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Patterns of Sexual Activity and the Development of Sexual Pain Across the Menopausal Transition

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Abstract

Objective: To examine whether patterns of frequency of sexual intercourse and demographic, menopausal status, genitourinary, health, and psychosocial factors are associated with developing sexual pain across the menopausal transition.

Methods: These were longitudinal analyses of questionnaire data from the multi-center, multi-racial and ethnic prospective cohort Study of Women's Health Across the Nation (1995–2008). We used multivariable discrete-time proportional hazards models to examine whether incident sexual pain was associated with preceding long-term (up to 10 visits) or short-term (two and three

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visits) sexual intercourse frequency patterns or other factors (e.g. menopause status, genitourinary symptoms, lifestyle factors, and mental health).

Results: Of the 2247 women with no sexual pain at baseline, 1087 (48.4%) developed sexual pain "at least sometimes" up to 10 follow-up visits over 13 years. We found no consistent association between prior patterns of sexual intercourse frequency and development of sexual pain. For example, neither decreases in intercourse frequency from baseline (adjusted hazard ratio (aHR) 0.93, 95% confidence interval (CI) 0.73, 1.19) nor decreases in frequency over three prior visits (aHR 1.00, 95% CI 0.72, 1.41) were associated with incident pain. Reasons for interruptions in intercourse activity at the prior visit, including lack of interest (aHR 1.64, 95% CI 0.74, 3.65) and relationship issues (aHR 0.36, 95% CI 0.04, 2.88), were not associated with developing pain. Being postmenopausal, using hormone therapy (aHR 3.16, 95% CI 1.46, 6.85) and reported vaginal dryness (aHR 3.73, 95% CI 2.88, 4.83) were most strongly associated with incident sexual pain.

Conclusion: Long- and short-term declines in sexual intercourse frequency across the menopausal transition were not associated with increased hazard of developing pain with intercourse. This empirical evidence does not support the common belief that a reduction in women's sexual frequency is responsible for their symptoms of sexual pain.

Precis

Long-term and short-term declines in sexual intercourse frequency across the menopausal transition were not associated with increased hazard of developing pain with intercourse.

Introduction

Painful intercourse is a frequently reported symptom in mid-life and older women with prevalence estimates ranging from 20% to 59% in peri- and postmenopausal women.[1,2] Genitourinary aging—the observed loss of vaginal elasticity, thinning mucosa, reduced lubrication, and reduced blood flow—is hypothesized as a primary cause of sexual pain that develops around menopause.[3] A popular notion is that women must maintain sexual intercourse activity to prevent sexual problems, in particular, reducing sexual activity over time increases the risk for developing sexual pain. This implies a personal responsibility for this symptom. The hypothesis that the physiological changes of increased blood flow and pelvic muscle contractions activated by intercourse and orgasm reduce dryness and tissue changes associated with vaginal atrophy[4] is largely based on an older cross-sectional observational study that concluded sexually active postmenopausal women had fewer physical signs of genitourinary aging than those who were inactive.[5]

Whether declining sexual intercourse frequency patterns precede sexual pain is not known. Results of previous longitudinal analyses from the Study of Women's Health Across the Nation (SWAN) indicated that pain with intercourse increased with progression across the menopausal transition[6] and that sexual pain preceded reduced sexual frequency.[7] Developing pain with intercourse was not associated with intercourse frequency reported at the prior visit.[8]

Our primary study objective was to examine longitudinally whether long- or short-term patterns of sexual intercourse frequency were associated with developing sexual pain in women across the menopausal transition. Secondarily, we examined other factors potentially associated with incident sexual pain. We hypothesized that factors other than sexual frequency changes (e.g. menopause status, poor health and genitourinary symptoms) would be associated with the development of sexual pain.

Methods

These longitudinal analyses used questionnaire data gathered approximately annually across the first 10 visits of SWAN (1995–2008), a multi-center, multi-racial and ethnic prospective cohort study of the menopausal transition. SWAN first identified cohort-eligible women through a cross-sectional survey of 16,065 community-dwelling midlife women recruited by random–digit-dialing or list-based sampling.[9] Each of seven sites recruited approximately 450 women from this sample for the prospective cohort study. Inclusion criteria for entry into the longitudinal cohort of 3302 women were: 1) age 42–52 years; and 2) self-identification of race or ethnicity category as Black (Detroit, MI; Chicago, IL; Pittsburgh, PA; and Boston, MA); Hispanic (Newark, NJ), Japanese (Los Angeles, CA), Chinese (Oakland, CA) or White (all sites). Exclusion criteria were: 1) inability to speak English, Spanish, Japanese, or Cantonese; 2) no menstrual period within three months before enrollment; 3) history of hysterectomy or bilateral oophorectomy prior to enrollment; 4) use of medication containing reproductive hormones at enrollment; or 5) pregnant or lactating. All women provided written informed consent for participation, and the institutional review board at each site approved the study protocols.

At baseline and follow-up visits 1–6, 8, and 10 over 13 years (1995–2008) SWAN participants completed self-administered questionnaires that included information about sexual activity. An exception to this data collection time frame occurred at the New Jersey site where study operations were halted during visits 7–10; thus, 278 Hispanic and 140 White women from this site completed questionnaires through visit 6 only. Women who reported having engaged in any sexual activities in the last six months were asked about frequency of sexual activities, such as intercourse, oral sex, and masturbation, and frequency of vaginal or pelvic pain during intercourse. We defined pain with sexual intercourse when women responded at least “sometimes” to the question: “During the past 6 months, have you felt vaginal or pelvic pain during intercourse?” for which response options were “always,” “almost always,” “sometimes,” “almost never,” and “never.” Based on a self-reported, five-point scale from daily to none, we coded sexual intercourse frequency as: 3 = more than once per week (“daily” and “more than once per week” combined), 2 = about once per week, 1 = once or twice per month and 0 = none/not at all. For women who reported no sexual activity, we asked for reasons including: “I do not have a partner,” “my partner has a physical problem,” “I have a physical problem,” “my partner is too tired or busy,” “I am too tired or busy,” “my partner is not interested,” “I am not interested,” and “other.” Based on response distributions, we categorized these as: no partner, physical problems, lack of sexual interest, and relationship issues. Women also self-reported frequency of lubricant use and other aspects of sexual functioning, such as desire and arousal.

