Association Between Widowhood and Risk of Diagnosis With a Sexually Transmitted Infection in Older Adults

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Widowhood has been shown to be associated with numerous health outcomes, including depression, disability, health care usage, and all-cause and cause-specific mortality.[1–6] One issue that has not been explored is whether widowhood is associated with increased sexual risk-taking. This topic is important, because untreated sexually transmitted infections (STIs) increase the risk of contracting other STIs, including HIV infection, and in themselves constitute socially stigmatized and often painful avoidable morbidity. Moreover, the proportion of incident HIV cases that are among those aged 50 years and older has risen in recent years, thus raising the possibility of a corresponding increase in the prevalence of STIs generally among older persons.[7]

The few studies that have looked at sexual risk-taking among older adults have documented a nonnegligible minority at risk for contracting STIs. For example, 1 national survey found that 5.5% of Americans aged 50 to 75 years reported having engaged in sexual behaviors identified as HIV risk factors, including 2.2% with multiple partnerships in the previous year. Yet fewer than 4% of older sexually active heterosexual risk-takers used condoms consistently during the preceding 6 months. In fact, in a subsample taken from high-HIV-risk cities, older risk-takers were only one sixth as likely to use condoms and one fifth as likely to have been tested for HIV as were risk-takers in their 20s.[8] In another nationally representative study, 9% of persons aged 60 to 69 years and 8% of persons aged 70 years or older who were sexually active in the previous 5 years reported 2 or more partners during that period. In addition, 2% of married persons aged 60–69 years and 3.5% of married persons aged 70 or more years acknowledged an extramarital partnership in the past 5 years. Relative to younger age groups, older Americans with multiple partners were less likely to report consistent condom use or behavior change in

response to the HIV/AIDS epidemic.[9] Other studies have similarly documented low levels of condom use among sexually at-risk older persons.[10] Although the precise efficacy of condoms among older persons is unknown, this failure to protect against STIs is especially worrisome given older women's greater physiologic susceptibility to infection compared with younger women.[10]

In the present study, we assessed whether widowhood is associated with increased sexual risk-taking by asking (1) Is widowhood associated with an increased risk of being diagnosed with an STI? (2) Does the association depend on the time that has elapsed since the spouse's death? In addition, because the introduction of oral erectile dysfunction (ED) medications in 1998 expanded the realm of what is sexually possible for many men—and thus, couples—in later life, we also asked, (3) Does the magnitude of the observed associations differ before and after these drugs came on the market?

METHODS

STIs in older populations are rare events that necessitate unusually large data sets to analyze. The data sets that we used for this study met this criterion and came from 7 sources, 5 of which were drawn from Medicare claims data. The first was the 1993 Denominator file, which contains information on all eligible Medicare beneficiaries aged 65 years and older in that year and which captures 96% of Americans in that age range.[11] According to Census estimates, the file, which contains more than 32 million persons, should contain 6.6 million married couples wherein both members are aged 65 years or older. Of these, we detected 5 496 444, or 83%, by use of a spousal identification algorithm (method 1) described elsewhere.[12,13] A limitation of this methodology is its greater sensitivity for couples wherein the wife earned less than her husband during their working lives. Nonetheless, this is the modal pattern among this age group, and the resulting pool has been shown to be representative of older married couples in the United States.[14]

We further restricted the population to couples wherein both partners were less than 99 years of age in 1993 and resided in the 50 states. From the resulting 4 874 817 couples,

Objectives. We assessed whether widowhood is associated with risk of diagnosis with a sexually transmitted infection (STI) among older adults in the United States and whether the associations observed in men differed before and after the introduction of sildenafil, the first oral erectile dysfunction medication approved by the Food and Drug Administration.

Methods. We used Cox proportional hazards regression to analyze the time to first STI diagnosis in a random sample of married, Medicare-eligible couples aged 67 to 99 years in 1993 (N = 420 790 couples).

Results. Twenty-one percent of male and 43% of female participants lost a spouse during the 9-year study period. Only 0.65% of men and 0.97% of women were diagnosed with an STI. Widowhood was associated with an increased risk of STI diagnosis for men only, with the largest effects found 0.5 to 1 year after a wife's death. Effects for men were larger after the introduction of sildenafil.

