ORIGINAL RESEARCH

Longitudinal Evaluation of Sexual Function in a Cohort of Pre- and Postmenopausal Women

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ABSTRACT

Introduction. Aspects of women's sexual functioning that have received relatively little attention are its stability and how changes in the different sexual response domains influence each other over time.

Aim. The aim of this study was to describe the changes and to evaluate the stability of self-reported sexual functioning over a 4-year period in a population sample of British women.

Methods. A 4-year follow-up study on N = 507 women, including 178 pre- and 329 postmenopausal women, was conducted. The validated Female Sexual Function Index (FSFI) was applied.

Main Outcome Measure. A multigroup path analytical model was used to examine autoregressive effects (the effect of a domain on itself at a later point in time) and cross-lag effects (one variable affecting another variable at a later point in time) across all FSFI domains of sexual functioning between pre- and postmenopausal women.

Results. Overall, the proportion of postmenopausal women suffering from a sexual dysfunction at measurement point 1 (T1) was higher compared with premenopausal women (pre: 34.3% vs. post: 14.5%). However, both groups showed a comparable number of women developing a sexual problem (pre: 22.2% vs. post: 23.2%) or improving their sexual functioning (7.4% vs. 7.6%) after the 4 years. Furthermore, path model analyses revealed that each domain at T1 significantly predicted its level 4 years later (β s ranging from 0.33 for arousal to 0.57 for lubrication), with the exception of sexual satisfaction. In terms of cross-lag effects, the changes in all domains except for pain were predicted either by levels of desire, arousal, or orgasm at T1 (β s ranging from 0.18 to 0.36) in both groups.

Conclusions. Women's sexual functioning was moderately stable across the 4 years. The main predictors of changes in sexual functioning and satisfaction were desire and arousal, highlighting their role as possible key players in women's sexual health. **Burri A, Hilpert P, and Spector T. Longitudinal evaluation of sexual function in a cohort of pre- and postmenopausal women. J Sex Med **;***-**-**.**

Key Words. Longitudinal Study; FSD; Sexual Functioning; Women; Cross-Lag; FSFI

Introduction

Previous research has highlighted the importance of a healthy sex life for the overall quality of life [1,2]. Female sexual function is thought to be composed of a cluster of domains including desire, subjective and genital arousal (i.e., lubrication), orgasm, satisfaction, and pain. Two aspects of women's sexual functioning that have received rela-

tively little attention are its stability or variation and how changes in the sexual function domains affect each other over time. While considerable research effort is being made in understanding the epidemiology of women's sexual problems by concentrating on the identification of potential risk factors, most studies have used and continue using cross-sectional designs (e.g., Burri and Spector [3] and Shifren et al. [4]). While these cross-sectional

studies show a decrease in female sexual function as age increases, there is limited follow-up data available illustrating how the various sexual function domains track together over time. But longitudinal studies in the field of female sexual health are urgently needed to test for overall trends, as well as for temporal changes in sexual function over time, and for the factors modifying these variables (i.e., causation). There are only sparse data on sex and aging longitudinally [5–7]. In addition, there is a lack of multidimensional studies focusing on all the domains of sexual function, consequently preventing exploration of their interactions over time.

The majority of the existing follow-up studies have addressed the disruptive effects of chronic illnesses and cancer conditions on women's sexual health by investigating the incidence of sexual problems, the nature of the sexual impairment, as well as posttreatment changes in sexual functioning (e.g., Andersen [8]). Population-based studies are rather scarce and have almost exclusively looked at sexual function and related distress in peri-menopausal women [5,7]. The process of aging and menopausal transition is accompanied by a range of physiological and psychological changes, such as the decrease in estrogen levels, the development of comorbid cardiovascular and metabolic conditions, etc. that all have the potential to affect a woman's sexual function [9].

