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Longitudinal Changes in Sexual Functioning as Women Transition Through Menopause: Results from the Study of Women's Health Across the Nation (SWAN)

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Abstract

Objective—Sexual functioning is an important component of women's lives. The extent to which the menopause transition is associated with decreased sexual functioning remains inconclusive. This study seeks to determine if advancing through the menopause transition is associated with changes in sexual functioning.

Design—A prospective, longitudinal cohort study of women aged 42–52 at baseline recruited at 7 US sites (N=3302) in the Study of Women's Health Across the Nation (SWAN). Cohort eligible women had an intact uterus, at least one ovary, were not currently using exogenous hormones, were either pre- or early perimenopausal, and self-identified as one of the study's designated racial/ethnic groups. Data from the baseline interview and six annual follow-up visits are reported. Outcomes are self-reported ratings of importance of sex; frequency of sexual desire, arousal, masturbation, sexual intercourse, and pain during intercourse; degree of emotional satisfaction and physical pleasure.

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Results—Adjusting for baseline age, chronological aging, and relevant social, health, and psychological parameters, the odds of reporting vaginal or pelvic pain increased and desire decreased by late perimenopause. Masturbation increased at early perimenopause, but declined during postmenopause. Menopausal transition was unrelated to other outcomes. Health, psychological functioning, and importance of sex were related to all sexual function outcomes. Age, race/ethnicity, marital status, change in relationship, and vaginal dryness were also associated with sexual functioning.

Conclusions—Pain during sexual intercourse increases and sexual desire decreases over the menopausal transition. Masturbation increases during the early transition, but then declines in postmenopause. Adjusting for other factors, the menopausal transition was not independently associated with reports of the importance of sex, sexual arousal, frequency of sexual intercourse, emotional satisfaction with partner, or physical pleasure.

Keywords

sexual functioning; menopause; aging; diverse populations

Sexual functioning is an important component of women's lives and has increasingly received public health, pharmaceutical, and medical attention.[1] Over 75% of the middle-aged women in the Study of Women's Health Across the Nation (SWAN) reported that sex was moderately to extremely important.[2] Sexual functioning, however, declines with age,[1, 3–8] leading to much debate on the contribution of menopause to sexual activity and functioning among women.

The menopausal transition is a gradual change from pre to post menopause, which is defined retrospectively after 12 months of amenorrhea. Some evidence suggests that sexual functioning declines over the menopausal transition, yet whether this decline is due to menopause, aging, or other variables remains inconclusive.[3, 4, 9–12] Understanding factors that affect sexual functioning can help clinicians counsel women. The majority of studies in this area are cross-sectional, not large enough to separate the effects of menopause from chronological aging, and/or do not include relevant covariates.

Relationship, psychosocial, and health factors are often reported as more important determinants of sexual function than ovarian function. Primary factors associated with a woman's sexual function include the availability of a partner,[10,13–15] relationship quality,[9,16–19] psychological function,[1,10,19–22] health,[13,20, 23] and race/ethnicity.[16,24]

Longitudinal data from SWAN provide the opportunity to disentangle the role of menopause from chronological aging in sexual functioning and activity among a multi-ethnic sample while also examining concurrent social, health, and psychological parameters. With 6 years of follow-up data, this large cohort of 3302 women at baseline provides the opportunity to examine changes in sexual functioning as women progress through the menopausal transition. The primary research question was: Independent of chronological aging and time, is advancing through the menopausal transition associated with a decline in sexual functioning? Secondarily, we were interested in 1) whether menopausal symptoms (hot flashes, night sweats, vaginal dryness) contributed to a dimunition in sexual functioning over and above menopausal status and 2) the relative contribution of menopause and other health, social, psychological, and relationship factors to sexual funtioning.

METHODS

SWAN is a multiethnic observational cohort study of the menopausal transition in 3302 women at seven sites across the United States.25 Details of enrollment have been previously

reported.[25] Baseline eligibility criteria included: age 42–52 years, intact uterus and at least one ovary, not currently using exogenous hormones affecting ovarian function, at least one menstrual period in the previous 3 months, and self-identification with a site's designated racial/ethnic group. Half of each site's sample consisted of white women and the other half from one minority population (African-American, Japanese, Chinese, or Hispanic).

Baseline and standardized assessments were completed annually in a clinic setting where physiological and self-report measures were administered by trained interviewers. Study forms were available in English, Cantonese, Japanese and Spanish and bilingual staff was used, as appropriate. Each site received Institutional Review Board approval and all participants gave written informed consent.

Measures

Sexuality outcome variables were measured at each study visit from baseline to visit 06 using a 20-item questionnaire designed to address sexual activity and function in women with and without partners. The questionnaire, which was self-administered and returned to staff in a sealed envelope, was derived from several sources as previously described:[16] The Massachusetts Women's Health Study,20 The National Health and Social Life Survey,26 the National Survey of Family Growth27 and the Women's Health Initiative Daily Life Form.[28] Variables of interest fall into the domains of importance of sex, sexual desire, frequency of activities (sexual intercourse and masturbation), physical pleasure, emotional satisfaction with partner, arousal, and pain. All questions were asked on 5-point Likert scales. All study women were asked how *important* was sex in their lives (not at all to extremely), how often they felt *desire* in the past 6 months to engage in any form of sexual activity either alone or with a partner (not at all to daily), frequency of engaging in masturbation in the past 6 months, and if they had engaged in sexual activities with a partner in the last 6 months (yes/no). Respondents who reported having engaged in sexual activities with a partner in the last six months were asked about *frequency* of sexual intercourse and *arousal* during sexual activity (not at all to daily), and degree of *emotional satisfaction* and *physical pleasure* from their relationship with a partner (not at all to extremely). Women who reported having sexual intercourse in the past 6 months were also asked about frequency of vaginal or pelvic *pain* during intercourse (not at all to daily).