We examined a number of demographic, genitourinary, health, and psychosocial factors that have been associated with changes in sexual intercourse frequency and with reporting of sexual pain in the literature,[6,10] and menopause status. We evaluated race and ethnicity due to differences in reporting of sexual pain in previous SWAN studies.[6] Women reported education level and difficulty paying for basics at baseline. Time-varying menopause status was based on menstrual bleeding patterns during the prior year collected at each visit as: premenopausal—less than three months of amenorrhea and no menstrual irregularities; early perimenopausal—less than three months of amenorrhea and some menstrual irregularities; late perimenopausal—three to 11 months of amenorrhea; and postmenopausal—at least 12 consecutive months of amenorrhea. Additional categories included unknown menopause status due to concurrent exogenous hormone therapy (HT) use in women who were not known to be postmenopausal and those having had a hysterectomy or bilateral oophorectomy after enrollment. At each visit, SWAN also elicited each woman's experience of the following genitourinary symptoms within the previous two to four weeks: vaginal dryness, urinary urgency, dysuria, and any urinary incontinence (collected at all visits) and vulvovaginal irritation (collected at visits 7–10) through self-administered questionnaires.

We calculated body mass index (BMI) as weight in kilograms/(height in meters)^2 based on follow-up visit measurements by certified staff using calibrated scales and stadiometers. Interviewers obtained information on medication use, including use of HT and vaginal estrogen. In self-report questionnaires, information was also elicited about general health, physical functioning,[11] depressive symptoms measured by the Center for Epidemiological Studies-Depression (CES-D)[12] and frequency of anxiety symptoms (irritability, feeling tense, racing heart and feeling fear for no reason).[13] We also included the symptom sensitivity score,[14] a measure of somatosensory amplification which is a tendency to experience somatic symptoms as intense, noxious, and disturbing and involves hypervigilance of body sensations. This construct is considered a trait and was measured only at visit 1. At visit 12, any history of childhood or adult sexual trauma was also ascertained.[15,16] We included these data even though they were collected outside of our 10-visit follow-up window and after reports of sexual pain because of the known associations between sexual trauma and sexual pain.[17]

Of the 3302 women originally enrolled in SWAN, 3267 (99.0%) completed the sexual functioning and behaviors questionnaire at baseline. Of these, 2873 (87.9%) had sexual intercourse activity during the 10 years of follow up and 2247 (78.2%), our analytic sample, also reported no sexual pain at baseline (Figure 1). Because our primary aim was to investigate the impact of sexual intercourse activity patterns prior to the development of sexual pain, we used data from the first 10 follow-up visits of SWAN, or interpolated between two approximately annual visits if such information for the intervening visit was missing. After visit 10, the time between participant sexual activity questions was three to seven years, making assumptions about interval sexual patterns less reliable so that data from those visits were not included in these analyses. For our analytic cohort we interpolated missing sexual frequency and pain data by multiple imputation using age, race or ethnicity due to noted differences in reporting, prior and subsequent sexual intercourse frequency, menopause status and health status (26.2% of frequency values and 25.7% of all pain values). About 13% of data could not be interpolated and were not included in our analyses.

We imputed missing reasons for no sexual activity by randomly assigning the previous or subsequent response category; 593 reponses could not be assigned a value.

After imputation, 194 women contributed data until they stopped reporting sexual intercourse activity for the remainder of the 10 visits.

To investigate thoroughly our primary objective (the effect of sexual intercourse frequency patterns in the years preceding the first report of sexual pain on the incidence of sexual pain), we used one descriptive and four analytical approaches of different patterns. In particular, given the hypothesis that physiological changes of increased blood flow and pelvic muscle contractions activated by intercourse reduce dryness and tissue changes, three of these four analytical approaches focused on the short-term patterns of sexual frequency, that is, most proximal to the onset of pain. Our descriptive approach included plotting *longitudinal profiles of intercourse frequency scores* using raw data in the year prior for those who did and did not develop pain. For our analytical approaches using imputed data, first, we examined whether long-term change in sexual intercourse frequency *from baseline to the visit prior* to the first report of sexual pain--defined as no change (reference), increase (e.g., from 1–2 times per month to weekly or more), or decrease (e.g., from weekly or more to 1–2 times per month)--were associated with subsequently developing sexual pain. Second, we analyzed patterns of short- term change in intercourse frequency *across* the *two visits prior* to the first report of sexual pain, defining these patterns as no change (reference), increase (which could include a change from none to any), or decrease (which could include a change from any to none) in frequency and no sexual intercourse activity for the two visits. Third, we assessed another short-term pattern of change in intercourse frequency *across* the *three visits prior* in women who remained sexually active across these visits, defining patterns of change in women who were sexually active across all three visits as: no change (reference), increase, increase then decrease (e.g., from 1–2 times per month at visit 1 to at least weekly at visit 2 to 1–2 times per month at visit 3), decrease, and decrease then increase (e.g., from at least weekly at visit 1 to 1–2 times per month at visit 2, to at least weekly at visit 3). Fourth, we examined the effect of sexual intercourse *interruption patterns across the three prior visits* in women who did not remain sexually active across these visits, that is, the effect of time when women reported no sexual intercourse activity prior to first report of pain after they had resumed sexual intercourse. We defined these categories as no sexual intercourse in the three visits prior (reference), interrupted but active at the visit prior, and interrupted but not active at the visit prior. In these analyses, we also included the following categorized reasons women reported for not having sexual intercourse activity at that visit: having no partner, physical and distance problems, lack of interest, and relationship problems.