Conclusions. Widowhood in older men, but not women, increased the risk for STIs, especially in the postsildenafil era. Clinicians should address sexual health issues with older patients, especially bereaved men taking erectile dysfunction medications. (*Am J Public Health.* 2009;99:2055–2062. doi:10.2105/AJPH.2009.160119)

we chose an 11.1% random sample (selected because it was the largest procurable before incurring a much higher fee). Finally, we excluded couples whose members resided in different zip codes in 1993. The resulting population-based sample comprised 518 240 couples, of which 2.7% were dropped because of missing covariates or data inconsistencies.

Our information on STI diagnoses was derived from *International Classification of Diseases, Ninth Revision* codes[15] obtained from (1) 1993 to 2002 Medicare provider analysis and review (MedPAR) records, which contain dates and diagnoses received for all hospitalizations; (2) 1993 to 2002 outpatient records, which contain comparable information for outpatient visits; and (3) 1993 to 2002 carrier records, which contain comparable information for physician office visits and laboratory tests. Our information on deaths came from 2002 Vital Status records, which contain daily mortality follow-up through January 1, 2002. Last, we used Area Resource File[16] and 1990 Decennial Census data for information on residential area characteristics and resources by county and zip code, respectively.

For our STI data, we used the first recorded date of any physician contact for a bacterial or viral STI, corresponding to either an inpatient or outpatient diagnosis or a lab result. The bacterial STIs analyzed consisted of chlamydia, gonorrhea, syphilis, trichomoniasis, chancroid, lymphogranuloma venereum, granuloma inguinale, and nongonococcal urethritis. We excluded cases explicitly indicated to have been acquired some time ago, e.g., late syphilis. The viral STIs analyzed consisted of genital herpes (caused by herpes simplex virus), HIV, human papilloma virus (including condyloma acuminatum, or genital warts), and certain retroviruses.

To control for baseline health status, we calculated the number of weeks spent hospitalized and constructed Charlson comorbidity scores (coded 0, 1, or ≥2 for each year[17]) from MedPAR data for 1991 and 1992. To ensure 2 complete years of data for all participants, we restricted the analytic sample to those aged 67 years or older on January 1, 1993, which resulted in a final sample size of 420 790 couples. Our measures of age, race/ethnicity,[3] and poverty (a couple-level variable indicating dual eligibility

in 1993 for Medicare and Medicaid services,[18] which implies living near or below the federal poverty level) have been validated.

We used the risk of being diagnosed with an STI as our indicator of the risk of contracting an STI and Cox proportional hazards regression to estimate the time to first STI diagnosis. The basic proportional hazards model, $h_i(t) = \lambda_0(t)\exp\{\beta_1 x_{i1} + \ldots + \beta_k x_{ik}\}$, states that the hazard for individual i at time t is the product of the baseline hazard function, which is left unspecified, and a linear function of a set of k covariates, which is exponentiated. Because sexual activity, and therefore STI risk, depends in part on age,[19] we used age rather than the alternative, calendar time, as the clock in our analysis, which allowed us to make no assumptions about the precise manner in which STI diagnosis risk varies with age.

The dependent variable in our models was thus age at first (observed) STI diagnosis, and persons with no diagnoses were censored at death or January 1, 2002, whichever came first. To control for secular trends in STI risk unrelated to the introduction of oral ED medications, we included indicators for calendar year in all models. Preliminary tests indicated that our variable for being non-Hispanic Black violated the proportional-hazards assumption. Consequently, all models were stratified by non-Hispanic Black race/ethnicity, which meant that we allowed the baseline hazard to differ by race/ethnicity but constrained the covariate coefficients to be equal for the 2 racial/ethnic groups analyzed. We used link tests to check model specification and Grambsch and Therneau tests based on Schoenfeld residuals to examine the proportional-hazards assumption. We used maximum-likelihood estimation methods in Stata version 9 (Stata Corp, College Station, TX) to estimate models separately for men and women.

To assess whether widowhood was associated with an increased risk of STI diagnosis, we estimated effects constrained to be constant over time. To determine whether the association depended on the elapsed time since the spouse's death, we allowed effects to vary with time in a separate set of models. To assess whether the magnitude of observed associations differed before and after oral ED medications became available, we used Wald

tests to evaluate whether estimated pre- and postmedication coefficients differed significantly.

