4.2)	2.8 (0.7–10.0)	0.9 (0.5–1.8)	2.2 (1.1–4.6)	
Separated or divorced	9.6 (7.8–11.9)	7.6 (4.9–11.5)	9.2 (5.4–15.2)	11.2 (8.2–15.3)		15.3 (13.3–17.7)	17.1 (13.3–21.6)	14.1 (8.7–22.0)	14.8 (11.5–18.9)	
Widowed	8.4 (6.7–10.5)	9.7 (6.5–14.4)	10.3 (5.9–17.3)	6.8 (4.7–9.7)		26.4 (23.4–29.6)	27.2 (21.5–33.8)	33.8 (27.2–41.2)	23.7 (19.9–28.0)	
Never married	2.3 (1.6–3.5)	1.9 (0.9–4.0)	1.1 (0.3–4.1)	3.1 (1.7–5.6)		3.7 (2.6–5.3)	4.4 (2.4–7.9)	5.1 (2.4–10.6)	2.9 (1.7–5.0)	
Education					0.008					0.04
< high school	17.5 (13.5–22.3)	19.4 (14.0–26.1)	24.5 (15.9–35.9)	13.2 (9.6–18.0)		21.7 (17.8–26.3)	25.3 (18.3–33.9)	25.7 (18.8–33.9)	18.6 (14.6–23.4)	
High school/equivalent	24.5 (21.0–28.4)	25.6 (19.7–32.5)	27.3 (20.0–36.2)	22.5 (18.6–27.0)		29.3 (26.0–32.9)	30.8 (25.3–36.9)	34.1 (26.9–42.0)	27.1 (21.9–33.0)	
Vocational certification/some college/associate's degree‖	26.3 (22.2–30.9)	30.6 (24.8–37.0)	19.4 (14.3–25.7)	26.2 (20.9–32.2)		32.9 (29.2–36.8)	32.1 (26.1–38.8)	23.8 (16.9–32.5)	36.1 (31.3–41.2)	
Bachelor or more	31.8 (26.3–37.8)	24.5 (15.7–36.0)	28.8 (22.1–36.6)	38.1 (31.4–45.3)		16.1 (13.1–19.5)	11.8 (7.9–17.3)	16.5 (11.1–23.8)	18.2 (14.3–23.0)	
Health care utilization										
Insurance¶										
n		244	153	358			252	150	429	
Medicare	60.6 (55.0–66.0)	61.2 (52.1–69.5)	62.8 (53.0–71.7)	59.5 (53.4–65.3)	0.77	65.6 (60.9–70.0)	67.9 (59.0–75.6)	69.4 (60.1–77.3)	63.2 (58.4–67.8)	0.33
Medicaid	5.3 (3.4–8.0)	5.5 (3.0–10.1)	5.7 (2.6–12.2)	4.9 (3.3–7.4)	0.88	8 (5.5–11.6)	12.1 (7.4–19.1)	10 (5.3–18.0)	5.3 (3.3–8.6)	0.01
Private insurance	66.9 (60.8–72.4)	70.1 (61.9–77.2)	66.6 (56.3–75.5)	65 (58.5–71.0)	0.43	62.8 (58.0–67.3)	57.9 (48.9–66.5)	51.8 (41.1–62.4)	68.6 (63.8–73.0)	0.004
Veterans administration	13.6 (10.7–17.1)	14 (9.0–21.1)	14.2 (9.2–21.4)	13.1 (9.6–17.6)	0.93	2.6 (1.5–4.4)	1.2 (0.4–4.0)	1.1 (0.2–7.8)	3.7 (1.9–7.0)	0.17
Other program	10.3 (7.7–13.5)	7 (3.6–13.1)	9.7 (5.2–17.3)	12.4 (8.9–17.0)	0.21	13.5 (10.8–16.7)	12.9 (8.9–18.3)	16.1 (10.4–24.0)	12.9 (9.7–17.1)	0.61
Place to go when sick	90.2 (87.3–92.4)	92.6 (88.4–95.4)	85.6 (78.8–90.4)	90.4 (85.7–93.6)	0.11	92.1 (89.9–93.8)	96.7 (93.5–98.3)	87.2 (74.5–94.1)	91.1 (87.8–93.6)	0.06
Times seen doctor (past 12 months)					0.002					<0.001
n		304	188	401			297	176	485	
None	8.2 (5.6–11.7)	2.4 (0.8–7.3)	12.4 (7.5–19.8)	10.3 (6.1–16.6)		4.8 (3.5–6.7)	1.9 (0.6–5.3)	7.1 (3.8–12.8)	5.7 (3.9–8.3)	
1–9	75.5 (71.5–79.1)	73.4 (65.4–80.1)	72 (62.6–79.9)	78.3 (72.7–83.0)		75.5 (72.6–78.2)	68.1 (61.5–74.1)	75.9 (68.5–82.1)	79.3 (76.1–82.1)	
≥10	16.3 (13.3–19.9)	24.2 (18.1–31.4)	15.6 (9.4–24.7)	11.5 (8.2–15.8)		19.7 (17.2–22.4)	30.1 (24.6–36.1)	17 (11.6–24.2)	15.1 (12.5–18.0)	