Overall, these previous studies report a decline in all phases of the sexual response, as well as higher levels of sexual distress as a consequence of aging and/or menopause [5–7,10]. In an 11-year prospective study on 257 mid-aged Australian-born women, for example, a decline in all domains of sexual function after the decade studied could be observed [5]. In another seminal prospective cohort study of 3,302 U.S. women (aged 42 to 52 years) as part of the Study of Women's Health Across the Nation (SWAN), Avis and colleagues found a decrease in sexual desire and an increase in painful intercourse during peri-menopause, with these changes being independent of chronological aging and likely related to menopausal changes [7]. Similarly, the Melbourne Women's Midlife Health Project found greater declines in sexual functioning among 197 women who transitioned from pre- to postmenopause compared with women who remained premenopausal [11]. A very recent follow-up study in an Australian cohort of 230 postmenopausal women from the Women's Healthy Ageing Project found 49.8% of women reporting being sexually active after a 10-year follow-up, with more active women also reporting

significantly higher levels of sexual distress [6]. However, women maintaining sexual activity showed stability in sexual functioning, whereas inactive women reported an overall decline. The most important predictors for sexual activity were partner availability and no history of depression. While overall the majority of studies suggest an increase in sexual distress, there are some conflicting data. In an earlier longitudinal study exploring sexual behavior and dysfunction in a population sample of 474 older urban Australian women, younger women and women with partners were found to have higher levels of distress than older women [10]. Women further showed a decrease in sexual activity and an increase in indifference toward sex, which—according to the authors—may be associated with the loss of intimate relationships as part of separation, divorce, or bereavement.

In the present study, we took advantage of data from two measurement points to determine longitudinal changes in six domains of sexual functioning to assess the long-term covariation in these domains and to compare the results in two groups of pre- and postmenopausal women. Such longitudinal data may be useful in depicting how multiple domains of sexual functioning vary together and affect each other over time, therefore enhancing our understanding of the importance of sexual functioning for sexual and relationship dissatisfaction.

Aim

The aim of this study was to describe the changes in sexual functioning over time. More specifically, we aimed to answer three questions: 1. To compare the proportion of pre- and postmenopausal women that developed a sexual problem over the 4-year course: Based on previous findings, we hypothesized that in the postmenopausal group, the proportion of women developing a sexual dysfunction from measurement point 1 (T1) to measurement point 2 (T2; 4 years apart) would be higher compared with premenopausal women because of the potentially impairing effects of menopause [5]. 2. To investigate changes in the sexual subdomains and compare them between pre- and postmenopausal women: Based on previous findings, we expected an increase in sexual desire, as well as a decrease of sexual pain symptoms in both groups [5]. However, research has also shown that not all domains of sexual functioning show a decline over time as age does not necessarily represent a global risk factor for sexual

problems. Therefore we expected no decrease in sexual satisfaction in pre- or postmenopausal women. 3. To understand how the subdomains affect each other over time: We hypothesized that sexual satisfaction at T1 would positively influence all subdomains at T2 in both groups, and that pain at T1 would negatively influence all other subdomains at T2, with this effect being stronger in the premenopausal group.

Materials and Methods

Sample Definition

The study sample consisted of females enlisted in the UK Adult Twin Registry—a cohort of unselected volunteer Caucasian twins [12]. The registry started in 1993 and initial research focused on rheumatologic and arthritic diseases, therefore explaining the relatively high mean age of the volunteers. All volunteers in the registry were recruited through successive national media campaigns and from other twin registers. The representativeness and comparability of the female cohort in terms of behavior, lifestyle factors, diseases, and sexual functioning have been repeatedly demonstrated [12–14].

The present study represents a sub-study within a larger project aiming at the disentangling of genetic and environmental influences underlying female sexual problems. For both data collection waves (T1 and T2), twins were contacted either by post or via e-mail and asked about their interest in completing a questionnaire related to sexual function. The first data collection (T1) was carried out in 2008/2009. It targeted a priori defined subsample of 3,154 female twin individuals (29.7% of twins from the entire TwinsUK registry) who had previously filled in sexuality-related questionnaires and had stated their interest in volunteering in future studies of this nature. Of the 3,154 targeted women, 1,589 returned the postal questionnaire (50% response rate). Women reporting never having been sexually active, being homosexual (Kinsey scale 5–7), not being in a relationship, and/or women with a high number of missing items were dropped from the sample (for more information on handling of missing items, see Burri et al. [14]). In the end, data from $N = 507$ women (aged between 18 and 85 years, with a mean age of 56.3 years, standard deviation [SD] = 11.63) were available for T1 [3,14].