The key independent variable of interest was a time-varying indicator for widowhood status. In models constraining effects to be constant with time, it was set to 0 until the spouse died and thereafter to 1. In duration-dependent models, we used a series of duration dummies indicating time since the spouse's death. The first approved oral ED medication, sildenafil citrate, trade name Viagra (Pfizer), received approval from the Food and Drug Administration on March 27, 1998. In models investigating whether the effects of widowhood on the risk of STI diagnosis differed before and after the advent of sildenafil, a presildenafil widowhood indicator was set to 1 after deaths that occurred before March 28, 1998. Upon reaching that date, however, it reverted to 0, and a postsildenafil widowhood indicator switched to 1. The latter variable also captured spousal deaths that occurred after sildenafil became available. As such, the time-varying sildenafil widowhood indicators reflected whether calendar time was pre- or postsildenafil, not whether the spousal death itself occurred before or after sildenafil was introduced.

We present results for 2 models. Model 1 controlled for calendar year only. Model 2 additionally controlled for individual- and aggregate-level factors hypothesized or found in previous studies to be associated with STI risk.[20–24] For example, some STIs are characterized by substantial geographic variation in prevalence, and studies have found that similar aggregate-level factors explain a significant proportion of that variation.[21,22,24] Because individual STI risk depends largely on the level of infection in one's community, contributing ecologic factors may thus represent an important determinant of risk.

We hypothesized that (1) the widowed would be at greater risk of contracting an STI than the married because of the former's greater opportunity and motivation for acquiring new sexual partners; (2) the relationship between widowhood and risk would change over time, as widowed individuals transitioned through stages of grief and recovery; and (3) the emergence of ED medications would amplify the observed effects.

RESULTS

The background characteristics of the sample, with a focus on individual- and couple-level attributes, are presented in Table 1. Individuals widowed during the study constituted 21% of male and 43% of female participants. A total of 0.65% of the men and 0.97% of the women were diagnosed with an STI during the study period. The rate was higher among nonwidowed than among widowed persons when differences in the mean length of follow-up, baseline STI trends, and other relevant factors were not accounted for.

Incidence data for the 6 STIs diagnosed most frequently during the study period and a breakdown by type are presented in Table 2. The most commonly diagnosed STI for men was gonorrhea; that for women was trichomoniasis. Although STI incidence data for older Americans are sparse and often of questionable quality as a result of incomplete reporting and the lack of mandatory reporting for most STIs, our figures are roughly consistent with what published estimates[25,26] suggest we might expect, given differences in the populations studied.

The first 2 columns of Table 3 present the results for models of the overall effect of widowhood on STI diagnosis risk. Constraining effects to be constant over time and adjusting for calendar year only (model 1), the loss of a spouse was associated with a large increase in risk for men (unadjusted hazard ratio=1.20; 95% confidence interval [CI]=1.07, 1.34) but not women (unadjusted hazard ratio=1.04; 95% CI=0.96, 1.12).

TABLE 1—Individual- and Couple-Level Characteristics, by Gender and STI Status: Medicare-Based Sample of Older Married Couples, United States, 1993–2002

	Men			Women		
	STI[a] (n = 2731), % or mean (SD)	No STI[a] (n = 418 059), % or mean (SD)	Total (n = 420 790), % or mean (SD)	STI[a] (n = 4076), % or mean (SD)	No STI[a] (n = 416 714), % or mean (SD)	Total (n = 420 790), % or mean (SD)
Widowed, 1993–2002	14.10	21.13	21.09	22.99	43.21	43.02
Died[b], 1993–2002	NA	52.52	52.18	NA	32.90	32.58
Race/ethnicity[c]						
Non-Hispanic White	82.86	90.57	90.52	86.48	92.44	92.38
Non-Hispanic Black	9.41	4.07	4.10	8.71	4.09	4.14
Other	7.73	5.36	5.38	4.81	3.47	3.48
Near or below federal poverty level, 1993	9.70	5.44	5.46	9.40	5.42	5.46
US region of residence, 1993						
New England	4.18	4.40	4.38	4.27	4.39	4.38
Middle Atlantic	15.60	13.54	13.56	15.28	13.54	13.56
East North Central	16.07	17.89	17.88	15.09	17.91	17.88
West North Central	5.82	9.88	9.85	5.69	9.89	9.85
South Atlantic	21.79	16.97	17.00	21.98	16.95	17.00
East South Central	5.82	6.50	6.50	6.23	6.50	6.50
West South Central	12.30	11.25	11.26	14.23	11.23	11.26
Mountain	5.31	5.76	5.76	4.91	5.77	5.76
Pacific	13.11	13.81	13.81	12.32	13.82	13.81
Charlson score, 1991						
Low (0)	88.86	89.04	89.04	92.86	92.66	92.66
Moderate (1)	5.24	4.87	4.88	3.66	3.51	3.51
Severe (≥2)	5.90	6.09	6.08	3.48	3.83	3.83
Charlson score, 1992						
Low (0)	86.74	87.05	87.04	92.03	91.34	91.34
Moderate (1)	5.42	5.05	5.06	3.43	3.77	3.77
Severe (≥2)	7.84	7.90	7.90	4.54	4.89	4.89
Age on January 1, 1993, y	75.96 (5.44)	76.64 (5.71)	76.63 (5.71)	73.37 (4.90)	74.23 (5.31)	74.22 (5.31)
Follow-up, 1993-2002, y	4.15 (2.44)	6.57 (2.96)	6.56 (2.96)	4.11 (2.49)	7.62 (2.45)	7.59 (2.48)
Hospitalization, 1991, wk/y	0.30 (1.02)	0.32 (1.28)	0.32 (1.28)	0.24 (1.00)	0.25 (1.18)	0.25 (1.18)
Hospitalization, 1992, wk/y	0.38 (1.26)	0.38 (1.54)	0.38 (1.53)	0.27 (1.14)	0.30 (1.33)	0.30 (1.33)