At each study visit, *menopausal status* was classified as *premenopausal* (menses in previous three months with no change in menstrual regularity in preceding year), *early perimenopausal* (menses in previous three months and changes in regularity in past year), *late perimenopausal* (no menses in previous 3 months but menses in previous 11 months), or *postmenopausal* (12 or more months of amenorrhea). Women who underwent a bilateral oophorectomy (N=119) were classified as *surgically menopausal*. Menopausal status was not classifiable for women who had a hysterectomy but kept at least one ovary prior to being classified as postmenopausal and they were omitted from the time of surgery onwards (N=80). Women who reported having taken hormone therapy in the previous 12 months were classified as *current hormone therapy users*, while past users were classified as *former hormone therapy users*. Among pre and perimenopausal women, hormone therapy use classification was irrespective of menopausal status since once a woman begins hormone therapy use, menopausal status cannot be determined.

Covariates included age (at baseline), time (since baseline), variables related to sexual functioning in our baseline analyses,[16] and variables that others have found related to sexual functioning. Covariates were organized as follows: menopausal factors (hot flashes, night sweats, vaginal dryness, use of lubricants during intercourse), social factors (race/ethnicity, education, marital status, change in relationship status, having children at home), health and lifestyle factors (self-reported health, alcohol consumption, body mass index, and cigarette

smoking), and psychological factors (attitudes towards aging and menopause, anxiety, depressive symptoms, and importance of sex).

The frequency of experiencing hot flashes, night sweats, and vaginal dryness in the past 2 weeks (not at all, 1–5 days, and 6–14 days) was assessed at each study visit as part of a general symptom list. Women who were sexually active were asked how often they had used lubricants in the past 6 months.

Race/ethnicity categories were white, African-American, Chinese, Japanese, or Hispanic. Marital status was categorized as married; single; or separated, widowed, or divorced. Several questions were used to assess relationship status change. 'New relationship' refers to beginning a committed relationship or starting a new relationship. 'Lose relationship' refers to ending a relationship or relationship getting worse. The number of children living at home was asked annually and categorized as none versus any.

Overall perceived health (excellent to poor) was self-assessed annually. Alcohol intake was assessed at baseline.29,30 At each interview, body mass index (BMI) was calculated as weight in kilograms divided by height in meters squared. Validated questions were used to obtain information on current smoking status.31

Attitudes towards aging and menopause (highly positive, slightly, or neutral/negative) were assessed at baseline using the scale previously developed.32 The Center for Epidemiologic Studies Depression Scale annually assessed depressive symptoms.33 Anxiety, assessed annually, was the summed score of the number of days in the past 2 weeks in which four symptoms (irritability or grouchiness, feeling tense or nervous, heart racing or pounding, fearful for no reason) were experienced.34

All covariates, except BMI, were assessed by self-report. In addition, study site was included in all adjusted models because it was a factor in the study sampling design.

Statistical Analyses

Univariate models, followed by models adjusted for baseline age and chronological aging provided an initial assessment of changes in sexual functioning domains across the menopausal transition. Multivariable models were constructed for all sexual functioning domains. Analyses were based on three sub-samples of the SWAN cohort. The primary sample, used for analyses of desire, importance of sex, and masturbation included 3288 participants with sexual functioning data from at least one visit. The mean (sd) number of observations per woman was 5.5 (2.0) out of a total of 7 possible visits. Data from visits at which women reported having engaged in sexual activity with a partner formed the subset for analysis of arousal, emotional satisfaction, physical pleasure, and frequency of intercourse (n=2789 women, mean (sd) of 5.4 (2.1) observations per woman). By necessity, analysis of pain during intercourse was restricted to visits at which women reported having had any sexual intercourse during the prior 6 months (n=2744, mean (sd) of 5.3 (2.1) observations per woman).

For all domains except pain and masturbation, the highest and lowest Likert scale responses were infrequently reported; therefore extreme groups were collapsed with adjacent response categories. More frequent experiences of vaginal or pelvic pain and masturbation were infrequently endorsed so these response categories were collapsed. The resultant 3-level ordinal variables were initially modeled using multivariable partial proportional odds models. However, these models showed little substantive difference in terms of results and added considerable complexity to model interpretation, relative to results from logistic regression models based on dichotomized outcomes. Hence the latter are reported.

Separate analyses modeled the probability of: feeling *sexual desire* at least once weekly; engaging in *sexual intercourse* at least once weekly; *masturbating* at all; feeling *aroused* during sexual activity always or almost always; feeling *vaginal or pelvic pain* during intercourse at least sometimes; sex being extremely or quite *important*; having a very or extremely *physically pleasurable* relationship with partner; and having a very or extremely *emotionally satisfying* relationship with partner. To facilitate presentation, we simplified our description of changes in these probabilities across the transition. For example, 'a decrease in arousal' means a relative decrease in the odds of reporting frequent arousal. Importance of sex was modeled as an outcome and was also included as an ordinal covariate in multivariable models for all other functioning domains.

Random effects logistic regression models, which incorporated a random intercept term to account for the correlation between repeated measures from the same woman, were used to model the association between each outcome and menopausal status, independently of aging and other covariates. All analyses were also run using conditional logistic regression models, in order to verify that the random effects models were suitably estimating longitudinal effects. Results from the random effects models are shown since these allowed for the estimation and presentation of key cross-sectional effects, such as ethnicity. Adjusted estimates of the probability of each dichotomous outcome were estimated from random effects models, assuming a mean random effect of zero. STATA (Version 8, STATA Corporation, College Station, TX) was used to perform all analyses.

RESULTS

Table 1 presents characteristics of the each analytic sample at baseline. By study design, almost half of the sample was white (47%) with the other half consisting of African American (28%), Hispanic (8.7%), Chinese (7.5%), and Japanese (8.5%) women. At baseline, 54% of the sample was premenopausal and 46% were early perimenopausal; mean age of the sample was 46.2. Table 2 shows the number of women in each menopausal status over time. By the sixth annual follow-up visit, 26% of the women were postmenopausal. Seventy-eight percent of the women reported being sexually active at baseline and 71% at visit 06. Lack of a partner was the primary reason stated by women for not being sexually active, with 13% of the women at baseline and 17.3% at visit 06 reporting they were not sexually active because they did not have a partner.

The number of women providing sexual functioning information decreased somewhat over the course of the study. Key factors in missing data were ethnicity, socio-economic status, overall health, and site, all of which were included in multivariable models to meet model assumptions that data are missing at random.