Table 1—*Continued*

	Men					Women				
Characteristic	Overall	Diagnosed diabetes*	Undiagnosed diabetes†	No diabetes‡	P value	Overall	Diagnosed diabetes	Undiagnosed diabetes	No diabetes	P value
Health status#										
Self-rated physical health					<0.001					<0.001
Poor or fair	28.4 (24.0–33.3)	41.4 (35.8–47.3)	22.3 (15.8–30.5)	21.9 (15.9–29.5)		25.6 (21.4–30.3)	39.8 (31.9–48.2)	23.4 (16.7–31.8)	18.6 (14.3–23.8)	
Good	27.9 (24.6–31.4)	30.9 (26.4–35.7)	30.9 (23.5–39.4)	24.6 (20.0–29.8)		32.6 (28.9–36.5)	40 (32.8–47.7)	32 (26.1–38.6)	28.7 (23.4–34.7)	
Very good or excellent	43.7 (39.3–48.1)	27.7 (22.7–33.4)	46.8 (37.7–56.1)	53.5 (46.8–60.1)		41.8 (37.8–46.0)	20.2 (14.7–27.1)	44.6 (37.3–52.0)	52.7 (47.0–58.3)	
Self-rated mental health					0.01					0.006
Poor or fair	9.1 (6.6–12.3)	13.1 (9.6–17.7)	6.4 (3.3–12.3)	7.3 (4.5–11.7)		12.3 (9.6–15.6)	15.6 (10.9–21.8)	7.5 (4.1–13.5)	12 (9.0–15.9)	
Good	25 (21.7–28.7)	26.8 (22.5–31.5)	27.8 (21.9–34.5)	22.7 (18.1–28.0)		26.8 (23.8–30.0)	29.3 (23.7–35.6)	35 (27.8–43.0)	22.9 (19.4–26.8)	
Very good or excellent	65.9 (61.6–70.0)	60.1 (54.6–65.3)	65.8 (59.7–71.3)	70 (63.8–75.6)		60.9 (57.0–64.7)	55.1 (48.8–61.3)	57.5 (49.4–65.2)	65.1 (60.0–69.9)	
Comorbid conditions										
Heart attack	16 (13.0–19.6)	18.8 (15.3–22.8)	14.9 (9.6–22.4)	14.5 (9.2–22.2)	0.5	8.9 (7.2–11.0)	16.4 (11.3–23.0)	4 (2.2–7.2)	6.4 (4.4–9.1)	<0.001
Heart failure	11.7 (9.5–14.3)	17.2 (13.1–22.4)	14.7 (10.5–20.2)	6.6 (4.5–9.5)	<0.001	6.6 (5.1–8.6)	14.4 (10.4–19.6)	3.4 (1.7–6.9)	3.5 (2.2–5.4)	<0.001
Peripheral vascular disease	4.5 (3.4–6.1)	7.8 (5.5–11.0)	5.9 (3.0–11.2)	1.7 (0.9–3.3)	<0.001	2.4 (1.6–3.6)	3.2 (1.5–6.7)	2.9 (1.4–5.9)	1.9 (1.0–3.4)	0.43
Stroke	8.7 (6.7–11.1)	11.6 (7.9–16.8)	8.9 (5.0–15.3)	6.5 (4.4–9.7)	0.1	7.7 (6.3–9.3)	12.1 (8.5–16.9)	5.9 (2.7–12.5)	5.8 (4.0–8.4)	0.04