Note. STI = sexually transmitted infection; NA = not applicable. Percentages may not sum to 100 because of rounding.
[a]Diagnosed with a bacterial or viral STI during the study period.
[b]Restricted to those who were not diagnosed with an STI during follow-up.
[c]Non-Hispanic Whites and "others" are grouped together in the analysis.

TABLE 2—Top 6 Sexually Transmitted Infections (STIs) Diagnosed Among Men and Women During the Study Period and Breakdown by Type: Medicare-Based Sample of Older Married Couples, United States, 1993–2002

	No. (%)
Men	
STI	
Gonorrhea	549 (20.10)
HPV	483 (17.69)
HIV	366 (13.40)
Syphilis	343 (12.56)
Genital herpes	287 (10.51)
Chlamydia	228 (8.35)
Subtotal	2256 (82.61)
STI type	
Bacterial	1569 (57.45)
Viral	1162 (42.55)
Total	2731 (100.00)
Women	
STI	
Trichomoniasis	872 (21.39)
Gonorrhea	686 (16.83)
HPV	594 (14.57)
Genital herpes	552 (13.54)
Syphilis	353 (8.66)
Chlamydia	328 (8.05)
Subtotal	3385 (83.05)
STI type	
Bacterial	2567 (62.98)
Viral	1509 (37.02)
Total	4076 (100.00)

Note. Only the first STI that a respondent was diagnosed with during follow-up was included in the analysis and counted here.

When we additionally controlled for a host of individual and contextual factors (model 2), the magnitude of the male coefficient decreased but remained significant at the 0.05 level (adjusted hazard ratio=1.16; 95% CI=1.03, 1.29).

When we allowed widowhood effects to vary with time, we found larger effects for men only for 0.5 to 1 year after a spouse's death (adjusted hazard ratio=1.35; 95% CI=1.03, 1.77). We also found some evidence that the risk of diagnosis for men was elevated immediately after and 3 or more years after the spouse's death, although these results were not robust to the additional controls in model 2.

The remaining columns of Table 3 present results for models assessing whether effects differed before and after the advent of sildenafil. As before, in models constraining effects to be constant over time, widowhood was associated with an increased risk of diagnosis for men only, with larger and more robust effects seen after sildenafil became available (presildenafil adjusted hazard ratio=1.13; 95% CI=0.96, 1.33; postsildenafil adjusted hazard ratio=1.18; 95% CI=1.02, 1.38). However, this finding must be interpreted with caution, because the point estimate of the difference between the pre- and postsildenafil coefficients did not differ significantly from zero (adjusted *P*=.67).

When we allowed pre- and postsildenafil effects to vary with time (Table 3; Figure 1), widowhood had the largest and most significant impact on STI diagnosis risk for men 0.5 to 1 year after a wife's death in the postsildenafil era (adjusted hazard ratio=1.83; 95% CI=1.26, 2.66), a finding that differed significantly from the presildenafil estimate (adjusted *P*=.03). The finding of essentially no effect for this time period before the introduction of sildenafil suggests that the overall effect observed was driven by the sizeable and statistically significant postsildenafil effect. Before sildenafil became available, diagnosis risk also was elevated 3 or more years after a wife's death (adjusted hazard ratio=1.43; 95% CI=1.01, 2.02), although the pre- and postsildenafil estimates did not differ significantly (adjusted *P*=0.16). As before, in both constrained and duration-dependent models for men, controlling for the additional factors contained in model 2 had the effect of reducing the magnitude of the estimated coefficients, although most that were significant in the unadjusted models remained so.