Unadjusted Outcomes by Menopausal Transition

Table 3 shows the response distribution for each outcome by menopause status. The dotted line shows how responses were categorized for analyses. In unadjusted analyses, menopausal status was related to all sexual function outcomes. Adjusting for baseline age and time, the effect of the menopausal transition was no longer associated with the importance of sex, masturbation, physical pleasure or emotional satisfaction. There remained significant decreases across the menopausal transition in the other four domains (desire, frequency, arousal, and pain) after adjustment for baseline age and time.

Multivariable Analyses

Results of multivariable models with additional covariates related to sexual functioning are shown in Figure 1 and Table 4. Figure 1 shows adjusted estimates of the probability of a woman reporting the dichotomous response for each outcome by menopausal status.

Menopausal transition remained significantly associated with desire (P=0.004) and vaginal/pelvic pain (P=0.020). The odds of reporting frequent desire were lower at both late perimenopause (OR [95% confidence interval (CI)], 0.62, [0.44–0.87]) and postmenopause (OR [95% CI], 0.50, [0.34–0.72]) compared to pre-menopause. The odds of reporting vaginal/pelvic pain were greater for early perimenopause (OR [95% CI], 1.37 [1.01–1.86]) and postmenopause (OR [95% CI], 2.04, [1.25–3.30]) and borderline for late perimenopause (OR [95% CI], 1.57 [0.99, 2.46). Although menopausal status was not significantly related to masturbation when adjusted for age alone, with the addition of other covariates, early perimenopausal women were more likely to report masturbating than premenopausal women (OR [95% CI], 1.33 [1.01, 1.77]. The overall test for the effect of menopause transition status was not statistically significant for frequency, arousal, importance, emotional satisfaction, or physical pleasure.

Sexual functioning among women who had a surgical menopause did not differ from premenopause. It should be noted, however, that this group was small (N=119) and included women who were taking hormone therapy following surgery. For the most part, sexual functioning of current and former hormone therapy users did not differ from premenopause, although current and former users reported more pain, but also more physical pleasure. Current and former hormone users were similar to each other with respect to results for all sexual function outcomes.

Hot flashes were not related to any outcome and night sweats were only related to masturbation with women who reported more frequent night sweats reporting less masturbation (OR [95% CI], 0.69 [0.49, 0.98]. Vaginal dryness, however, was an important factor associated with masturbation, pain, arousal, physical pleasure, and emotional satisfaction. Women who reported 1–5 days of vaginal dryness were at greater risk for reporting pain during intercourse (OR [95% CI], 3.72 [2.97–4.65]), less arousal (OR [95% CI], 0.75 [0.60–0.93]), and more frequent masturbation (OR [95% CI], 1.56 [1.24, 1.96] while those who reported 6 or more days of vaginal dryness had an even greater risk of pain (OR [95% CI], 9.44 [6.84–13.0]), less arousal (OR [95% CI], 0.39 [0.29–0.53]), less physical pleasure (OR [95% CI], 0.41 [0.29–0.57]), and less emotional satisfaction (OR [95% CI], 0.68 [0.52–0.89]) than women who did not report vaginal dryness.

In contrast to findings that menopausal factors were unrelated to most aspects of sexual functioning, age, social, health, and psychological factors were highly related. The importance of sex, depression or anxiety, and race/ethnicity were related to all domains of sexual function. Women who rated sex as quite or extremely important reported more desire (OR [95% CI], 110.5 [85.4–143.0]), frequency of masturbation (OR [95% CI], 2.95 [2.25, 3.86], arousal (OR [95% CI]. 21.9 [16.3–29.8]), frequency of sexual intercourse (OR [95% CI], 25.6 [18.6–35.4]), physical pleasure (OR [95% CI], 30.9 [22.9–41.9]), emotional satisfaction (OR [95% CI], 10.8 [8.4–13.9]) and less pain (OR [95% CI] 0.46 [0.35–0.62]) than women who reported that sex was not important. Women with CES-D score ≥16 or higher anxiety also reported worse sexual functioning on all domains. Self-assessed health was strongly and consistently related to all outcomes except masturbation, with worse health related to worse sexual functioning.

Racial/ethnic differences were found for all domains. Chinese and Japanese women reported less importance, desire, masturbation, arousal, and more pain, while African-American

women reported greater importance, frequency, and pain, but less arousal, emotional satisfaction, and physical pleasure than did Caucasian women.

Other significant variables associated with sexual function were age, education, marital status, change in relationship status, and attitudes toward aging and menopause. Age and change in relationship were related to all outcomes except pain. Women who had a new relationship reported higher importance, desire, arousal, frequency, and emotional satisfaction, while women who lost a relationship reported more masturbation, less arousal, frequency, emotional satisfaction, and physical pleasure.

DISCUSSION

This large, community-based study of middle-aged women found a decrease in sexual desire, increase in painful intercourse beginning in the late perimenopause, and a temporary increase in masturbation during early perimenopause. These changes were independent of chronological aging, menopausal symptoms, and health, social, and psychological factors. In adjusted analyses, menopausal transition was unrelated to arousal, frequency of sexual activity, physical pleasure, or satisfaction with partner. Although vasomotor symptoms were largely unrelated to sexual functioning, vaginal dryness was highly associated with pain and lower arousal, emotional satisfaction, and physical pleasure. The most important variable related to sexual functioning was importance of sex, which was highly related to all outcomes. Psychological status, physical health, and relationship status were also important.

We did not find that hormone therapy users reported better sexual functioning, but these results must be interpreted with caution. Current and former hormone therapy users reported more physical pleasure, but also more vaginal/pelvic pain. However, the timing of hormone therapy in relation to the experience of pain and desire was not assessed and we could not determine whether hormone therapy provided any diminution of pain or increase in desire. The reason for hormone therapy use was not available and menopausal status was not determinable for women who initiated hormone therapy prior to the final menstrual period. The consistent pattern of results for both current and former users suggest “confounding by indication.” That is, women who have a troublesome symptom (such as vaginal/pelvic pain) chose to take estrogen to treat the problem, making it appear that pain is an effect of hormone therapy. We should note, however, that the present study was not designed to determine the effect of hormone therapy on sexual functioning, a question best addressed in a clinical trial in which treatment assignment is random.