Poor kidney function	4.6 (3.1–6.8)	7.2 (4.7–10.9)	2.7 (1.3–5.5)	3.5 (1.8–6.8)	0.03	4.4 (3.2–5.9)	9.5 (6.5–13.8)	3 (1.3–7.0)	2 (1.0–4.1)	<0.001
Hypertension	55.7 (51.6–59.7)	72.5 (65.6–78.5)	49.8 (40.6–58.9)	46.5 (40.4–52.7)	<0.001	53.8 (49.9–57.8)	76.7 (69.4–82.7)	57.5 (47.1–67.4)	40.3 (36.3–44.4)	<0.001
Poor/fair vision	15.9 (12.3–20.2)	19.2 (14.2–25.5)	14.9 (9.3–23.2)	13.9 (9.1–20.6)	0.17	16.9 (13.8–20.5)	25.7 (19.5–33.1)	17.6 (11.8–25.5)	11.9 (9.0–15.6)	<0.001
Modified Charlson index**					0.004					0.02
0	28.8 (25.4–32.3)	20.5 (16.7–24.9)	33.8 (28.3–39.7)	32.5 (26.9–38.5)		24 (20.7–27.7)	18.3 (13.4–24.4)	27 (18.1–38.2)	26.3 (21.5–31.6)	
2	49.3 (45–53.6)	49.6 (44.4–54.8)	46.9 (40.0–53.9)	50.1 (43.5–56.7)		50.5 (46.9–54.1)	47.6 (39.9–55.4)	54.5 (45.2–63.4)	50.9 (46.2–55.6)	
≥3	21.9 (19.3–24.9)	29.9 (24.2–36.3)	19.3 (14.1–26.0)	17.5 (14.0–21.7)		25.5 (22.4–28.7)	34.2 (28.5–40.3)	18.6 (12.9–26.0)	22.9 (19.3–26.9)	
CES-D index††					0.06					0.36
0–8	80.2 (77.0–83.0)	74.5 (67.3–80.5)	81.4 (73.9–87.2)	83.6 (78.8–87.6)		73.7 (70.4–76.7)	70.5 (65.7–75.8)	72.5 (63.4–80.1)	75.7 (71.1–79.7)	
≥9	19.8 (17.0–23.0)	25.5 (19.5–32.7)	18.6 (12.8–26.1)	16.4 (12.4–21.2)		26.4 (23.3–29.7)	29.5 (24.2–35.3)	27.5 (19.9–36.6)	24.3 (20.3–28.9)	
Katz Activities of Daily Living					0.007					<0.001
0	70 (65.7–74.0)	59.5 (51.1–67.4)	73.8 (65.3–80.8)	75.8 (69.6–81.1)		59.4 (55.4–63.3)	43.4 (36.9–50.1)	63.9 (54.3–72.5)	66.7 (62.3–70.8)	
1	13.3 (11.0–16.1)	18.8 (14.0–24.7)	8.9 (5.5–14.0)	11.4 (8.9–14.4)		16.4 (13.5–19.7)	21 (15.7–27.4)	14 (8.5–22.4)	14.6 (11.4–18.5)	
2	5.1 (3.7–7.1)	7 (4.5–10.9)	7 (3.9–12.4)	3 (1.7–5.3)		7.7 (6.2–9.6)	10.7 (7.8–14.6)	10.6 (6.2–17.6)	5.3 (3.6–7.5)	
≥3	11.5 (9.1–14.5)	14.7 (10.6–20.0)	10.4 (6.1–17.0)	9.8 (5.8–16.0)		16.5 (13.9–19.5)	24.9 (20.3–30.2)	11.5 (7.5–17.4)	13.5 (10.4–17.3)	