The second data assessment was conducted from February to October 2013. In contrast to T1,

data collection was conducted via an online questionnaire. The same exclusion criteria as in T1 were applied (i.e., no sexual activity, homosexual orientation, missing values). From the $N = 507$ women at T1, $n = 241$ women filled in the questionnaire and fulfilled the inclusion criteria at T2. At T1, no follow-up was planned; hence, the participants were not informed about a potential second data assessment, which could partially explain the high drop-out rate.

Confidentiality was assured and the twins were unaware of the precise research hypothesis addressed in the present study. The study was approved by the St. Thomas' Hospital Research Ethics Committee and all twins provided informed consent.

Measures

Sexuality outcomes were measured using the well-established Female Sexual Function Index (FSFI) [15]. The 19 items provide a multidimensional assessment of sexual functioning in the past 4 weeks and capture the domains of desire, arousal, lubrication, orgasm, satisfaction, and pain. The FSFI can be administered to women across a wide age range, including peri-menopausal and postmenopausal women. Response options are on a Likert-type scale ranging from 1 to 5 for items 1 and 2. For all other items (3–19), the range is from 0 to 5 with the supplementary option “no sexual activity.” Details on response options, domain score computation, and domain factor weights can be found in Rosen et al. [15]. The questionnaire has received extensive psychometric evaluation in clinical and nonclinical samples [14,15]. The FSFI has shown excellent psychometric properties when applied to this subsample of women [14]. In the present study, the commonly used cutoff of 26.55 was used to distinguish women with a sexual problem from “healthy” women [15]. Because no cutoff scores for the individual subdomains have been suggested thus far, changes in the specific domains of sexual functioning (i.e., progression and/or remission of sexual problems) will be illustrated based on the domain mean scores.

Current relationship dissatisfaction was used as a control variable and was assessed with a single item at T1 (“How satisfied are you with your current relationship?”) with response options being on a Likert-type scale ranging from 1 (very satisfied) to 6 (very dissatisfied). Additional socio-demographic characteristics were assessed using a set of study specific self-constructed questions.

Statistical Analysis

For descriptive statistics, means, SDs, and inter-correlations between all study variables were calculated. In aim 1, we examined whether the decline in sexual functioning in pre- and postmenopausal women is clinically meaningful. In order to test for clinical significance in this nonclinical sample, we followed an adapted version of the classical JT method [16,17].

For study aims 2 and 3, a multigroup path analytical model in pre- (age ≤ 49) and postmenopausal women (age ≥ 50) was computed (see Figure 1). This approach allows the examination of changes over time across all variables (i.e., desire, arousal, orgasm, lubrication, pain, sexual satisfaction as measured by the FSFI). More specifically, it allows to simultaneously test for autoregressive effects (i.e., the effect of a domain on itself at a later point in time) and for cross-lag effects (i.e., one variable affecting another variable at a later point in time). In addition, this approach allows the comparison of group differences between pre- and postmenopausal women. To test our hypotheses, a saturated model was computed first (degree of freedom [df] = 0). Regression parameters were then restricted to be equal across groups and common fit indices were used to identify the best fitting model [18]. Because it is known that sexual functioning can be influenced by the level of relationship dissatisfaction, this variable (from T1) was included into the model in order to control for its influence [3].

In terms of autoregressive effects (aim 2), a lower association would indicate that the level of a specific variable at T1 is unlikely to predict the level at T2, whereas a high association would indicate stability. Cross-lag effects (aim 3) indicate whether the level of one variable predicts changes over time in another variable, by controlling for the auto-correlated effects. A positive and significant association, for example, would mean that a high level in a specific variable predicts an increase in another variable.

Data handling and descriptive analyses were carried out using STATA software (StataCorp. 2007, Stata Statistical Software: Release 10, StataCorp LP, College Station, TX, USA). Lavaan package 0.5–16 in R (R version 3.1; R Core Team) was used to compute the multigroup path analytical model [19,20]. Robust maximum likelihood estimator in Lavaan was used to adjust for skewed scales. For dropout handling, we first tested whether dropouts could be predicted with a logistic regression. If dropout could be significantly predicted, these variables were included as auxiliary variables in the model, indicating that dropouts most likely followed a missing at random mechanism. Using full information maximum likelihood estimation would then lead to unbiased results.