Findings of an association between menopause transition and an increase in vaginal or pelvic pain and a decrease in sexual desire, independent of aging and a range of covariates, strengthens results from cross-sectional studies that have shown greater pain[16, 35, 36] and lower sexual interest or desire among peri or postmenopausal women.[9,11,12,20,35] The increase in masturbation during early perimenopause is an interesting finding and may be related to the concurrent increase in painful intercourse. The decline in masturbation post menopause may be related to the concurrent decline in desire. The lack of an association between menopause transition and frequency of sexual intercourse or satisfaction with partner is also consistent with other cross-sectional research[12,19,20] and, together with the lack of an association with importance of sex and arousal, suggests that these domains of sexual function are not directly related to the menopause transition.

These results suggest a plausible causal pattern underlying declines in sexual functioning as increases in pain may lead to lowered sexual desire. Vulvovaginal epithelium is rich in estrogen receptors, and estrogens are a necessity for urogenital maturation, maintenance and genital vascular congestion during arousal.[37] Lower estrogen levels in the late transition

may lead to decreased vascular engorgement and vaginal secretions during sex, resulting in a diminished sense of pleasure from subjective arousal and a disruption in the intimacy-based sexual response cycle.[38]

These results from SWAN highlight the importance of including social, health, and relationship factors in the context of menopause and sexual functioning. These factors and in particular, feelings toward one's partner or starting a new relationship, have also been identified by others as highly important.[1,10,19,20,39–42]

Similar to the Melbourne Women's Midlife Health Project (MWMHP), we found declines in all areas of sexual functioning in unadjusted analyses of menopausal status. Controlling only for age, the MWMHP also found greater declines in sexual functioning among 197 women who transitioned from pre to postmenopause compared to women who remained premenopausal.[4] Subsequent analyses from the Melbourne study found that prior sexual function and relationship factors were more important determinants of libido and sexual responsiveness than estradiol level.6 Although the Penn Ovarian Aging Study found an increase in overall sexual dysfunction with advanced menopausal status, several critical factors such as health, vaginal dryness, aging, and relationship status were not assessed.10

Despite controlling for a wide range of variables, we found racial/ethnic differences for all outcomes. African-American women reported higher frequency of sexual intercourse, consistent with other research showing that African-American women are more likely to engage in vaginal intercourse than other sexual activities such as oral or anal intercourse.[2,26,43,44] Findings for Chinese and Japanese women are consistent with data showing that Asian women tend to engage in fewer different manifestations of sexuality than Western women and that sexuality is more linked to procreation in Asian cultures.[45] Results are also consistent with findings from the Global Study of Sexual Attitudes and Behaviors which found that Asian countries reported low levels of satisfaction with sexual function and the importance of sex.[46] These findings suggest that sexual behavior has a strong cultural component.

Several limitations of these data should be mentioned. First, the questionnaire did not include items on the sexual limitations of the woman's partner, an important consideration for aging women. Second, the sexual functioning questionnaire was not one of the more newly developed, validated questionnaires.[35,47] However, the items were derived from previously published questionnaires and tap the primary domains of sexual functioning assessed by these measures. Third, as is inevitable in longitudinal studies, some participants missed visits or were lost to follow-up, resulting in missing data. The analytic methods used are relatively robust to missing data, and multivariable models incorporated numerous factors strongly associated with the likelihood of data being missing. However, the potential impact of missing data on analysis results should be considered. Future research in this area needs to examine partner limitations more closely and follow women through the early postmenopausal years. This analysis did not consider the possible relation between sexuality and sex steroid levels – a complex question that demands a detailed analysis and will be the subject of future SWAN work.

These results from SWAN have clinical relevance. Therapy to prevent menopause transition-associated vaginal pain may help slow or prevent subsequent/simultaneous declines in sexual desire. The strong associations of psychological status, physical health, and social factors with sexual function underscore the clinical imperative to explore and address these factors when discussing women's concerns regarding sexual dysfunction. The very strong association of the importance of sex with all domains of sexual function

suggests that asking patients about the importance of sex may be a cornerstone of the management of the sexual concerns of midlife women.

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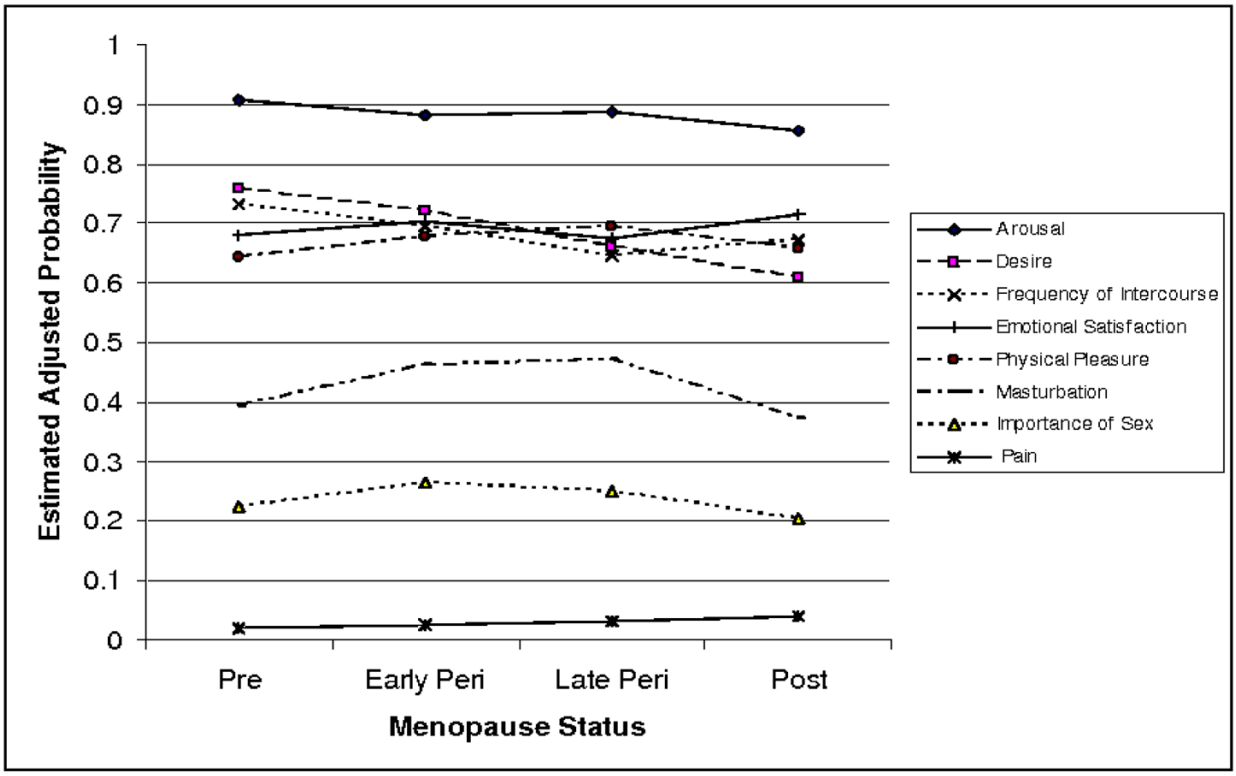

Figure 1.