Data are weighted prevalence % (95% CI). *Diagnosed diabetes: self-report, or taking diabetes medication. A1C value was not used as a criterion for classifying individuals as "diagnosed diabetes." †Undiagnosed diabetes: no self-report or diabetes medication but have A1C ≥6.0 %. ‡No diabetes: no self-report or diabetes medication and A1C <6.0. §Race or ethnic group was determined on the basis of the questions "Do you consider yourself primarily white or Caucasian, black or African American, American Indian, Asian, or something else?" and "Do you consider yourself Hispanic or Latino?" Six respondents who reported being both Hispanic and black or African American were included in the black group. ‖Vocational certification, some college level training, or associate's degree. ¶Insurance types not mutually exclusive. #Health status was self-reported in response to the question, "Would you say your health is excellent, very good, good, fair, or poor?" Specific comorbid conditions were also self-reported in response to the question, "Has a medical doctor ever told you that you have any of the following conditions?" with the option to choose all that apply. **The Katz modification of the Charlson index was used to assess comorbidities. Conditions included myocardial infarction, congestive heart failure, peripheral vascular disease, connective tissue disease, ulcer disease, dementia, liver disease, and renal disease. Diabetes was excluded (16). ††The 11-item Iowa short form of the CES-D scale was used to assess depressive symptoms (18).

Table 2—Sexual activity and behavior in older men and women stratified by diabetes status

| Characteristic | No. respondents | Weighted % (95% CI) | | | | AOR (95% CI)* | |
		Total (overall)	Diagnosed diabetes	Undiagnosed diabetes	No diabetes	Undiagnosed vs. diagnosed diabetes	No diabetes vs. diagnosed diabetes
Sexual activity with a partner (in previous 12 months)							
Men	926	67.8 (62.8–72.4)	61.3 (52.4–69.5)	68.5 (60.7–75.4)	71.9 (66.3–76.8)‖	1.34 (0.82–2.18)	1.38 (0.90–2.11)
Women	998	41.2 (37.1–45.5)	33.4 (27.4–40.0)	41 (31.5–51.3)	45.5 (39.1–52.0)‖	1.56 (0.85–2.85)	1.68 (1.18–2.38)#
Frequency (≥2–3 times per month)‡							
Men	562	64.1 (59.4–68.6)	59.8 (52.6–66.6)	66.4 (55.2–75.9)	65.6 (57.9–72.6)	1.26 (0.74–2.16)	1.21 (0.75–1.94)
Women	321	63.6 (56.6–70.0)	65.6 (49.8–78.5)	63.8 (49.3–76.2)	62.8 (53.3–71.4)	0.98 (0.35–2.73)	0.91 (0.41–2.01)
Vaginal intercourse (usually or always)‡							
Men	567	84.5 (80.1–88.1)	79.8 (72.4–85.7)	83.8 (71.5–91.5)	87.5 (82.8–91.0)	1.32 (0.59–2.96)	1.74 (0.98–3.08)
Women†	323	85.5 (80.0–89.7)	82.9 (69.0–91.4)	87.9 (77.0–94.1)	85.8 (78.7–90.8)	1.5 (0.49–4.57)	1.25 (0.50–3.08)
Performed oral sex (usually or always)‡							
Men†	557	13.7 (9.4–19.4)	10.5 (5.8–18.3)	8.2 (3.8–16.9)	17.6 (10.6–27.9)	0.76 (0.25–2.32)	1.82 (0.79–4.21)
Women†	314	10.5 (5.4–19.2)	7.3 (2.5–19.3)	16.7 (5.4–41.2)	10 (4.7–19.8)	2.55 (0.41–16.03)	1.41 (0.37–5.43)
Received oral sex (usually or always)‡							
Men†	552	14.8 (10.2–20.8)	13.7 (8.3–21.8)	10.2 (4.9–19.9)	17.2 (10.1–27.9)	0.71 (0.26–2.00)	1.31 (0.59–2.87)
Women†	315	9.5 (6.0–14.7)	5.5 (1.5–17.7)	6.1 (0.8–35.6)	12 (8.0–17.7)	1.11 (0.10–12.69)	2.35 (0.60–9.18)
Sexual touching¶ (usually or always)‡							
Men†	581	92.1 (89.2–94.3)	92.7 (87.5–95.9)	89.8 (78.9–95.4)	92.7 (88.1–95.6)	0.69 (0.23–2.10)	0.99 (0.41–2.43)
Women†	331	87.6 (82.7–91.3)	89.0 (80.5–94.0)	77.1 (59.7–88.4)	90.0 (84.0–93.9)	0.42 (0.15–1.17)	1.11 (0.49–2.54)
Masturbation (in previous 12 months)§							
Men	850	53.4 (48.7–58.0)	46.5 (39.9–53.3)	47.6 (39.5–55.7)	60.5 (53.0–67.5)‖	1.11 (0.70–1.77)	1.74 (1.13–2.68)#
Women	862	22.5 (19.1–26.3)	14.9 (10.9–19.9)	15.1 (9.1–24.1)	28.9 (23.9–34.6)‖	1.05 (0.53–2.08)	2.33 (1.50–3.63)#