For our secondary aim, to identify other factors potentially associated with the development of pain, we examined concomitant reported sexual activities other than intercourse (masturbation, oral sex), reported importance of sex, arousal and desire, genitourinary symptoms (vaginal dryness, vulvar irritation (in visits 7–10), urinary urgency, urinary incontinence), and use of vaginal lubricants. We also evaluated other factors that could have influenced sexual frequency changes or reporting of pain. Time-varying variables included age, marital status, menopause status, BMI, perceived health, HT use, antidepressant use,

physical activity, depressive and anxiety symptoms, while factors measured at a single point in time were education level and difficulty paying for basics at baseline, symptom sensitivity at visit 1, and childhood or adult sexual trauma at visit 12.

We used logistic regression models of intercourse frequency pattern data to approximate discrete-time proportional-hazards regressions, providing hazard ratios (HR) and their 95% confidence intervals (CI). For our primary aim, we estimated hazard ratios for unadjusted associations between the four sexual frequency patterns and incident sexual pain. We then examined these associations adjusting for potentially confounding variables and other covariates identified in our secondary aim analyses. Model selection was performed by forcing in study site and then adding one by one the variables from unadjusted analyses with p-values of 0.2 or less to achieve the variable combination with the lowest Akaike Information Criterion (AIC).[18] We used similar methods for our secondary aim: assessing unadjusted and adjusted associations between other factors of interest and the development of sexual pain.

Results

In the analytic sample (N=2247, Figure 1), response to the sexual functioning and behaviors questionnaire remained high across all visits (90.4% at visit 10). The majority of women (97.7%) reported having sex with men. The baseline characteristics of women who dropped out after contributing some data to our analyses (N=576) differed a little from those of our original analytic sample (N=2247). First, due to loss of the New Jersey site's 418 participants, the proportion of White and Hispanic women contributing data after visit 6 was lower. Otherwise, compared to our original analytic sample, women who dropped out were more likely at baseline to be divorced, widowed or separated (22.2% versus 18.1%, p=0.001), to have high school or less education (28% versus 22.1%, p=0.001), to report somewhat or very hard time paying for basics (44.2% versus 36.1%, p<0.001), and to report sexual intercourse activity at least once per week (60.2% versus 55.9%, p=0.04).

At baseline, women in the analytic sample reported that sex was at least moderately important to them (83.0%), about half were engaged in masturbation (50.7%) and oral sex (53.1%), and the majority (85.1%) were engaged in sexual intercourse at least 1–2 times per month. Of the 2247 women, 1087 (48.4%) women developed sexual pain "at least sometimes", and 135 (6.0%) reported sexual pain either "always" or "almost always" when they first reported sexual pain. Baseline characteristics of women who were more likely to develop sexual pain over the 10 years included Chinese and Japanese ethnicities, being married, reporting no difficulty in paying for basics, reporting sex was not very or not at all important, and either reporting intercourse no or 1–2 times monthly (Table 1). Vaginal estrogen use was low despite a high prevalence of vaginal dryness (36.2% at visit 10) with the maximum number of women (N = 51; 2.7%) reporting such use at visit 10.

For our primary objective of investigating relationships between long- and short-term sexual intercourse frequency changes and the development of sexual pain, the results of our analyses did not suggest an association between a decline in frequency and new reports of sexual pain as follows.

Longitudinal profiles of intercourse frequency scores for women who did (48.4%) and did not (51.6%) develop sexual pain across the 10 follow-up visits were similar (Figure 2). Overall, sexual intercourse frequency declined in both groups from baseline to visit 10 from an average frequency of almost once per week to about once or twice per month.

In both unadjusted and adjusted analyses, we observed no clear associations between the four sexual intercourse frequency patterns of change and development of sexual pain (Table 2). First, when evaluating the relationship between long-term longitudinal change in sexual frequency *from baseline to the visit prior* across the 10 follow-up visits and pain, neither an increase nor a decrease in frequency, compared to no change in sexual frequency, was associated with incident sexual pain in either our unadjusted or adjusted models (increase adjusted HR (aHR) 0.90, 95% CI 0.67, 1.21; decrease aHR 0.93, 95% CI 0.73, 1.19). Second, when evaluating short-term sexual intercourse patterns across the two visits prior, the pattern of no sexual intercourse to any was associated with an unadjusted increased hazard of developing sexual pain (HR 1.51, 95% CI 1.15, 1.99), while the patterns of any to none and no sexual activity were associated with reduced unadjusted hazard of developing sexual pain (any to none: HR 0.60, 95% CI 0.41, 0.89 and no sexual intercourse for two visits: HR 0.40, 95% CI 0.29, 0.55) compared to women engaged in sexual intercourse acitivy with a stable frequency. However, after adjustment for demographic, health, and other sexual behaviors, these associations were no longer statistically significant (none to any: aHR 1.80, 95% CI 0.84, 3.85; any to none: aHR 1.03, 95% CI 0.59, 1.79; no intercourse for two visits: aHR 1.01, 95% CI 0.30, 3.43). Third, we found no statistically significant associations between patterns of sexual intercourse frequency *across the three visits prior* and the development of sexual pain in both unadjusted and adjusted analyses.

Fourth, for women who had *interruption patterns across three visits* in their sexual intercourse activity, we found only one pattern associated with the development of sexual pain. Compared to women who had no intercourse for three visits, women who were sexually inactive in the last one or two of the three visits prior had a higher hazard of developing pain in both unadjusted (HR 3.53, 95% CI 2.56, 5.53) and adjusted (aHR 3.28, 95% CI 1.48, 7.30) models, while we observed no association for women who were sexually active in the last one or two of the three visits prior (HR 1.31, 95% CI 0.77, 2.22 and aHR 0.98, 95% CI 0.55, 1.76). Reasons for interruptions in sexual activity (e.g., not having a partner or reporting relationship issues with the partner) were not significantly associated with the risk of developing pain.