Adjusted probabilities of sexual functioning at each stage of the menopause transition. Reporting that sex was extremely or quite *important*; feeling *sexual desire* at least once per week; engaging in *sexual intercourse* at least once per week; having a very or extremely *emotionally satisfying* relationship; having a very or extremely *physically pleasurable* relationship; always or almost always feeling *aroused* during sexual activity; feeling vaginal or *pelvic pain* sometimes, always or almost always during intercourse; any engaging in *masturbation.* Estimates are adjusted for all covariates shown in Table 3. Pre = premenopausal; Peri = perimenopausal; Post = postmenopausal.

Table 1

Baseline characteristics for each of the three analytic samples.

Variable	All women (N=3288)†	Women who engaged in sexual activity in last 6 months (N=2789) †	Women who engaged in sexual intercourse in last 6 months (N=2744) †
Age(mean)	46.2	46.1	46.1
Body Mass Index(mean)*	28.3	27.9	27.8
	% (N)	% (N)	% (N)
Ethnicity			
Caucasian	46.96 (1544)	47.01 (1311)	46.61 (1279)
African-American	28.32 (931)	28.11 (784)	28.24 (775)
Hispanic	8.70 (286)	8.39 (234)	8.49 (233)
Chinese	7.51 (247)	7.78 (217)	7.91 (217)
Japanese	8.52 (280)	8.71 (243)	8.75 (240)
Education			
High School or less	25.02 (815)	24.69 (682)	24.81 (674)
>High School	32.15 (1047)	32.84 (907)	32.83 (892)
College	20.23 (659)	19.91 (550)	19.84 (539)
Post College	22.60 (736)	22.56 (623)	22.52 (612)
Marital Status			
Single, Never married	13.52 (437)	9.51 (261)	9.11 (246)
Married or living with partner	66.14 (2139)	73.54 (2018)	74.00 (1995)
Separated/Widowed/Divorced	20.35 (658)	16.95 (465)	16.89 (456)
Attitudes Towards Aging and Menopause‡			
Negative/Neutral	20.04 (645)	19.44 (531)	19.46 (523)
Positive	32.40 (1043)	32.06 (876)	31.99 (860)
High Positive	47.56 (1531)	48.05 (1325)	48.55 (1305)
Overall Health			
Excellent	21.36 (691)	22.34 (613)	22.33 (603)
Very good	36.35 (1176)	36.77 (1009)	36.65 (990)
Good	29.09 (941)	28.61 (785)	28.66 (774)
Fair/Poor	13.20 (427)	12.28 (337)	12.37 (334)
Menopause Status			
Premenopausal	53.63 (1722)	53.61 (1461)	53.6 (1437)
Early Perimenopausal	46.37 (1489)	46.39 (1264)	46.4 (1244)

†The totalsample sizes shown here do not account for small amount of missing covariate data

*weight(kg)/height(cm)^2

‡See methods section for a description of how this variablewas scored.

Table 2

Menopausal status at each visit.

		Menopausal Status								
	N	Pre %	Early Peri %	Late Peri %	Post %	Surgical %	Current Hormone Therapy User %	Former Hormone Therapy User %	Mean Age (Years)	Sexually Active %
Baseline	3262	46.3	53.7	-	-	-	-	-	46.2	78.5
V01	2802	25.3	60.9	4.5	1.9	0.6	6.7	-	46.9	76.7
V02	2639	16.6	56.4	7.5	4.6	1.5	11.7	1.8	47.9	75.5
V03	2546	11.1	50.9	8.4	8.6	1.9	14.4	4.7	48.9	75.1
V04	2436	6.7	43.1	9.4	14.2	2.6	17.1	7.0	49.9	72.1
V05	2324	4.2	35.6	9.6	20.6	3.4	16.9	9.7	51.0	70.5
V06	2092	2.9	27.8	9.2	26.2	3.8	18.4	11.8	52.0	71.5

Table 3

Percent distribution of responses to sexual functioning questions over all visits for total sample and by menopausal status.[†]

Domain	Menopausal Status							
	All Women	Pre	Early Peri	Late Peri	Post	Current HT user	Former HT user	Surgical
Desire								
No. of Observations	17,811	3,432	8,342	1,163	1,730	2,017	801	326
Not at all	10.9%	7.2%	8.8%	15.7%	23.9%	10.8%	11.7%	15.3%
1–2 times/mo.	37.5	34.5	37.2	38.8	41.0	38.6	41.5	36.2
About once/wk.	27.3	28.4	28.7	24.1	20.4	29.1	22.6	27.0
>once/wk.	21.9	27.0	22.6	19.1	13.6	19.5	20.7	19.3
Daily	2.5	2.9	2.7	2.4	1.3	2.0	3.5	2.2
Masturbation								
No. of Observations	17,394	3,351	8,152	1,125	1,676	1,999	777	314
Not at all	50.8%	50.8%	49.4%	54.8%	61.8%	44.6%	51.7%	53.8%
<once/mo.	22.5	22.0	21.9	22.4	21.3	26.8	23.7	20.1
1–2 times/mo.	16.6	16.0	17.6	14.2	12.5	19.0	16.0	15.0
About 1/wk.	6.8	7.3	7.5	5.7	3.5	6.7	5.7	7.3
>once/week	3.0	3.7	3.4	2.5	0.9	2.7	1.9	3.5
Daily	0.3	0.2	0.3	0.4	0.0	0.3	1.0	0.3
Importance[*]								
No. of Observations	15,525	3,338	7,536	940	1256	1,636	571	248
Not at All	7.2%	5.5%	6.3%	9.9%	13.9%	7.6%	6.7%	12.1%
Not Very	21.6	19.7	21.0	22.9	30.2	21.5	20.0	19.4
Moderately	41.9	43.7	43.0	38.6	35.1	41.1	39.8	39.9
Quite	22.6	23.5	22.9	22.9	16.9	23.2	24.7	21.8
Extremely	6.7	7.7	6.7	5.7	4.0	6.5	8.9	6.9
Arousal								
No. of Observations	12,959	2,588	6,255	786	1,032	1,487	584	227
Never	1.2%	0.5%	0.8%	2.3%	2.3%	1.6%	2.7%	1.8%