*All odds ratios are adjusted for age-group, comorbidities, and depression unless otherwise noted. †The unadjusted model was used because of the small number of cases. ‡Respondents were asked about this activity or behavior if they reported having sex in the previous 12 months. §This question was asked of all respondents by means of a self-administered questionnaire. ‖Association with diabetes status was significant at $P < 0.05$. ¶Kissing, hugging, caressing, or other ways of sexual touching. #Odds ratio was significant at $P < 0.05$.

fined as a change in the odds ratio of ≥10%, was identified.

All analyses accounted for the survey sampling design through incorporation of sampling strata and clusters, as well as weights that adjusted for a differential probability of selection and differential nonresponse. All reported estimates are weighted. All analyses were performed with STATA statistical software (version 10).

RESULTS

Sociodemographic and health characteristics by diabetes status
Table 1 summarizes the demographic and health characteristics of the analytic sample, stratified by diabetes status. Self-rated health and capacity for activities of daily living were consistently lower, and the prevalence of several diabetes complications and comorbidities were consistently higher for individuals with diagnosed diabetes compared with those with no diabetes, with intermediate results for those with undiagnosed diabetes.

Partnership and sexual activity by diabetes status
Men, regardless of age or diabetes status, were more likely than women to be married or living with a partner (Table 1) and were significantly more likely than women to be currently sexually active (Table 2). Sixty-one percent of men (69% of partnered men) and 33% of women (62% of partnered women) with diagnosed diabetes were currently sexually active. Women with diagnosed diabetes were less likely than men with diagnosed diabetes (adjusted odds ratio [AOR] 0.28 [95% CI 0.16–0.48]) and other women (0.63 [0.45–0.87]) to be sexually active. Among sexually active individuals, the majority engaged in sexual activity at least two to three times per month and neither the frequency of sexual activity nor specific partnered sexual behaviors differed by diabetes status or gender.

Sexual behaviors and problems by diabetes status
Among sexually active individuals, partnered sexual behaviors did not differ by gender or diabetes status (Table 2). However, adults with diagnosed diabetes were less likely than others to

masturbate (AOR 0.50 [95% CI 0.32–0.78 for women] 0.66 [0.44–0.97 for men]) and to experience orgasm with masturbation (Table 3).

Sexual problems were ascertained only for individuals who were sexually active in the prior 12 months (Table 3). Men with diagnosed diabetes were more likely than other men to report lack of interest in sex (AOR 1.72 [95% CI 1.12–2.63]); among women, interest in sex did not differ by diabetes status. The prevalence of orgasm problems (inability to climax or climaxing too quickly) was similarly elevated among men with diagnosed and undiagnosed diabetes compared with men without diabetes, but erectile difficulties were elevated only among men with a diabetes diagnosis (2.52 [1.53–4.14]).

Among all individuals who had not been sexually active for ≥3, men with diagnosed diabetes were more likely than all other groups (men and women) to report that they had not had sex because of their own physical health problems (60.9 vs. 34.5% for men with undiagnosed diabetes and 39.4% for men with no diabetes, *P* < 0.001; 16.2% of women with diabetes vs. 8.5% with undiagnosed diabetes and 9.2% with no diabetes). Among women, the common reasons for sexual inactivity were similar between those with diagnosed and no diabetes, but women with undiagnosed diabetes were more likely to report lack of interest as a reason for sexual inactivity (54.5% for undiagnosed diabetes vs. 44.9% for diagnosed diabetes and 38.0% for no diabetes, *P* < 0.05).

Communication with a physician about sexual issues by diabetes status

Men with diagnosed diabetes were more than twice as likely (46.8%) as women with diagnosed diabetes (18.8%) to discuss sex with a physician compared with 28.0% of men and only 11.3% of women with undiagnosed diabetes (supplementary Fig. 3*A* and *B*, available in an online appendix). Among those who had discussed sexual matters with a physician, 16.7% of men overall (10.0% of men with diagnosed diabetes) compared with 30.5% of women overall (28.4% of women with diagnosed diabetes) reported that the physician initiated the conversation. Approximately one-third of sexually active men and women with sexual problems reported avoiding sex because of problems (Table 3); this number did not vary by diabetes status.