For our secondary objective, we found several factors associated with the development of sexual pain in our unadjusted and adjusted models (Table 3). The factors most strongly associated with the development of sexual pain were late peri- or post-menopause status, regardless of HT use and vaginal dryness, and these were largely unaffected by adjustment for other covariates in our models. Even after adjustment, Chinese and Japanese women were more likely to report development of sexual pain compared to White women. Though we lacked information on whether oral sex was received or given, frequent oral sex was negatively associated with sexual pain; most women who engaged in oral sex also engaged in intercourse (5742 woman-visits reporting intercourse and oral sex compared with 80 woman visits reporting oral sex alone). In exploratory adjusted analyses, arousal was

associated with a reduced hazard of sexual pain when oral sex was not in the model, suggesting that these two variables were related, though they were not highly correlated (data not shown). Finally, after adjustment, a number of factors were no longer associated with the development of pain: age, BMI, self-reported health, physical activity, lubricant use, symptom sensitiivity, depressive symptoms, and importance of sex.

Discussion

Our longitudinal analyses over 13 years of follow-up and across the menopausal transition revealed that long- and short-term declines in sexual intercourse frequency or episodic sexual inactivity were not clearly associated with an increased hazard of developing pain with intercourse. These important longitudinal findings do not support the belief that women can prevent sexual pain by maintaining a certain level of sexual activity.

Among the long- and short-term sexual frequency pattern changes across 10 follow-up visits, we found three unadjusted associations contrary to the hypothesis that interruptions in activity lead to pain; however, the associations disappeared after adjustment. We found only one adjusted association between sexual inactivity and pain, specifically women who were not sexually active in the last one or two of the three visits prior had a higher hazard of developing pain. Yet, within this pattern, a higher proportion of women who developed pain reported sexual inactivity at only one visit. Given no clear clinical explanation for this adjusted association, we hypothesize that this finding was a consequence of unmeasured factors or a single chance significant finding among multiple comparsions.

For our secondary objective, we found that women were most at risk for developing sexual pain in the late peri- and postmenopause, independent of age; the use of systemic HT did not appear to reduce this risk. This finding is consistent with previous studies demonstrating a higher risk of sexual pain with advancing menopausal transition stage but no relationship with HT use[6] or with endogenous estrogen levels.[19] Unsurprisingly, reporting of vaginal dryness had the strongest association with developing pain. Chinese and Japanese women were more likely to report incident sexual pain in adjusted analyses. In previous SWAN analyses, Chinese and Japanese women also reported lower sexual desire and physical pleasure compared to White and Black women.[6,20] Differential findings by race/ethnicity about sexual functioning may represent unmeasured factors such as shared cultural or community beliefs, values, and practices.[21]

Only two factors were associated with a reduced hazard of developing sexual pain: engaging in oral sex and arousal at the visit prior. Both oral sex and arousal have been associated with perception of higher quality relationships,[22] which in turn has been associated with higher sexual functioning.[23] Importantly, a number of factors related to sexual pain in other studies[6,10,17] were not associated with incident sexual pain in our cohort, in particular, any history of sexual trauma. That we did not observe that such an association may reflect our focus on pain developing across the menopausal transition in women who had previously reported pain-free intercourse.

Our study had some important strengths. First, the prospectively collected data from a large, racially and ethnically diverse, community-based sample of sexually active women over 13 years allowed us to evaluate incident pain across the menopausal transition with good statistical power and generalizability as well as temporal relations. Additionally, SWAN's comprehensive and standard data collection across time allowed us to explore, evaluate and control for a number of factors that potentially affect sexual frequency and the development of sexual pain.

Our study results, should be interpreted in light of several limitations. Loss to follow up can lead to selection bias in cohort studies, though SWAN's retention was good, and participation in the sexual function questionnaire remained high at visit 10. Some women in our sample may have experienced pain prior to baseline. Sexual frequency and pain questions were elicited over the previous six months making recall bias possible. These questions were not asked at all of the ten follow-up visits; however, we used multiple imputation for most missing data. SWAN asked questions about a history of childhood and adult sexual trauma at Visit 12, after the ten-visit time frame of our analyses. While measurement bias for traumatic adult experiences was possible as some women may have experienced trauma after visit 10, this bias was likely small.[24]

Our study results provide a critical public health and clinical message: women whose sexual intercourse activity declines do not appear to be at higher risk for developing sexual pain compared to women who maintain or increase sexual frequency. This empirical evidence does not support the common belief that reduced sexual intercourse is responsible for women's sexual pain. Rather, sexual pain has many etiologies.[25] For example, our study confirmed the relationship between vaginal dryness and sexual pain, but use of vaginal estrogen was low, possibly signifying underuse of one potential treatment. Women and their health care professionals should focus on developing individualized strategies to prevent and treat sexual pain and not attribute pain to reduced intercourse frequency.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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A list of members of the Clinical Centers, NIH Program Office, Central Laboratory, Coordinating Center, and Steering Committee are in Appendix 1 online at http://links.lww.com/xxx