Interestingly, for women, once sildenafil was on the market, widowhood appeared to be associated with a reduced risk of diagnosis 1 to 2 years after a husband's death (adjusted hazard ratio=0.77; 95% CI=0.59, 0.99), an effect that differed significantly from the corresponding presildenafil effect (adjusted *P*=0.03). Although we hesitate to put too much faith in the robustness of this finding, it is not implausible that married women are at increased STI risk relative to widowed women as the result of a greater likelihood of husband infidelity in the postsildenafil era, as suggested by some qualitative studies.[27]

DISCUSSION

Limited prior research has examined the sexual health of older persons, much less widowed older persons. Part of the reason is a perceived reluctance on the part of older individuals to divulge details of their sex lives. More fundamentally, however, this dearth of attention reflects the cultural assumption that older adults do not have sex.[10,28,29] Yet they do, as evidenced by community-based and nationally representative studies affirming that older individuals continue both to consider sex an important part of life and to engage in it.[9,10,19,28,30–33]

We asked whether the loss of a spouse is associated with greater sexual risk-taking, as reflected in a higher incidence of diagnosed STIs. We found that widowhood increased the risk of STI diagnosis for men but not for women. This finding is consistent with studies showing higher levels of sexual desire, greater sexual frequency, and more sexual partners among older men than women.[9,19,28,30,32,33] Gender-based disparities in sexual frequency and partnerships have been attributed primarily to unbalanced sex ratios at older ages and, to a lesser extent, greater sexual conservatism among older women (especially among the pre–baby boom generation), which manifests as a greater reluctance to engage in nonmarital sex.[20,32] The former is largely attributable to men's greater propensity to adopt younger partners and their shorter life expectancy.[19,20] The role of differential mortality is especially stark: an estimated 46% of women but only 16% of men aged 65 years and older were widowed in 1997, resulting in 4 times as many widows as widowers in that age range.[34] At ages 75 and older, an estimated 64% of women compared with only 22% of men are widowed.[30]

In addition, whereas women are less likely to report sexual dissatisfaction as they age, men are more likely to. Compared with older partnerless women, older partnerless men are more likely to report sexual dissatisfaction[30] and less likely to attribute their partnerless state to a lack of interest in sex.[19] Combined with increasing sex ratios at older ages, these findings suggest

TABLE 3—Cox Models of the Hazard of Diagnosis with a Sexually Transmitted Infection Among Men and Women as a Function of Widowhood and Whether Sildenafil Was Available: Medicare-Based Sample of Older Married Couples, United States, 1993–2002