Results

The result of the logistic regression showed education to be a potential predictor for dropout

Figure 1 In the path analytical multigroup model, one model is simultaneously computed for each group (peri- and postmenopausal women). Each domain of female sexual function (e.g., sexual desire, sexual arousal) measured at T1 predicts itself at T1 (arrow with solid line) and the other domains (arrow with dashed lines), and these associations are controlled for relationship satisfaction (arrow with gray line)

Table 1 Means, SD of study variables, as well as inter-correlations between all study variables (at T1)

		Inter-correlation						
	M/SD	1	2	3	4	5	6	7
FSFI								
Desire (1)	3.28 (1.00)							
Arousal (2)	4.28 (1.27)	0.43						
Lubrication (3)	4.85 (1.36)	0.28	0.63					
Orgasm (4)	4.66 (1.37)	0.24	0.69	0.52				
Satisfaction (5)	4.86 (1.24)	0.31	0.57	0.40	0.49			
Pain* (6)	5.33 (1.07)	0.18	0.33	0.47	0.28	0.24		
Total FSFI (7)	27.80 (5.13)	0.54	0.86	0.78	0.78	0.70	0.56	
Control variables								
Relationship dissatisfaction (8)	3.47 (2.16)	−0.47	−0.48	−0.35	−0.38	−0.93	−0.21	−0.65

*Higher pain scores mean less sexual pain

All inter-correlations of the FSFI are significant at $P < 0.001$

FSFI = Female Sexual Function Index; M = mean; SD = standard deviation

($\beta = 0.11$, $P = 0.000$) and was subsequently included as an auxiliary variable in the multigroup path analytical model.

Descriptive

Table 1 shows the means, SDs, and inter-correlations for all study variables at T1. In accordance with previous study findings, all domains of the FSFI correlated significantly with each other, with r 's ranging from 0.18 to 0.69 [3,14]. The highest correlation could be found between arousal and orgasm ($r = 0.69$) and the lowest between desire and sexual pain ($r = 0.18$).

Sexual Functioning over Time

According to the FSFI cutoff score of 26.55, 14.5% of women in the premenopausal group suffered from a sexual problem and 55.1% were healthy at both time points. Of the premenopausal women, 7.3% transitioned from dysfunctional to healthy, and 23.2% developed a sexual dysfunction from T1 to T2. In postmenopausal women, the proportion of women reporting a sexual dysfunction at both time points was higher compared with premenopausal women, with 34.3% remaining healthy and 7.4% even showing an improvement (from dysfunctional to healthy) over the 4-year course. Comparable with peri-menopausal women, 22.2% of postmenopausal women showed a significant decline in their sexual functioning (from healthy to dysfunctional).

Stability and Cross-Lag Effects of Sexual Functioning

In the path analytical model, we tested the stability (auto-regression) and the cross-lag effects of the six sexual functioning domains by simultaneously controlling for relationship dissatisfaction. The path analytical model fitted the data well ($\chi^2 =$

41.1; $df = 32$; $P = 0.13$; Comparative Fit Index (CFI) = 0.996; Tucker Lewis Index (TLI) = 0.975; root mean square error of approximation (RMSEA) = 0.028).

Table 2 provides the test results of the auto-correlations (i.e., the stability of each factor over time). The results show that in both groups of women, the level of each factor at T1 significantly predicted its level 4 years later (desire $\beta = 0.35$, $P < 0.001$; arousal $\beta = 0.64$, $P < 0.001$; orgasm $\beta = 0.51$, $P < 0.001$; lubrication $\beta = 0.48$, $P < 0.001$; pain $\beta = 0.33$, $P < 0.001$), indicating moderate, yet significant stability. No significant auto-correlations were found for sexual satisfaction.