CONCLUSIONS — Our findings, based on nationally representative U.S. data, indicate that two-thirds of men and approximately one-third of women aged 57–85 years with diabetes were sexually active. Although diabetes was associated with a higher rate of sexual inactivity, those who were active participated in partnered sexual behaviors and activity at a rate similar to that of those without diabetes. As a group, the majority of individuals with diabetes were married or living with a partner, although women with diabetes were more likely to be alone. Sexually active adults with diabetes had a similar prevalence of sexual problems, and women were more likely than men to avoid sex because of these problems. However, fewer than one in five women with diagnosed diabetes compared with nearly half of men had discussed sex with a physician. Individuals with undiagnosed diabetes, particularly women, were even less likely than others to have discussed sex with a physician.

In this study, we combined self-report measures, medication, and biological measures from a population-based probability sample to stratify individuals as having diagnosed, undiagnosed, or no diabetes. There is not yet full agreement about using A1C to diagnose diabetes in older adults (9,10,20), but our strategy generated estimated prevalences of diagnosed and undiagnosed diabetes comparable to 2005–2006 U.S. population estimates using fasting plasma glucose and/or oral glucose tolerance testing for community-residing individuals aged ≥60 years (among those with A1C results, 20.5% [95% CI 17.5–24%] of 901 women and 25% [21–29%] of 843 men had diagnosed diabetes, whereas 19% [16–22%] of women and 22% [19–25%] of men had undiagnosed diabetes) (21). Repetition of the analyses shown here using a 6.5% glycosylated hemoglobin threshold for diabetes classification in this population yielded few qualitative differences in the outcomes of interest but did result in a far smaller undiagnosed diabetic group (4.7% in women and 5.6% in men) than found by classification based on traditional diagnostic criteria. Using either threshold, as a group, individuals with undiagnosed diabetes are different from those with diagnosed diabetes in two important ways. First, those with undiagnosed diabetes seemed to be earlier in the course of the disease. Second, undiagnosed diabetes is a pathophysiological state that lacks the psychological burden

and/or social stigma associated with having diagnosed diabetes (5).

The etiology of sexual problems associated with undiagnosed diabetes (controlling for other physical and psychological factors known to be associated with sexual problems) might reflect a predominant physiological mechanism whereas the etiology of sexual problems associated with diagnosed diabetes might be more likely to have an additional, diabetes-specific psychosocial component. Although cross-sectional data cannot determine the causal direction of such relationships, understanding the sexuality of individuals with undiagnosed compared with that of those with diagnosed and no diabetes can shed light on the pathological mechanisms and the natural history of both diabetes and sexual dysfunction in later life.

In this study, aside from the expected higher prevalence of erectile dysfunction in men with diagnosed diabetes (55%) (1), the prevalence of many sexual problems did not differ significantly according to diabetes status. Dropping out from sexual activity may partly explain the lack of a diabetes association with sexual problems, especially in women. This finding is suggested by the significantly higher prevalence of sexual inactivity among women with diagnosed diabetes compared with that for men and a greater lack of interest in sex among sexually inactive women with diabetes compared with those without. Furthermore, women with diabetes (diagnosed and undiagnosed) were nearly half as likely as other women to report masturbating, suggesting a reduction in sexual drive that was independent of partner status and of knowledge of the disease. The prevalence of masturbation was also lower in men with diagnosed or undiagnosed diabetes compared with that in men without but was three times higher than in women with diabetes (45%).