Menopause. Author manuscript; available in PMC 2010 July 22.

Domain	Menopausal Status							
	All Women	Pre	Early Peri	Late Peri	Post	Current HT user	Former HT user	Surgical
Almost never	4.4	4.1	3.9	5.3	5.6	5.2	5.8	7.1
Sometimes	26.5	22.2	26.7	28.9	36.3	26.8	20.7	30.8
Almost always	39.5	40.2	40.5	38.3	35.7	38.7	36.6	35.2
Always	28.4	33.0	28.1	25.2	20.1	27.8	34.1	25.1
Frequency								
No. of Observations	12,819	2,553	6,177	782	1,020	1,477	582	228
Not at all	3.9%	3.5%	3.7%	4.7%	5.9%	3.9%	4.1%	0.9%
1–2 times/mo.	38.1	34.2	37.8	41.3	42.1	39.9	43.1	39.0
About once/wk.	31.5	32.1	31.6	30.4	30.5	32.4	27.0	35.5
>once/wk.	25.1	28.5	25.4	22.5	20.1	23.2	25.6	22.8
Daily	1.4	1.7	1.5	1.0	1.5	0.5	0.2	1.8
Emotional Satisfaction								
No. of Observations	12,961	2,589	6,258	786	1,031	1,487	585	225
Not at all	2.5%	2.4%	2.4%	3.1%	2.3%	2.8%	2.7%	3.6%
Slightly	10.1	10.1	10.0	9.7	11.5	9.3	11.1	11.1
Moderately	33.1	32.4	34.5	31.8	35.8	29.9	28.7	26.7
Very	39.2	38.6	38.9	40.8	37.4	40.8	39.5	44.4
Extremely	15.2	16.6	14.3	14.6	13.0	17.2	18.0	14.2
Physical Pleasure‡								
No. of Observations	9,982	2,481	5,247	525	425	941	252	111
Not at all	1.7%	1.5%	1.5%	1.5%	3.5%	2.0%	2.8%	0.9%
Slightly	9.0	8.5	8.4	13.3	11.8	9.7	9.9	10.8
Moderately	30.6	30.4	31.4	28.6	35.3	28.5	23.0	23.4
Very	42.7	41.8	43.1	39.6	39.1	43.2	45.6	57.7
Extremely	16.1	17.9	15.6	17.0	10.4	16.7	18.7	7.2
Pain								
No. of Observations	12,674	2,533	6,130	764	998	1,452	571	226
No Sexual activity	1.2%	0.7%	1.2%	2.4%	1.6%	1.3%	1.2%	1.7%

Domain	Menopausal Status							
	All Women	Pre	Early Peri	Late Peri	Post	Current HT user	Former HT user	Surgical
Never	54.2	60.7	54.9	52.4	47.7	48.3	47.9	49.5
Almost never	21.7	23.0	21.4	19.9	20.3	23.2	20.1	21.2
Sometimes	19.4	13.7	19.9	20.2	23.2	22.3	20.1	21.2
Almost always	2.5	1.5	1.8	3.6	5.2	3.5	4.7	2.6
Always	0.8	0.2	0.5	1.1	1.9	1.1	1.9	3.5

† the hash line between response categories shows the cut-point for the dichotomized response.

* This question was not asked at visit 05.

‡ This question was not asked at visit 05 or 06

Table 4

Odds ratios and confidence intervals for each outcome, estimated from multivariable random effects logistic regression models[†]