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References

1. Hunter MM, Nakagawa S, Van Den Eeden SK, Kuppermann M, Huang AJ. Predictors of Impact of Vaginal Symptoms in Postmenopausal Women. Menopause N Y N. 2016;23(1):40–46. doi:10.1097/GME.0000000000000482
2. Kingsberg SA, Krychman M, Graham S, Bernick B, Mirkin S. The Women's EMPOWER Survey: Identifying Women's Perceptions on Vulvar and Vaginal Atrophy and Its Treatment. J Sex Med. 2017;14(3):413–424. doi:10.1016/j.jsxm.2017.01.010 [PubMed: 28202320]
3. Portman DJ, Gass MLS, Vulvovaginal Atrophy Terminology Consensus Conference Panel. Genitourinary syndrome of menopause: new terminology for vulvovaginal atrophy from the International Society for the Study of Women's Sexual Health and the North American Menopause Society. Menopause N Y N. 2014;21(10):1063–1068. doi:10.1097/GME.0000000000000329
4. Brody S. Penile – vaginal intercourse is better: evidence trumps ideology. Sex Relatsh Ther. 2006;21(4):393–403. doi:10.1080/14681990600891427
5. Leiblum S, Bachmann G, Kemmann E, Colburn D, Swartzman L. Vaginal atrophy in the postmenopausal woman. The importance of sexual activity and hormones. JAMA. 1983;249(16):2195–2198. [PubMed: 6834616]
6. Avis NE, Brockwell S, Randolph JF, et al. Longitudinal Changes in Sexual Functioning as Women Transition Through Menopause: Results from the Study of Women's Health Across the Nation (SWAN). Menopause N Y N. 2009;16(3):442–452. doi:10.1097/gme.0b013e3181948dd0
7. Thomas HM, Bryce CL, Ness RB, Hess R. Dyspareunia is Associated with Decreased Frequency of Intercourse in the Menopausal Transition. Menopause N Y N. 2011;18(2):152–157. doi:10.1097/gme.0b013e3181eeb774
8. Waetjen LE, Crawford SL, Chang PY, et al. Factors associated with developing vaginal dryness symptoms in women transitioning through menopause: a longitudinal study. Menopause N Y N. 2018;25(10):1094–1104. doi:10.1097/GME.0000000000001130
9. Sowers M, Crawford S, Sternfeld B, et al. SWAN: A Multicenter, Multiethnic, Community-Based Cohort Study of Women and the Menopausal Transition. In: Menopause: Biology and Pathobiology. San Diego: Academic Press; 2000:175–188.
10. McCool-Myers M, Theurich M, Zuelke A, Knuettel H, Apfelbacher C. Predictors of female sexual dysfunction: a systematic review and qualitative analysis through gender inequality paradigms. BMC Womens Health. 2018;18(1):108. doi:10.1186/s12905-018-0602-4 [PubMed: 29929499]
11. McHorney CA, Ware JE, Raczek AE. The MOS 36-Item Short-Form Health Survey (SF-36): II. Psychometric and clinical tests of validity in measuring physical and mental health constructs. Med Care. 1993;31(3):247–263. doi:10.1097/00005650-199303000-00006 [PubMed: 8450681]
12. Radloff LS. The CES-D Scale: A self-report depression scale for research in the general population. 1977. doi:10.1177/014662167700100306
13. Gold EB, Colvin A, Avis N, et al. Longitudinal analysis of the association between vasomotor symptoms and race/ethnicity across the menopausal transition: study of women's health across the nation. Am J Public Health. 2006;96(7):1226–1235. doi:10.2105/AJPH.2005.066936 [PubMed: 16735636]
14. Barsky AJ, Goodson JD, Lane RS, Cleary PD. The amplification of somatic symptoms. Psychosom Med. 1988;50(5):510–519. doi:10.1097/00006842-198809000-00007 [PubMed: 3186894]
15. Bernstein DP, Stein JA, Newcomb MD, et al. Development and validation of a brief screening version of the Childhood Trauma Questionnaire. Child Abuse Negl. 2003;27(2):169–190. doi:10.1016/s0145-2134(02)00541-0 [PubMed: 12615092]
16. Garcia L, Qi L, Rasor M, Clark CJ, Bromberger J, Gold EB. The relationship of violence and traumatic stress to changes in weight and waist circumference: longitudinal analyses from the study of women's health across the nation. J Interpers Violence. 2014;29(8):1459–1476. doi:10.1177/0886260513507132 [PubMed: 24212978]
17. Mitchell KR, Geary R, Graham CA, et al. Painful sex (dyspareunia) in women: prevalence and associated factors in a British population probability survey. BJOG Int J Obstet Gynaecol. 2017;124(11):1689–1697. doi:10.1111/1471-0528.14518
18. Akaike H. Information measures and model selection. Int Stat Inst. 1983:277–291.

19. Randolph JF, Zheng H, Avis NE, Greendale GA, Harlow SD. Masturbation frequency and sexual function domains are associated with serum reproductive hormone levels across the menopausal transition. J Clin Endocrinol Metab. 2015;100(1):258–266. doi:10.1210/jc.2014-1725 [PubMed: 25412335]

20. Cain VS, Johannes CB, Avis NE, et al. Sexual functioning and practices in a multi-ethnic study of midlife women: baseline results from SWAN. J Sex Res. 2003;40(3):266–276. doi:10.1080/00224490309552191 [PubMed: 14533021]

21. Blanc A Acculturation and Sexual Attitudes: a Systematic Review. Sex Res Soc Policy. Published online October 6, 2021. doi:10.1007/s13178-021-00652-0

22. Liu H, Shen S, Hsieh N. A National Dyadic Study of Oral Sex, Relationship Quality, and Well-Being among Older Couples. J Gerontol Ser B. 2019;74(2):298–308. doi:10.1093/geronb/gby089

23. Dewitte M, Mayer A. Exploring the Link Between Daily Relationship Quality, Sexual Desire, and Sexual Activity in Couples. Arch Sex Behav. 2018;47(6):1675–1686. doi:10.1007/s10508-018-1175-x [PubMed: 29497914]

24. Jones JS, Rossman L, Diegel R, Van Order P, Wynn BN. Sexual assault in postmenopausal women: epidemiology and patterns of genital injury. Am J Emerg Med. 2009;27(8):922–929. doi:10.1016/j.ajem.2008.07.010 [PubMed: 19857408]

25. Goldstein I, Clayton AH, Goldstein AT, Kim NN, Kingsberg SA. Textbook of Female Sexual Function and Dysfunction: Diagnosis and Treatment. John Wiley & Sons; 2018.