Interestingly, the rate of erectile dysfunction was not markedly elevated in men with undiagnosed diabetes (36 vs. 32% in men without diabetes), but the inability to experience orgasm was high and comparable to that of men with diagnosed diabetes (29 vs. 16% in men without diabetes). This finding suggests that loss of orgasmic function may not only occur as a consequence of erectile dysfunction as described by others (22) but also may actually precede erectile dysfunction, at least as perceived by some men with diabetes. In women, inability to experience orgasm with masturbation was also significantly higher among those

Table 3—Sexual problems associated with diabetes conditions in sexually active men and women

Characteristic	No. respondents	Weighted % (95 CI)				AOR (95% CI)*	
		Total (overall)	Diagnosed diabetes	Undiagnosed diabetes	No diabetes	Undiagnosed vs. diagnosed diabetes	No diabetes vs. diagnosed diabetes
Lack of interest in sex							
Men	580	28.3 (24.2–32.8)	37.6 (30.3–45.6)	23.9 (16.0–34.1)	24.8 (19.4–31.1)#	0.57 (0.30–1.07)	0.59 (0.38–0.91)††
Women	326	47.6 (40.1–55.2)	44.3 (30.6–58.9)	54.7 (39.0–69.6)	46.9 (37.6–56.3)	1.47 (0.66–3.30)	1.13 (0.55–2.32)
Inability to climax							
Men	568	21.4 (17.8–25.5)	26.1 (18.3–35.8)	28.5 (20.9–37.5)	15.9 (11.6–21.4)#	1.16 (0.57–2.36)	0.55 (0.31–0.99)††
Women	308	37.3 (31.7–43.2)	43.6 (31.5–56.5)	26.3 (16.2–39.7)	37.9 (31.1–45.2)	0.43 (0.19–0.98)	0.8 (0.41–1.54)
Climaxing too quickly							
Men	565	29 (24.4–34.1)	36.3 (26.0–48.0)	34 (23.0–47.1)	22.9 (18.0–28.6)	0.92 (0.49–1.74)	0.53 (0.29–0.96)††
Women†	313	7.8 (4.9–12.2)	13.1 (6.1–25.9)	7.8 (2.5–21.4)	5.8 (3.2–10.2)	0.56 (0.13–2.40)	0.41 (0.15–1.10)
Pain during intercourse							
Men†	580	3.9 (2.5–6.1)	4.4 (2.2–8.6)	4.7 (1.7–12.8)	3.3 (1.6–7.0)	1.09 (0.30–3.95)	0.76 (0.25–2.32)
Women†	326	17.4 (13.1–22.8)	15.7 (8.9–26.2)	17 (6.7–36.8)	18.2 (12.0–26.6)	1.1 (0.29–4.25)	1.2 (0.58–2.47)
Sex not pleasurable							
Men†	578	6.2 (4.4–8.7)	6.7 (3.8–11.5)	5.7 (3.3–9.5)	6.2 (3.6–10.5)	0.84 (0.39–1.83)	0.92 (0.39–2.19)
Women†	323	24 (18.7–30.3)	23.6 (13.6–37.8)	18.7 (9.7–33.1)	25.7 (18.6–34.3)	0.75 (0.26–2.16)	1.12 (0.50–2.50)
Anxiety about performance							
Men	575	26.5 (22.6–30.8)	31.3 (23.6–40.2)	28.6 (20.7–38.0)	23 (18.4–28.3)	0.87 (0.49–1.55)	0.66 (0.42–1.04)
Women†	322	10.9 (8.0–14.5)	11.2 (5.7–20.9)	7.7 (2.6–20.5)	11.6 (8.0–16.6)	0.66 (0.17–2.58)	1.04 (0.44–2.47)
Difficulty achieving or maintaining an erection							
Men	577	39.2 (33.8–44.8)	55.3 (43.2–66.8)	35.6 (25.8–46.9)	31.5 (25.6–38.0)#	0.45 (0.24–0.82)††	0.38 (0.22–0.66)††
Difficulty with lubrication							
Women	321	41.9 (35.4–48.6)	43.5 (32.1–55.6)	46.7 (30.5–63.7)	39.9 (31.9–48.4)	1.28 (0.53–3.09)	0.94 (0.51–1.75)
Avoidance of sex because of sexual problems‖¶							
Men	383	27.9 (22.4–34.2)	27.7 (19.3–38.1)	23.8 (14.2–37.1)	30.1 (22.5–38.9)	0.86 (0.36–2.05)	1.14 (0.60–2.15)
Women†	243	35.1 (27.3–43.9)	32.2 (19.7–47.8)	39.2 (21.7–59.9)	35 (27.5–43.3)	1.36 (0.48–3.86)	1.13 (0.60–2.15)
Inability to experience orgasm with masturbation (never/rarely/sometimes)**							
Men‡	425	15.7 (12.4–19.7)	21.1 (14.4–29.9)	9 (4.0–18.9)	14.9 (10.3–20.9)	0.31 (0.11–0.88)††	0.66 (0.31–1.40)
Women§	218	33.6 (27.2–40.6)	48.9 (36.7–61.2)	24.3 (13.0–40.7)	30.2 (22.8–38.7)	0.34 (0.13–0.89)††	0.71 (0.33–1.52)