Finally, we aimed to test whether the changes between the factors across time are dependent of each other (aim 3; see Table 2). For both pre- and postmenopausal women, the following cross-lag effects were found: changes in desire were predicted by the level of arousal at T1 ($\beta = 0.35$, $P < 0.015$); changes in arousal were predicted by orgasm ($\beta = 0.36$, $P < 0.039$); changes in orgasm were predicted by arousal ($\beta = 0.29$, $P < 0.025$); and changes in lubrication were predicted by desire ($\beta = 0.18$, $P < 0.015$). Changes in sexual satisfaction were predicted by desire ($\beta = 0.54$, $P < 0.011$) and pain ($\beta = 0.70$, $P < 0.034$) in postmenopausal, whereas such—or any—predictive effects for sexual satisfaction could not be observed in premenopausal women. While desire, arousal, and orgasm all had predictive effects on various domains across both groups, no such effects could be detected for lubrication or sexual satisfaction. Furthermore, pain only predicted sexual satisfaction in the postmenopausal group (Table 2). Results further showed no predictive effects of relationship dissatisfaction on any of the FSFI domains at either T1 or T2 (Figure 1).

Table 2 Direct effects (significant auto-correlations, significant cross-lag effects, and significant effects of the control variables) of the path analytical model

	Premenopausal women			Postmenopausal women		
	Estimate	s.e.	P	Estimate	s.e.	P
Auto-correlation						
Desire T1 → Desire T2	0.35	0.08	0.000	0.35	0.08	0.000
Arousal T1 → Arousal T2	0.64	0.19	0.001	0.64	0.19	0.001
Orgasm T1 → Orgasm T2	0.51	0.11	0.000	0.51	0.11	0.000
Lubrication T1 → Lubrication T2	0.48	0.09	0.000	0.48	0.09	0.000
Pain T1 → Pain T2	0.33	0.16	0.045	0.33	0.16	0.045
Sexual satisfaction T1 → Sexual satisfaction T2	0.40	0.22	0.080	0.00	0.24	0.997
Significant cross-lag effects						
Arousal T1 → Desire T2	0.35	0.10	0.015	0.35	0.10	0.015
Orgasm T1 → Arousal T2	0.36	0.17	0.039	0.36	0.17	0.039
Arousal T1 → Orgasm T2	0.29	0.13	0.025	0.29	0.13	0.025
Desire T1 → Lubrication T2	0.18	0.07	0.015	0.18	0.07	0.015
Desire T1 → Sexual satisfaction T2	n.s.			0.54	0.21	0.011
Pain T1 → Sexual satisfaction T2	n.s.			0.70	0.33	0.034
Control variable						
Relationship dissatisfaction → Desire T1	0.12	0.08	0.130	−0.03	0.13	0.981
Relationship dissatisfaction → Arousal T1	−0.02	0.17	0.902	−0.18	0.22	0.397
Relationship dissatisfaction → Orgasm T1	−0.07	0.11	0.537	−0.17	0.15	0.237
Relationship dissatisfaction → Lubrication T1	−0.03	0.09	0.726	−0.15	0.10	0.163
Relationship dissatisfaction → Pain T1	−0.03	0.18	0.802	−0.12	0.14	0.389
Relationship dissatisfaction → Sexual satisfaction T1	0.06	0.22	0.775	−0.31	0.30	0.300

Non-standardized results are depicted

n.s. = not significant; P = significant level; s.e. = standard error; T1 = measurement point 1; T2 = measurement point 2

Discussion

There is a paucity of longitudinal studies on women's sexual functioning investigating how the various domains predict each other over time. In the present study, we took advantage of data from two measurement points (4 years apart) to examine the remission and progression of sexual problems across all domains of sexual functioning in two groups of pre- and postmenopausal women and to test how these domains influence each other over time. To the best of our knowledge, this is the first longitudinal study exploring how the various domains influence each other over time.

Sexual Functioning over Time

In the present study, we examined how many women in the pre- and postmenopausal groups either showed no change in their sexual functioning, remitted from a sexual problem, or progressed from healthy into a sexual problem within a 4-year time span. According to the FSFI cutoff score of 26.55 to differentiate healthy women from women suffering from a sexual dysfunction, a considerably larger proportion of postmenopausal women reported a sexual problem (34.3%) compared with their premenopausal counterparts (14.49%). This supports our initial hypothesis stating that because of the disruptive effects of menopause-related biological changes on sexual

functioning, a larger proportion of postmenopausal women are expected to report a sexual problem [9]. Interestingly, however, the number of women developing a sexual problem over the 4-year assessment period was not significantly higher in post- compared with premenopausal women (23.2% vs. 22.2%). Around 7% of women in both groups even showed a remission from their sexual problem and therefore an improvement of their sexual health. These findings somewhat question the role of menopausal transition as a “global” and “enduring” risk factor for sexual problems. For clinical practice, it is important to note that improvement of a woman's sexuality is possible even at a later stage and despite biological impairments that may be present.