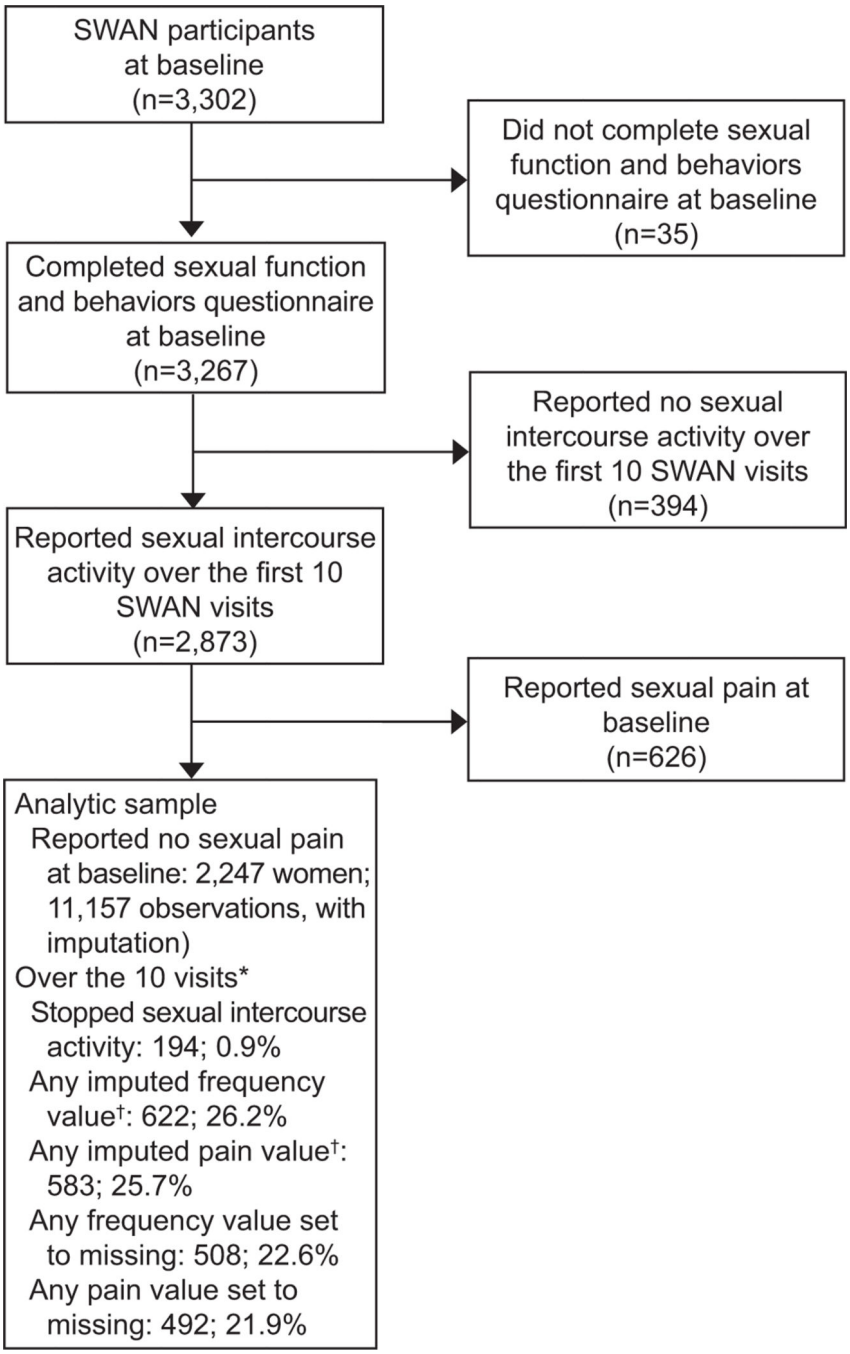

Figure 1.

Study of Women's Health Across the Nation (SWAN), derivation of analytic cohort. * All values include 418 women from New Jersey site who dropped out at visit 6. †Outside of the values imputed for visits 7 and 9 for all women.

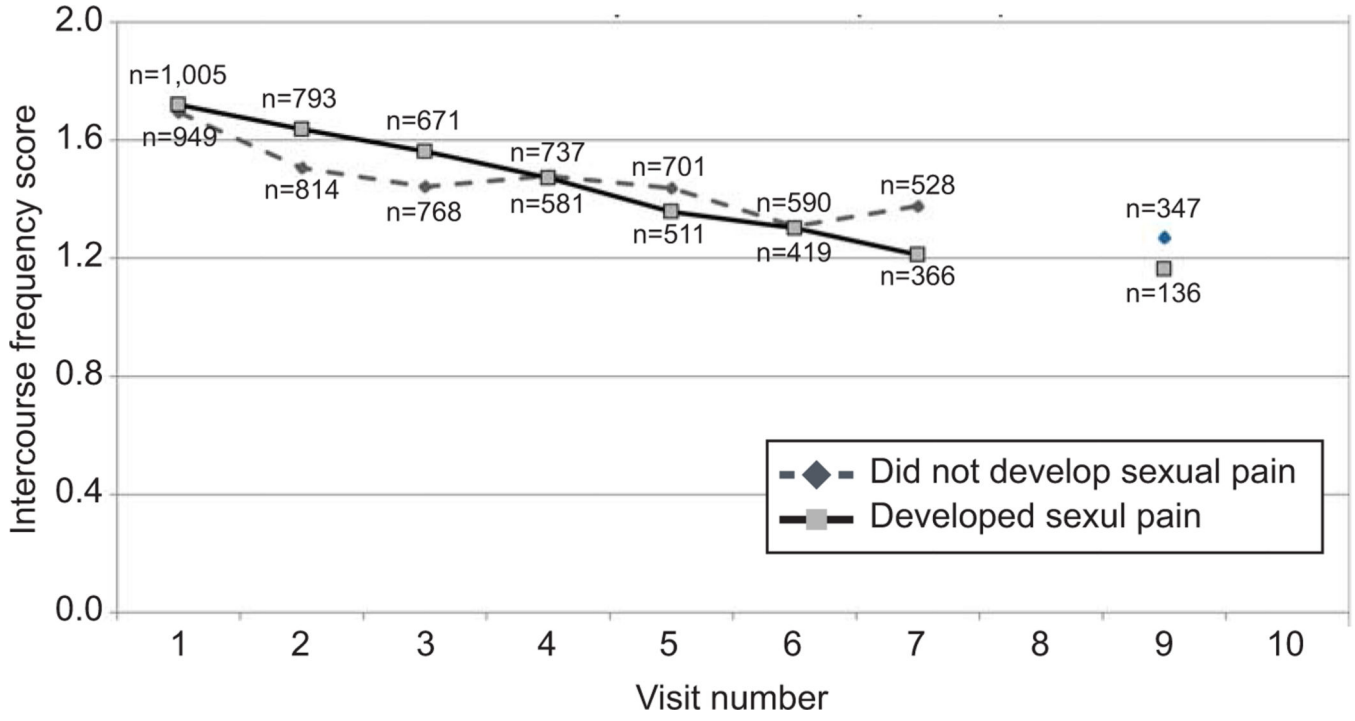

Figure 2.