*All odds ratios are adjusted for age-group, comorbidities, and depression unless otherwise noted. †The unadjusted model was used because of the small number of cases. ‡Model adjusted for age-group and race. §Model adjusted for Charlson index and race. ‖Respondents were asked about this activity or behavior if they reported having sex in the previous 12 months ¶This question was asked only of respondents who reported at least one sexual problem. #Association with diabetes status was significant at P < 0.05. **This question was asked of all respondents by means of a self-administered questionnaire. Answer options included never, rarely, and sometimes. It was asked of everyone who reported masturbation, not exclusively of those who were sexually active. ††Odds ratio was significant at P < 0.05.

with diagnosed diabetes. Physicians who do ask about sexual function tend to engage patients with partners (23) and focus on male erectile issues for which treatment is readily available. Asking about orgasm function in relation to partnered sex and masturbation and expanding these discussions to include women may assist in prevention of downstream sexual problems and personal and interpersonal distress and in earlier diagnosis of diabetes in some individuals. Although no pharmacological treatment is approved as a remedy for anorgasmia, interventions such as education to inform the patient that anorgasmia is known to occur for a substantial proportion of sexually active individuals with diabetes, directed masturbation, use of a clitoral pump in women, and discussion of ways to enhance sexual arousal and intimacy can be therapeutic.

Medications are another important iatrogenic etiology of later-life sexual problems (24). Glucose-lowering medications are largely thought to improve sexual function by mitigating glycemic-related microvascular damage, as seen in clinical studies of erectile function in men with diabetes (4). The stratification strategy used in our study classifies all individuals taking glucose-lowering medications as having diagnosed diabetes. This strategy would tend to underestimate the association between diagnosed diabetes and sexual function, particularly for the subgroup with uncontrolled diabetes. However, other medications used to treat diabetes, including antihypertensive and cholesterol-lowering drugs, may have deleterious effects on sexual function (24). Because of sample size, this study is limited by an inability to account for the effects of other medications in estimating the association between diabetes status and aspects of sexuality. Prospective clinical trials are needed to fully elucidate the effects and interactions of medications on sexual activity and function among middle-age and older adults with diabetes; virtually nothing is documented about the effects of diabetes medications on sexuality in older women.

The prevalence of specific sexual problems was only assessed for those who were sexually active in the prior 12 months, therefore underestimating the prevalence of sexual problems in this population. Next, in addition to the expected differences in population prevalence estimates for undiagnosed diabetes, reanalysis using a glycosylated hemoglo-

bin cut point criterion of 6.5% results in differences between the groups for some outcomes, in part because of loss of precision in estimates. For example, the rate of erectile dysfunction was still higher in men with undiagnosed diabetes (40.5%) compared with that of men without diabetes (32.1%), but the AOR comparing these two groups was no longer significant (0.63 [95% CI 0.25–1.58]). No substantive differences were found in diabetes status comparisons among sociodemographic, health, or communication variables. As with virtually all clinical and population-based research on human sexuality, these data were self-reported, although the interview methods are widely accepted as being valid (25). Use of a population-based probability sample adds to prior knowledge (1,2) about later-life diabetes and sexuality by disaggregating individuals with undiagnosed or preclinical diabetes from those with no diabetes. This study builds on prior work by filling a void of information about older women's sexuality and gender differences in sexuality among middle-age and older adults with diabetes. Further research should be powered to also look at age-group comparisons.

In conclusion, many middle-aged and older adults with diabetes are sexually active. Sexual problems are common but are infrequently discussed with physicians, especially among women. Physician knowledge about sexuality in relation to diabetes should improve patient education and counseling, as well as the identification of symptoms that could signal undiagnosed disease or a high risk for disease. Attention to potentially treatable sexual problems in middle-aged and older adults with diabetes should improve quality of life and enhance overall diabetes management.

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