	Outcome							
Variable	Importance of Sex OR (95% CI)	Sexual Desire OR (95% CI)	Masturbation OR (95% CI)	Arousal OR (95% CI)	Pelvic Pain OR (95% CI)	Frequency of Intercourse OR (95% CI)	Emotional Satisfaction OR (95% CI)	Physical Pleasure OR (95% CI)
Menopause Related								
Menopausal status								
Pre menopause	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Early Peri	1.24 (0.96, 1.61)	0.82 (0.65, 1.03)	1.33(1.01,1.77) *	0.76 (0.57,1.01)	1.37 (1.01,1.86)*	0.83 (0.63, 1.10)	1.11 (0.87, 1.41)	1.17 (0.90, 1.53)
Late Peri	1.16 (0.79, 1.70)	0.62 (0.44, 0.87)**	1.38(0.91,2.11)	0.80 (0.52, 1.23)	1.57 (0.99,2.46)	0.66 (0.43, 1.02)	0.96 (0.67, 1.39)	1.27 (0.83, 1.96)
Post	0.88 (0.58, 1.33)	0.50 (0.34, 0.72)***	0.92(0.60,1.42)	0.61 (0.38, 0.96)*	2.04 (1.25, 3.30)**	0.74 (0.46, 1.19)	1.18 (0.80, 1.75)	1.06 (0.64, 1.77)
Surgical menopause	1.18 (0.59, 2.36)	0.76 (0.39, 1.45)	1.37(0.51,3.71)	0.48 (0.21, 1.08)	0.68 (0.30, 1.57)	0.52 (0.24, 1.14)	1.23 (0.61, 2.48)	1.96 (0.79, 4.87)
Current Hormone User	1.08 (0.75, 1.56)	0.76 (0.55, 1.05)	1.14(0.77,1.71)	0.66 (0.45, 0.99)*	1.81 (1.19, 2.76)**	0.85 (0.57, 1.26)	1.30 (0.93, 1.82)	1.49 (1.02, 2.18)*
Former Hormone User	1.24 (0.76, 2.03)	0.51 (0.33, 0.78)***	1.38(0.80,2.37)	0.86 (0.50, 1.48)	1.83 (1.06, 3.16)*	0.72 (0.43, 1.22)	1.26 (0.81, 1.97)	1.82 (1.01, 3.27)***
Hot Flashes								
None	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
1–5 days	0.88 (0.72, 1.08)	1.09 (0.91, 1.30)	0.87(0.70,1.09)	1.09 (0.87, 1.35)	1.04 (0.82, 1.31)	0.89 (0.72, 1.10)	1.13 (0.93, 1.36)	1.09 (0.87, 1.36)
6 + days	0.95 (0.70, 1.27)	1.02 (0.79, 1.32)	0.89(0.65,1.21)	1.13 (0.83, 1.56)	1.22 (0.89, 1.68)	0.75 (0.55, 1.03)	1.31 (0.99, 1.73)	1.14 (0.82, 1.59)
Night Sweats								
None	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
1–5 days	1.04 (0.84, 1.27)	0.99 (0.83, 1.19)	1.08(0.86,1.35)	1.08 (0.87, 1.36)	1.00 (0.80, 1.26)	0.96 (0.77, 1.19)	1.14 (0.94, 1.37)	1.02 (0.82, 1.28)
6+ days	0.95 (0.69, 1.30)	1.17 (0.89, 1.56)	0.69(0.49,0.98)*	1.10 (0.78, 1.55)	0.98 (0.69, 1.39)	1.28 (0.91, 1.81)	1.23 (0.91, 1.67)	1.28 (0.89, 1.83)
Vaginal Dryness								
None	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
1–5 days	1.04 (0.84, 1.29)	1.05 (0.87, 1.27)	1.56(1.24,1.96) ***	0.75 (0.60, 0.93)**	3.72 (2.97, 4.65)***	1.25 (1.00, 1.56)*	0.98 (0.81, 1.18)	0.85 (0.68, 1.06)
6+ days	0.94 (0.68, 1.29)	0.89 (0.68, 1.15)	1.21(0.89,1.65)	0.39 (0.29, 0.53)***	9.44 (6.84, 13.0)***	0.90 (0.64, 1.24)	0.68 (0.52, 0.89)**	0.41 (0.29, 0.57)***
Use of Lubricants								
Always/almost always					Referent			
Sometimes/almost never					0.53 (0.39, 0.74)***			

	Outcome							
Variable	**Importance of Sex OR (95% CI)**	**Sexual Desire OR (95% CI)**	**Masturbation OR (95% CI)**	**Arousal OR (95% CI)**	**Pelvic Pain OR (95% CI)**	**Frequency of Intercourse OR (95% CI)**	**Emotional Satisfaction OR (95% CI)**	**Physical Pleasure OR (95% CI)**
Never					0.20 (0.14, 0.28)***			
Age	0.89 (0.84,0.94)***	0.89 (0.86, 0.93)***	0.93(0.87,0.99) **	0.89 (0.85, 0.94)***	0.98 (0.94, 1.04)	0.94 (0.89, 0.99)*	0.99 (0.95, 1.03)	0.92 (0.87, 0.96)***
Time	0.93 (0.88, 0.97)***	0.90 (0.86, 0.94)***	0.99(0.94,1.04)	0.94 (0.89, 0.99)*	0.97 (0.92, 1.03)	0.89 (0.85, 0.94)***	0.95 (0.91, 0.99)*	0.89 (0.83, 0.96)**
Social								
Race/ethnicity								
Caucasian	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
African-American	1.69 (1.15, 2.49)**	0.93 (0.70, 1.24)	0.13(0.08,0.21) ***	0.45 (0.31, 0.65)***	1.48 (1.01, 2.17)*	1.64 (1.12, 2.39)*	0.57 (0.42, 0.77)***	0.69 (0.50, 0.97)*
Chinese	0.33 (0.15, 0.72)**	0.43 (0.25, 0.72)**	0.06(0.03,0.11) ***	0.37 (0.20, 0.70)**	2.83 (1.47, 5.46)**	1.39 (0.64, 3.03)	0.68 (0.39, 1.18)	0.66 (0.36, 1.22)
Hispanic	0.41 (0.15, 1.10)	0.92 (0.43, 1.93)	0.62(0.25,1.56)	0.11 (0.04, 0.29)***	1.28 (0.48, 3.44)	1.64 (0.56, 4.77)	0.58 (0.26, 1.30)	0.45 (0.18, 1.13)
Japanese	0.16 (0.09, 0.30)***	0.26 (0.16, 0.43)***	0.07(0.03,0.16) ***	0.63 (0.34, 1.20)	2.74 (1.47, 5.12)**	0.48 (0.26, 0.90)*	0.70 (0.42, 1.16)	1.02 (0.58, 1.79)
Education								
High School or less	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
>High School	1.80 (1.23, 2.64)**	1.09 (0.81, 1.45)	5.01(3.31,7.56) ***	1.37 (0.94, 1.99)	1.05 (0.73, 1.50)	1.06 (0.72, 1.55)	1.20 (0.88, 1.62)	1.47 (1.05, 2.05)*
College	1.71 (1.04, 2.82)*	1.03 (0.74, 1.43)	18.7(11.5,30.5) ***	2.03 (1.33, 3.10)**	0.83 (0.55, 1.25)	0.88 (0.56, 1.38)	1.39 (0.99, 1.96)	1.45 (0.99, 2.12)
Post-College	2.15 (1.34, 3.43)**	1.27 (0.91, 1.76)	21.0(13.2,33.5) ***	2.56 (1.68, 3.91)***	0.84 (0.55, 1.27)	0.65 (0.42, 1.01)	1.57 (1.12, 2.21)**	2.08 (1.42, 3.03)***
Marital Status								
Married	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Single	0.52 (0.36,0.75)***	0.58 (0.43, 0.78)***	2.77(1.89,4.06) ***	1.53 (0.99, 2.36)	1.25 (0.80, 1.94)	0.79 (0.52, 1.22)	0.51 (0.36, 0.71)***	0.94 (0.63, 1.41)
Sep./wid/div	0.93 (0.71, 1.23)	0.64 (0.51, 0.80)***	2.35(1.78,3.12) ***	2.16 (1.54, 3.03)***	0.68 (0.48, 0.97)*	0.57 (0.42, 0.78)***	0.71 (0.54, 0.92)*	2.66 (1.94, 3.65)***
Partner Status								
No Change	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
New Relationship	3.01(2.06, 4.40) ***	1.53 (1.05, 2.25)*	1.05(0.68,1.61)	2.60 (1.54, 4.38)***	0.82 (0.51, 1.32)	1.63 (1.08, 2.45)*	1.57 (1.09, 2.25)*	1.37 (0.88, 2.14)
Lose Relationship	1.15 (0.90, 1.48)	1.13 (0.90, 1.43)	1.76(1.33,2.33) ***	0.55 (0.41, 0.75)***	1.18 (0.87, 1.61)	0.71 (0.54, 0.95)*	0.41 (0.32, 0.54)***	0.57 (0.43, 0.77)***
Children (<18 years)								
None	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
At least one	0.87(0.69, 1.09)	0.99 (0.83, 1.20)	0.68(0.53,0.88) **	0.92 (0.73, 1.16)	0.92 (0.73, 1.16)	1.08 (0.86, 1.36)	0.82 (0.68, 0.99)*	1.09 (0.88, 1.36)