Longitudinal profiles of year prior sexual intercourse frequency score* in women who did and did not develop sexual pain over ten follow-up visits in study of women's health across the nation (1995–2008). *Intercourse frequency score in year prior: 0=none; 1=one−two times per month; 2=about once per week; 3=more than once per week. Figure represents raw data values. Over the 10 visits, of the women in these profiles, 483 women remained in the analytic sample, 151 women were removed from the analyses after stopping sexual intercourse activity, 875 women were removed from the analyses after developing sexual pain, 576 (418 from New Jersey site after visit 6) women dropped out of the study, and 162 women had missing data.

Table 1:

Baseline Characteristics of the Analytic Cohort Comparing Women with Incident Sexual Pain to Those Who Never Developed Sexual Pain, Baseline through Visit 10, Study of Women's Health Across the Nation (1995–2008), N=2247

	Incident Sexual Pain (N=1087)		Never Developed Sexual Pain (N=1160)		
Baseline Characteristic	**N**	**%**	**N**	**%**	**p-value**
Age, years (mean,SD)	45.7	±2.7	45.8	±2.6	0.74
Race or Ethnicity					<0.001
Black	250	40.8	363	59.2	
Chinese	125	73.5	45	26.5	
Hispanic	46	28.4	116	71.6	
Japanese	137	69.5	60	30.5	
White	528	48.0	573	52.0	
Marital status					0.02
Single	99	45.8	117	54.2	
Married, living as married	803	50.4	789	49.6	
Widowed, divorced, separated	175	43.1	231	56.9	
Education					0.17
High school or less	227	45.7	270	54.3	
More than high school	853	49.2	881	50.8	
Difficulty paying for basics					<0.01
Not very hard	730	51.2	696	48.8	
Somewhat	278	43.1	367	56.9	
Very hard	75	44.9	92	55.1	
Childhood sexual trauma (Visit12)					0.77
No	734	58.4	522	41.6	
Yes	125	59.5	85	40.5	
Adult sexual trauma (Visit12)					0.53
No	769	58.7	542	41.3	
Yes	92	56.1	72	43.9	
Importance of sex					0.01
Not very, not at all	195	51.5	184	48.5	
Moderate	523	50.6	511	49.4	
Quite, extreme	354	43.9	453	56.1	
Frequency of intercourse *					0.005
None	31	53.4	27	46.6	
Less than monthly	113	40.9	163	59.1	
1–2 times per month	348	53.0	309	47.0	
At least once per week	595	47.4	661	52.6	

Baseline Characteristic	Incident Sexual Pain (N=1087)		Never Developed Sexual Pain (N=1160)		
	N	%	N	%	p-value
Frequency of oral sex *					0.05
None	453	45.3	548	54.7	
1–2 times/month	344	51.3	326	48.7	
At least weekly	221	47.7	242	52.3	
Frequency of masturbation *					0.09
None	504	46.7	576	53.3	
Less than monthly	239	49.7	242	50.3	
1–2 times/month	202	52.5	183	47.5	
At least weekly	105	43.4	137	56.6	

Numbers may not add up to 100% due to missing data

P-values obtained from chi-squared test for categorical variables and t-test for continuous variables

* in the past six months

Table 2.

Unadjusted and Adjusted Hazard Ratios of the Association Between Four Sexual Frequency Patterns and the Development of Sexual Pain after Baseline in the First Ten Follow-up Visits, Study of Women's Health Across the Nation (1995–2008), N=2247 (Number of Observations=11,157)

Change in sexual intercourse frequency *from baseline to the visit prior*				
	Unadjusted		**Adjusted***	
	HR	**95%CI**	**aHR**	**95%CI**
No change N=2052(6650)†	Reference			
Increase N=778(1702)	0.86	0.70–1.07	0.90	0.67–1.21
Decrease N=936(2805)	1.14	0.97–1.34	0.93	0.73–1.19
Change in pattern of sexual intercourse frequency *across the two visits prior*				
	Unadjusted		**Adjusted***	
	HR	**95%CI**	**aHR**	**95%CI**
No change: N=1273(3860)	Reference			
Increase: N=671(908)	1.06	0.82–1.37	1.23	0.91–1.66
Decrease: N=826(1168)	1.07	0.85–1.35	1.06	0.80–1.40
None to any: N=500(578)	1.51	1.15–1.99	1.80	0.84–3 .85
Any to none: N=448(560)	0.60	0.41–0.89	1.03	0.59–1 .79
No intercourse for two visits: N=438(1279)	0.40	0.29–0.55	1.01	0.30–3.43
Change in pattern of sexual intercourse frequency *across the three visits prior*				
	Unadjusted		**Adjusted***	
	HR	**95%CI**	**aHR**	**95%CI**
No change: N=812(2110)	Reference		Reference	
Increase: N=432(581)	1.04	0.75–1.45	1.31	0.89–1.92
Increase then decrease: N=288(342)	1.28	0.88–1.86	1.56	0.99–2.45
Decrease: N=608(937)	1.01	0.77–1.34	1.00	0.72–1.41
Decrease then increase: N=291(327)	1.06	0.70–1.59	1.40	0.86–2.26
Sexual intercourse *interruption patterns across the three visits prior* with reason for interruption				
	Unadjusted		**Adjusted***	