	Overall		Before Sildenafil		After Sildenafil	
	Model 1, UHR (95% CI)	Model 2, AHR (95% CI)	Model 1, UHR (95% CI)	Model 2, AHR (95% CI)	Model 1, UHR (95% CI)	Model 2, AHR (95% CI)
	Men					
Overall	1.20 (1.07, 1.34)†	1.16 (1.03, 1.29)**	1.19 (1.01, 1.40)**	1.13 (0.96, 1.33)	1.22 (1.04, 1.41)**	1.18 (1.02, 1.38)**
Time since death of spouse, y						
<0.5	1.27 (0.97, 1.67)*	1.23 (0.94, 1.61)	1.25 (0.89, 1.77)	1.20 (0.85, 1.69)	1.31 (0.85, 2.02)	1.29 (0.84, 1.99)
0.5 to <1	1.39 (1.06, 1.82)**	1.35 (1.03, 1.77)**	1.08 (0.73, 1.61)	1.03 (0.69, 1.53)	1.86 (1.28, 2.69)†[a]	1.83 (1.26, 2.66)†[a]
1 to <2	1.11 (0.88, 1.40)	1.07 (0.85, 1.35)	1.06 (0.77, 1.45)	1.01 (0.73, 1.38)	1.17 (0.84, 1.65)	1.16 (0.82, 1.62)
2 to <3	1.15 (0.89, 1.47)	1.10 (0.86, 1.42)	1.11 (0.77, 1.60)	1.05 (0.73, 1.52)	1.18 (0.83, 1.67)	1.15 (0.81, 1.64)
≥3	1.19 (0.99, 1.42)*	1.14 (0.95, 1.36)	1.52 (1.08, 2.14)**	1.43 (1.01, 2.02)**	1.12 (0.91, 1.37)	1.07 (0.87, 1.32)
	Women					
Overall	1.04 (0.96, 1.12)	1.00 (0.93, 1.08)	1.09 (0.98, 1.22)	1.05 (0.94, 1.17)	0.98 (0.88, 1.09)	0.95 (0.86, 1.06)
Time since death of spouse, y						
<0.5	1.01 (0.84, 1.22)	0.98 (0.81, 1.19)	0.97 (0.76, 1.23)	0.93 (0.73, 1.19)	1.09 (0.80, 1.48)	1.07 (0.79, 1.46)
0.5 to <1	1.00 (0.82, 1.22)	0.97 (0.80, 1.19)	1.08 (0.85, 1.37)	1.04 (0.82, 1.33)	0.87 (0.62, 1.23)	0.86 (0.61, 1.21)
1 to <2	0.98 (0.84, 1.14)	0.95 (0.82, 1.11)	1.13 (0.93, 1.36)	1.08 (0.90, 1.31)	0.78 (0.60, 1.01)*[a]	0.77 (0.59, 0.99)**[a]
2 to <3	1.10 (0.93, 1.28)	1.06 (0.91, 1.25)	1.17 (0.94, 1.46)	1.12 (0.90, 1.40)	1.02 (0.81, 1.28)	1.00 (0.79, 1.25)
≥3	1.06 (0.94, 1.19)	1.02 (0.91, 1.15)	1.12 (0.88, 1.43)	1.07 (0.84, 1.37)	1.03 (0.90, 1.17)	0.99 (0.87, 1.13)

Note. N = 420 790. AHR = adjusted hazard ratio; UHR = unadjusted hazard ratio. Model 1 was stratified by non-Hispanic Black race/ethnicity and controlled for calendar year only. Model 2 was additionally controlled for poverty status, region of residence, baseline health status, and the following contextual variables: violent-crime rate, doctors per capita, hospital beds per capita, infant mortality rate, local per capita expenditures on health and hospitals, percentage urban, percentage non-Hispanic Black, percentage Hispanic, percentage unemployed, percentage of the population below poverty level, percentage home ownership, percentage of the population with < 9 y of schooling, percentage of the population aged 0–14 y, percentage of the population aged ≥ 40 y, male to female ratio, percentage female-headed families, percentage married, divorce rate, and crude birth rate.
[a]Differs significantly (P < .05) from the corresponding "before sildenafil" coefficient.
*P < .10; **P < .05; †P < .001.

a possible explanation for elevated STI risk, as indicated by elevated diagnosis risk, after widowhood for men but not women: bereaved older men may be more motivated and able to seek out new sexual partners. Consistent with this explanation, a nationally representative survey found that among those aged 57 to 85 years and without a regular partner, 22% of men but only 4% of women were sexually active in the previous year.[19]

Studies of other health outcomes have documented changes over time in the size of widowhood effects.[1,3–5] With the exception of larger effects found for men within a year of a wife's death, a finding that appears to be driven by large and statistically significant postsildenafil effects in that time interval, we found only minimal support for our second research hypothesis, that widowhood effects vary with time since the spouse's death. Of course, the failure to find statistical significance for additional duration intervals may have been due to insufficient statistical power resulting from the small number

of STI diagnoses in the data, even in a sample of our size.

We found support for our third research hypothesis: that effects differed before and after the advent of sildenafil. Depending on the definition used and the population studied, ED has been estimated to afflict between 22% and 52% of men aged 60 to 70 years and between 44% and 69% of men aged 70 years and older in the United States.[32,35–40] Male impotence was long viewed as an unfortunate corollary of aging for some men that little could be done about. That changed when sildenafil, the first medical ED treatment that required no injections, suppositories, or special devices, came on the market in 1998.[27,41,42] (Two additional oral ED medications, vardenafil and tadalafil, were released in 2003, after this study had concluded.)