Because the FSFI does not offer cutoff scores for the individual domains, it is at this stage not possible to say whether the improvement in total sexual functioning is due to an improvement in any subdomain—especially the more physiologic ones—or whether it is the effect of increased sexual satisfaction that itself might translate to overall sexual functioning. It is well known that age does not represent a global risk factor for sexual dysfunction and that especially in older age, women tend to be more comfortable with their sexuality and find other ways to enjoy a healthy sex life. Once they might have come to terms with the initial decline in physiologic sexual functioning, these women might

develop a somewhat more positive and holistic understanding of sexuality.

Stability of the Domains over 4 Years

In terms of stability, all subdomains—with the exception of sexual satisfaction—significantly predicted themselves over time across both groups. The highest stability over the 4 years could be observed for arousal, orgasm, and lubrication, whereas desire and pain were less stable. Although the domains differed in the extent of their stability, these differences were relatively small. The high stability of arousal, orgasm, and for lubrication is somewhat surprising, given that the majority of women were peri-menopausal. Menopause-related hormonal and vaginal changes have been repeatedly shown to dampen sexual arousal and to affect women's lubrication and their ability to achieve orgasm [21]. Genital vasocongestion can be affected by lower estrogen levels during menopausal transition, as the vulvovaginal epithelium is rich in estrogen receptors, resulting in decreased vaginal secretion and vasoengorgement during arousal [18]. Similarly, reduced blood supply to the clitoris and vaginal atrophy can impair genital sensitivity, therefore leading to lower orgasm frequency [21]. Our results partly agree with previous reports from a longitudinal Australian study of 2,252 women aged 20 to 64 years, where lacking interest in sex showed the highest persistence/recurrence after 12 months (65%), closely followed by vaginal dryness complaints (60%) [22]. In contrast to the Australian study, less stability could be observed for desire in our study. Desire is the domain known to be generally more susceptible to environmental influences, such as interpersonal conflicts, stress, etc., which could explain the overall lower stability and greater variability over the 4-year period. Similarly, the prospective SWAN study conducted on 3,302 U.S. women aged 42 to 52 found a significant decrease in sexual desire as women progressed through menopause [7].

Surprisingly, sexual satisfaction at T1 did not predict sexual satisfaction at T2. In other words, sexual satisfaction seems to be much more variable over time than the more physiologic and affective domains of sexual responsiveness. Sexual satisfaction is not only closely linked to sexual functioning but also to relationship satisfaction, making it more vulnerable to impairments in both factors, therefore potentially explaining the higher variability of sexual satisfaction across the 4-year course [3].

How Do the Domains Affect the Change of Each Other?

The findings from our path analyses extend the previous literature by illustrating how changes across time between the domains are dependent of each other. An overall picture emerged in that three of the six domains predicted changes in four domains across both groups. More specifically, arousal at T1 predicted changes in desire and arousal, orgasm at T1 predicted changes in arousal over the 4 years, and desire at T1 predicted changes in lubrication—after controlling for the effects of all subdomains and relationship dissatisfaction. The fact that arousal, desire, and orgasm play such a large role for changes in sexual functioning has potential implications. Sexual desire is thought to be a motivational state that motivates us to engage in sexual activities. It has previously been argued that sexual desire may not be a distinct phase in the sexual response cycle but rather that it is present through all the different phases, i.e., arousal, orgasm, and even resolution [23]. Our results underline these theoretical suggestions by empirically proving that the subjective feelings of desire and arousal are the main motivational factors which effects extend to all the other aspects of the female sexual response cycle [24]. As such, this has also implications for clinical practice, where treatment approaches should focus more on development and maintenance of sexual motivation, hence, the increase of libido. Nowadays, a range of treatment approaches have shown to be efficient in increasing sexual desire (including different psychotherapeutic and pharmacologic approaches) and clinicians should consider focusing on the promotion of sexual desire even when other sexual problems (such as orgasmic difficulties) are presented as the main sexual complaint.