Change in sexual intercourse frequency *from baseline to the visit prior*				
	Unadjusted		**Adjusted***	
	HR	**95%CI**	**aHR**	**95%CI**
	HR	**95%CI**	**aHR**	**95%CI**
No intercourse for three visits: N=305(803)	Reference		Reference	
Interrupted, active at prior visit: N=402(643)	1.31	0.77–2.22	0.98	0.55–1.76
Interrupted, inactive at prior visit: N=436(654)	3.53	2.26–5.53	3.28	1.48–7.30
Reason for interruption				
No partner: N=404(1345)	Reference		Reference	
Physical problems: N=154(307)	0.97	0.54–1.71	0.61	0.31–1.19
Lack of sexual interest: N=80(124)	1.47	0.72–3.02	1.64	0.74–3.65
Relationship issues: N=39(58)	0.33	0.05–2.41	0.36	0.04–2.88
Other: N=9(13)	1.57	0.20–12.21	2.35	0.27–20.52

HR (hazard ratios), aHR (adjusted HR), CI (confidence intervals)

*Each of the four patterns represent individual models adjusted for the same variables: study site, race or ethnicity, symptom sensitivity score; concurrent: age, marital status, menopause status, BMI, self-reported health, physical function score, depressive symptoms, vaginal dryness, urinary incontinence; prior visit: lubricant use, importance of sex, oral sex frequency.

†N=number of women contributing to the (number of observations) within each pattern

Table 3.

Unadjusted and Adjusted Hazard Ratios for Association Between Potential Risk Factors and the Development of Sexual Pain after Baseline in the First Ten Follow-up Visits, Study of Women's Health Across the Nation (1995–200), N=2247 (Number of Observations=11,157)

	Unadjusted		Adjusted*	
	HR	**95%CI**	**aHR**	**95%CI**
Demographic and health characteristics				
Age (per year)	1.09	1.07–1.10	1.00	0.96–1.05
Race or Ethnicity				
Black	0.75	0.56–1.00	0.68	0.45–1.03
Chinese	2.02	1.46–2.80	1.66	0.98–2.82
Hispanic	0.68	0.27–1.70	1.28	0.13–12.55
Japanese	1.68	1.24–2.27	2.85	1.66–4.90
White	Reference		Reference	
Education				
High school or less	Reference			
More than high school	1.00	0.77–1.35		
Difficulty paying for basics at baseline				
Not hard at all	Reference			
Somewhat hard	1.09	0.64–1.87		
Very hard	1.22	0.73–2.03		
Marital status in concurrent year				
Married, living as married	Reference		Reference	
Single	0.87	0.56–1.34	1.54	0.90–2.65
Separated, divorced, widowed	0.68	0.49–0.95	0.79	0.52–1.22
Menopause status				
Premenopausal	Reference		Reference	
Early perimenopausal	1.50	0.83–2.69	1.24	0.66–2.35
Late perimenopausal	3.27	1.76–6.07	2.72	1.36–5.46
Not postmenopausal using hormone therapy	1.92	1.01–3.65	1.43	0.69–2.95

	Unadjusted		Adjusted*	
	HR	95%CI	aHR	95%CI
Postmenopausal	2.97	1.65–5.35	2.40	1.21–4.79
Postmenopausal using hormone therapy	3.23	1.68–6.20	3.16	1.46–6.85
Surgical	2.13	1.00–4.54	1.91	0.81–4.55
BMI (kg/m^2)				
<18.5	1.56	0.81–3.03	1.79	0.82–3.89
18.5–24.9	Reference		Reference	
25–29.9	0.70	0.54–0.91	0.93	0.69–1.27
30+	0.67	0.52–0.87	0.90	0.64–1.28
Self-reported health				
Very good, excellent	Reference		Reference	
Good	1.00	0.78–1.27	0.79	0.58–1.08
Fair, poor	1.56	1.13–2.15	1.27	0.84–1.94
Physical function score				
1–85 any limitation	Reference			
86–100 no limitation	0.84	0.67–1.06	1.03	0.77–1.38
Other sexual characteristics at prior visit				
Importance of sex				
Moderate or less	Reference		Reference	
Quite, extreme	0.66	0.52–0.83	0.78	0.59–1.03
Frequency of arousal				
Never, almost never	Reference			
Sometimes	0.71	0.43–1.17		
Almost always, always	0.52	0.32–0.84		
Frequency of desire				
Not at all	Reference			
1–2 times/month	1.00	0.55–1.82		
At least weekly	0.70	0.39–1.26		
Lubricant use frequency				

	Unadjusted		Adjusted*	
	HR	95%CI	aHR	95%CI
Never, almost never	Reference		Reference	
Sometimes	1.44	1.04–1.99	1.00	0.67–1.48
Almost always, always	2.09	1.58–2.77	1.18	0.83–1.69
Frequency of sexual touching				
Less than monthly	Reference			
1–2 times/month	0.88	0.47–1.67		
About once per week	0.71	0.38–1.35		
More than once per week	0.74	0.40–1.38		
Oral sex frequency				
Once or less per week	Reference		Reference	
More than once per week	0.49	0.29–0.83	0.49	0.26–0.95
Masturbation frequency				
Less than monthly	Reference			
1–2 times/month	1.15	0.88–1.50		
About once per week	0.80	0.52–1.25		
More than once per week	0.54	0.26–1.11		
Genitourinary symptoms reported at concurrent visit				
Vaginal dryness	3.84	3.11–4.74	3.73	2.88–4.83
Vulvar irritation or itching	1.28	0.96–1.71		
Urinary urgency	1.19	0.96–1.48		
Urinary incontinence	1.33	1.03–1.71	1.26	0.93–1.72
Psychosocial characteristics at concurrent visit				
Symptom sensitivity score/unit increase (Visit 1)	1.03	1.01–1.05	1.03	1.00–1.07
Depressive symptoms (>15 on CES-D)	1.33	0.99–1.78	1.35	0.93–1.96
Anxiety (score>4)	1.18	0.88–1.58		
Anti-depressant use (any)	0.92	0.68–1.24		
Reported childhood sexual trauma (Visit 12)	1.05	0.76–1.45		
Reported adult sexual trauma (Visit 12)	0.81	0.53–1.23		

HR (hazard ratios), aHR (adjusted HR), CI (confidence intervals)

* Adjusted for variables shown under "Adjusted" model column, study site, and change in sexual intercourse frequency patterns across three prior visits.