The launch of sildenafil was widely promoted by Pfizer and was celebrated in the media.[43] As a result, its adoption was so precipitous that, with more than 2.9 million prescriptions filled and

over $400 million in sales in the first 3 months it was available,[41,44] it set a record for having the fastest initial sales growth of any pharmaceutical.[41,45] As evidence of its popularity, prescriptions for ED medications increased almost 7 fold between 1997 and 1998, when 92% were for sildenafil; that figure rose to 98% 3 years later, amounting to more than 14 million prescriptions and 105 million sildenafil tablets dispensed in the United States in 2001 alone.[42] As further evidence, in 2004, an estimated 15% of men aged 60 to 70 years and 8% of men aged 70 years and older had used sildenafil or another ED drug in the previous 2 weeks.[32] Those findings are similar to the results of a 2000 survey of male health professionals that found that 11% and 12% of these 2 age groups, respectively, reported past treatment of ED.[37]

The precipitousness of sildenafil's emergence and adoption allows us to treat it as a natural experiment. Further justification for incorporating sildenafil into the analysis is the moral panic that emerged after its introduction,
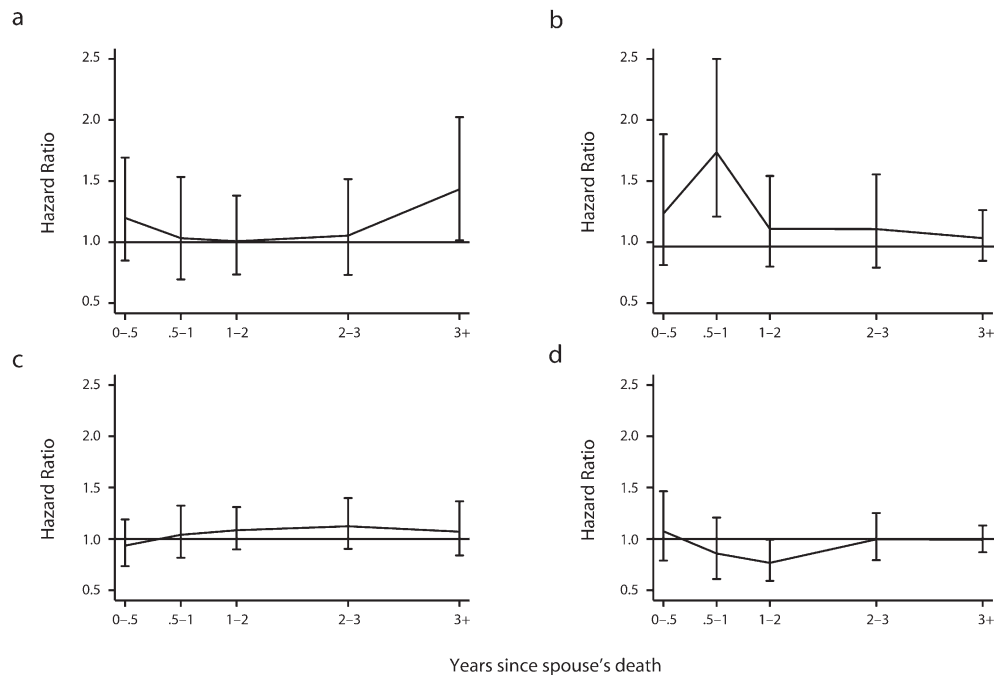
Note. Hazard ratios and 95% confidence intervals are from adjusted Cox regression models.

FIGURE 1—Effect of widowhood, depending on time since spouse's death, on the risk of diagnosis with a sexually transmitted infection for (a) men before the advent of sildenafil, (b) men after the advent of sildenafil, (c) women before the advent of sildenafil, and (d) women after the advent of sildenafil: Medicare-based sample of older married couples, United States, 1993–2002.

when numerous articles in the popular[46–48] and, to a more muted extent, academic press[25,33,45,49–51] raised the possibility that it would usher in an epidemic of STIs, including HIV, in the older population. Although no evidence to date suggests that this epidemic has materialized,[52] no study that we know of has empirically investigated whether the advent of sildenafil—and the increased opportunities it afforded for sexual risk-taking by men previously afflicted with ED—affected the incidence of STIs, generally, among older persons.[53] As such, our finding that the elevated risk of STI diagnosis associated with widowhood for men appeared to have increased after the introduction of sildenafil constitutes the first empirical attempt at an exploration of the effect of sildenafil on sexual risk-taking in this population.