	Outcome							
Variable	Importance of Sex OR (95% CI)	Sexual Desire OR (95% CI)	Masturbation OR (95% CI)	Arousal OR (95% CI)	Pelvic Pain OR (95% CI)	Frequency of Intercourse OR (95% CI)	Emotional Satisfaction OR (95% CI)	Physical Pleasure OR (95% CI)
Health/Lifestyle								
Health								
Excellent	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Very good	0.65(0.51, 0.82) ***	0.78 (0.63, 0.97)*	1.21(0.93,1.57)	0.83 (0.63, 1.10)	1.38 (1.04, 1.84)*	0.80 (0.62, 1.03)	0.75 (0.60, 0.93)*	0.75 (0.58, 0.98)*
Good	0.46(0.34, 0.60) ***	0.70 (0.55, 0.90)**	1.15(0.85,1.55)	0.76 (0.56, 1.05)	1.73 (1.25, 2.40)**	0.65 (0.48, 0.88)**	0.59 (0.46, 0.76)***	0.65 (0.48, 0.88)**
Fair/Poor	0.33(0.22, 0.49) ***	0.53 (0.39, 0.74)***	0.90(0.60,1.33)	0.38 (0.25, 0.57)***	2.37 (1.57, 3.56)***	0.76 (0.51, 1.14)	0.50 (0.36, 0.71)***	0.39 (0.26, 0.58)***
Alcohol	2.16(1.51, 3.09) ***	1.19 (0.97, 1.46)	1.81(1.46,2.24) ***	1.07 (0.82, 1.39)	0.75 (0.57, 0.99)*	0.99 (0.76, 1.29)	0.94 (0.77, 1.16)	115 (0.91, 1.46)
Body mass index	0.99 (0.97, 1.02)	0.99 (0.98, 1.01)	1.03(1.01,1.06) **	0.99 (0.97, 1.01)	0.97 (0.95, 0.99)**	0.95 (0.93, 0.97)***	1.00 (0.99, 1.02)	1.01 (0.99, 1.03)
Current Smoker								
No	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Yes	0.85 (0.59, 1.23)	1.29 (0.98, 1.69)	1.38(0.96,1.97)	1.16 (0.81, 1.65)	1.04 (0.73, 1.49)	0.92 (0.64, 1.30)	1.14 (0.85, 1.51)	1.18 (0.85, 1.63)
Psychological								
Attitudes toward Aging								
Negative/Neutral	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Positive	1.36 (0.86, 2.14)	1.53 (1.15, 2.04)**	0.80(0.52,1.23)	1.01 (0.69, 1.45)	0.89 (0.62, 1.27)	1.39 (0.91, 2.12)	1.39 (1.02, 1.89)*	1.49 (1.06, 2.10)*
High Positive	1.95 (1.28, 2.96)**	1.41 (1.06, 1.86)*	1.16(0.79,1.71)	1.67 (1.16, 2.39)**	0.79 (0.56, 1.13)	1.16 (0.76, 1.76)	1.93 (1.43, 2.60)***	2.22 (1.59, 3.10)***
Depression								
Not depressed	Referent	Referent	Referent	Referent	Referent	Referent	Referent	Referent
Depressed	0.76 (0.60, 0.95) *	0.96 (0.78, 1.18)	1.09(0.85,1.39)	0.74 (0.58, 0.95)*	1.61 (1.25, 2.07)***	0.88 (0.69, 1.12)	0.57 (0.46, 0.71)***	0.67 (0.52, 0.86)**
Anxiety	1.02 (0.97, 1.06)	0.96 (0.92, 0.99)*	1.07(1.02,1.13) **	0.95 (0.90, 0.99)*	1.03 (0.98, 1.08)	0.93 (0.89, 0.98)**	0.87 (0.83, 0.91)***	0.93 (0.88, 0.97)**
Importance of Sex								
Not at all/Not very		Referent	Referent	Referent	Referent	Referent	Referent	Referent
Moderately		15.5 (12.6, 19.0)***	2.00(1.59,2.52) ***	4.75(3.74,6.04)***	0.63 (0.49, 0.80)***	5.58(4.27,7.30)***	3.08(2.48,3.83)***	4.73 (3.69, 6.06)***
Extremely/Quite		110.5 (85.4,143.0)***	2.95(2.25,3.86) ***	21.9(16.3, 29.8)***	0.46 (0.35, 0.62)***	25.6 (18.6, 35.4)***	10.8(8.38, 13.9)***	30.9 (22.9, 41.9)***

†Analyses model the odds of: sex being quite or extremely *important*; feeling *sexual desire* at least once per week; any *masturbation;* always or almost always feeling *aroused* during sexual activity; feeling vaginal or *pelvic pain* sometimes, always or almost always during intercourse; engaging in *sexual intercourse* at least once per week; reporting very or extremely *emotional satisfaction*; and reporting very or extremely *physical pleasure*.

*p<.05;

** p<.01;
*** p<.001