Of further note is that pain and desire were the sole predictors of sexual satisfaction in the postmenopausal group only. This result is somewhat unexpected but might be explained by desire having the strongest predictive effect on the majority of the domains, which all tap into sexual satisfaction. Lubrication though—the more physiological domain—did not show any predictive effects on any aspects of sexual functioning nor sexual satisfaction. This further strengthens the assumption that desire and arousal are the main players/motivators for women's sexual functioning and overall satisfaction.

The predictive effects of desire, arousal, and orgasm remained significant even after controlling

for relationship dissatisfaction. Our results tentatively suggest that levels of sexual functioning across all domains can be predicted by desire, arousal, and orgasm, whereby desire seems to be of particular importance in predicting not only future levels of sexual functioning but also overall sexual satisfaction. Epidemiologic studies have repeatedly shown the strong link between desire and arousal (e.g., high comorbidities), and recent modifications in the *Diagnostic Statistical Manual* 5th version (DSM-5) even suggest a conceptual overlap so that subsequently hypoactive desire dysfunction and arousal problems have been merged into a single syndrome called “sexual interest/arousal disorder” [3,25]. This is reflected in our findings, where desire and arousal were the only domains that simultaneously predicted each other after a 4 years’ period, offering further evidence for the intermixture of the two domains.

Limitations

Apart from the potential limitations already discussed, several others need to be addressed. First, we cannot exclude the possibility that our data are affected by reporting biases such as recall bias, which might have led to over- or under-matching of the reports, especially in terms of lifelong sexual functioning. However, path analyses were conducted on recent FSFI, which is unlikely to be affected by this specific bias. Second, our data are based on self-reports, which might be subject to personal biases. Third, the generalizability of our results may be limited, as a convenience sample of volunteers, instead of a complete random sample of the general population, was used. This is unlikely, as our twin cohort has already shown to be representative of the general population and to be similar to singletons for a wide range of common health and lifestyle factors [12–14]. Fourth, no information on sexual distress was available for T2 so that the role of sexual distress in determining long-term sexual functioning and satisfaction could not be explored but should be considered in future studies. Fifth, our response rate was relatively low (50% for T1 and 27.3% for T2) compared with other medical surveys but respectable compared with other sex surveys [26]. However, a low response rate does not automatically mean that the results are systematically biased. Comparison of socio-demographic information in T1 responders and non-responders suggested significant differences in years of education and marital status, with non-responders reporting slightly more years of education (10.6 vs. 10.2 years). Furthermore, non-

responders were significantly less often in a relationship (27% vs. 31%) or married (43% vs. 49%) compared with responders, suggesting that women who were not in a relationship at the time of the survey felt less capable to answer the questions because of a lack of or because of lower levels of sexual activities. Responders and non-responders in T2 were further compared in terms of their sexual functioning at T1. The only significant difference that could be detected was for recent desire, with T2 responders reporting slightly more sexual desire (FSFI score 3.4 vs. 3.2) compared with T2 non-responders. Overall, those few differences found between responders and non-responders do not support a systematic bias. In terms of the considerable amount of “dropouts” from T1 to T2, this can be explained by the fact that at T1, women were not informed about a possible follow-up. In summary, we believe that despite these caveats, these results offer an important insight and complement current research on women’s sexuality.

Conclusion

Overall, women’s sexual functioning proved to be moderately stable across 4 years, suggesting that there is considerable variation and hence, room for improvement of one’s sexual functioning supporting via a range of sex and cognitive behavioral treatment approaches. Our results further suggest that despite the potentially impairing effects of menopause and menopausal transition, sexual satisfaction and functioning in postmenopausal women can be improved, and sexual problems can show spontaneous remission. These findings somewhat question the role of menopausal transition as a “global” and “enduring” risk factor for sexual problems. For clinical practice, it is important to note that improvement of a woman’s sexuality is possible even at a later stage and despite possible biological impairments that may be present. Finally, the main predictors of changes in sexual functioning and sexual satisfaction were desire and arousal, highlighting their role as the main “players” in women’s sexual health.

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Conflict of Interest: A. Burri is an investigator, speaker, and advisory board member for Menarini.

Statement of Authorship

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