Limitations

Our study has limitations, however. First, because this was an ecological study, we cannot ascribe causality to our findings. Lacking information on individual participants' sexual behavior, sexual partners, and medication use, we cannot know with certainty that the observed changes in STI diagnosis risk were due to behavioral changes of the kind we hypothesize. To minimize the possibility that the observed changes were the result of periodic fluctuations in underlying STI prevalence unrelated to the availability of sildenafil, we controlled for calendar year in all models. However, we cannot rule out the possibility that the introduction of sildenafil increased men's risk of being diagnosed with an STI after widowhood for reasons unrelated to sexual activity. For example, with the extensive media attention to older male sexuality that accompanied sildenafil's release, it is possible that older men felt more comfortable approaching their physicians to discuss sexual health problems. Physicians, too, may have experienced increased awareness of or comfort with older men's sexuality and sexual concerns, making them more likely to broach the topic with older male patients, sometimes leading to STI testing. Through either mechanism, diagnosis rates

could have increased without a concomitant increase in underlying STI incidence. Consistent with this explanation is our finding of an effect for men but not women; older women might have been less affected because sildenafil was not marketed to them (indeed, evidence suggests that conversations with physicians about sex are rarer for older women than for older men[19]). Less clear, however, is why diagnosis rates would increase after the introduction of sildenafil for widowers but not for married men, the relevant comparison for our analysis.

Another limitation is the high percentage of STI cases that go undiagnosed as a result of failure to experience symptoms, to recognize existing symptoms, or to seek treatment for observed symptoms because of embarrassment or lack of access to medical services. For some STIs, the percentage of cases that go undiagnosed is exceedingly high (e.g., more than 90% for herpes simplex virus type 2[54]). Moreover, rates of underdiagnosis likely increase with age,[55] because older individuals are less routinely screened for STIs,[25] are less knowledgeable

about symptoms,[56] are less likely to perceive themselves as at risk,[8,9] and are more likely to delay seeking health care for suspected STIs.[57,58] Consequently, our estimates of the effect of widowhood on STI risk are likely (conservatively) biased toward zero, and the true incidence of STIs in our study population is likely higher than the very low diagnosis rates presented here.

Moreover, because STIs are more commonly asymptomatic in women,[59] our finding that widowhood increased STI risk only for men may reflect higher levels of underdiagnosis in women that are obscuring an effect that in reality does exist. Mitigating this gender imbalance, however, is the possibility of greater detection among women as a result of their having greater access to routine reproductive health services. In contrast, men, who more often lack regular reproductive health care providers, are more likely to feel that they must resort to stigmatized STI clinics for STI-related care, as evidenced by their greater use of those facilities.[25]

Finally, mistakes in medical coding might have occurred, and our efforts to screen out diagnoses reflecting older infections might not always have been successful. Moreover, although we attempted to restrict our analysis to STIs, diagnoses for a few conditions analyzed can also reflect asexual etiologies. As such, a major limitation of our analysis is our reliance on STI diagnoses as our indicator of STI incidence and, by extension, sexual risk-taking among older adults. Nonetheless, our study also had advantages, including an unusually large data set, extensive individual- and aggregate-level controls, and the fact that we did not rely on self-reports for our STI data, which is especially valuable given that STIs are stigmatized and therefore underreported conditions.

Conclusions

Qualitative, clinic-based, and community-based studies have shown that older patients typically want physicians to broach the subject of sexual health with them, even if they are unwilling to initiate the discussion themselves.[29,31] Unfortunately, despite this eagerness on the part of older persons and increased calls from the medical community for greater attention to older individuals' sexual health needs, older adults are far less likely than are younger age groups to have clinicians raise the issue of STIs with them.[29,60–63] A recent, nationally

representative study found that only 38% of men and 22% of women aged 57 to 85 years reported having discussed sex with a physician since turning 50.[19] In another study, more than 60% of primary care physicians surveyed rarely or never discussed HIV/AIDS with older patients, and only one third regularly discussed risk reduction strategies.[61] This lack of awareness or reluctance on the part of clinicians to address sexual health issues is especially problematic given older individuals' reduced symptom awareness, perceived risk, and use of preventive measures relative to younger populations.

We documented a small but nonnegligible proportion of older adults with known STIs. This study provides support for the notion that clinicians need to be more aware of the possibility of STIs in older patients and to address sexual health issues with them, including obtaining sexual histories, when appropriate. This is particularly the case for older male patients who have lost a spouse, especially if they are taking drugs for ED. Additionally, more data collection and research is needed on the impact of relationship status, transitions into widowhood, and the availability and use of ED medications on the sexual health of older individuals. ∎

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Contributors

K. P. Smith contributed toward originating the study, completed the analyses, and led the writing. N. A. Christakis obtained the data, contributed toward originating the study, and reviewed drafts of the article.

Human Participant Protection

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