Journal of Affective Disorders 364 (2024) 132–138

Contents lists available at ScienceDirect

Journal of Affective Disorders

journal homepage: www.elsevier.com/locate/jad

Research paper

Association between severe premenstrual disorders and change of romantic relationship: A prospective cohort of 15,606 women in Sweden

Veronika Westermark [a,*], Yihui Yang [a], Elizabeth Bertone-Johnson [b,c], Emma Bränn [a], Marion Opatowski [a], Nancy Pedersen [d], Unnur A. Valdimarsdóttir [a,e,f], Donghao Lu [a,*]

[a] Unit of Integrative Epidemiology, Institute of Environmental Medicine, Karolinska Institutet, Stockholm, Sweden
[b] Department of Biostatistics and Epidemiology, School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, MA, USA
[c] Department of Health Promotion and Policy, School of Public Health and Health Sciences, University of Massachusetts Amherst, Amherst, MA, USA
[d] Department of Medical Epidemiology and Biostatistics, Karolinska Institutet, Stockholm, Sweden
[e] Department of Epidemiology, Harvard T.H. Chan School of Public Health, Boston, MA, USA
[f] Center of Public Health Sciences, Faculty of Medicine, University of Iceland, Reykjavik, Iceland

ARTICLE INFO

Keywords:
Premenstrual disorder
Premenstrual syndrome
Premenstrual dysphoric disorder
Relationship status

ABSTRACT

Background: Premenstrual disorders (PMDs) affect women's quality of life, yet the impact on romantic relationships remains unclear. This study aimed to examine the association between severe PMDs and relationship disruption and initiation.

Methods: We conducted a prospective cohort study of 15,606 women during 2009–2021 in Sweden. PMDs were assessed with the modified Premenstrual Symptom Screening Tool at baseline (one-time retrospective self-report), while relationship status was obtained from national population registers during follow-up. Poisson regression was employed to assess the risk of relationship change.

Results: At baseline (mean age 33.5 years), 1666 (10.6 %) women met the criteria for severe PMDs. All women were followed for 9.1 years on average for any change of relationship status. Among married/cohabiting women, PMDs were positively associated with relationship disruption (Incidence risk ratio, IRR =1.21, 95 % CI: 1.01–1.43, $p = 0.03$). A more pronounced association was suggested for premenstrual dysphoric disorder (IRR = 1.22, 95 % CI: 1.01–1.45, p = 0.03) than severe premenstrual syndrome (IRR = 1.01, 95 % CI: 0.43–1.96, $p = 0.98$) and among women without depression/anxiety (IRR = 1.21, 95 % CI: 1.00–1.47, $p < 0.05$) than among those with (IRR = 0.99, 95 % CI: 0.61–1.54 $p = 0.96$) and IRR = 1.01, 95 % CI: 0.57–1.72, $p = 0.97$). Among single women, a null association was found between PMDs and relationship initiation (IRR = 1.05, 95 % CI: 0.95–1.15, $p = 0.32$).

Limitations: PMDs were not assessed using prospective symptom charting.

Conclusions: Married/cohabiting women with probable severe PMDs have an increased risk of relationship disruption. PMDs were not associated with relationship initiation in single women. Healthcare professionals should recognize relationship challenges in women with severe PMDs, and they may require support to maintain healthy relationships.

1. Introduction

Premenstrual disorders (PMDs) are characterized by cyclic physiological, behavioral, and somatic symptoms that affect a large portion of women of reproductive age worldwide (Direkvand-Moghadam et al., 2014). The symptoms begin during the luteal phase and improve at the beginning of menses (O'Brien et al., 2011; Direkvand-Moghadam et al., 2014). PMDs primarily include premenstrual syndrome (PMS) and premenstrual dysphoric disorder (PMDD); in the latter, affective symptoms predominate and affect psychosocial function, including interpersonal relationships (Steiner et al., 2006). Moderate/severe PMS affects 20–40 % of women in reproductive age (Rapkin and Winer, 2009), while the estimated prevalence of PMDD is 1.6 %–8 % (Epperson et al., 2012; Reilly et al., 2024). The impairment caused by PMDD may reach a level of severity comparable to that of a major depressive disorder (Halbreich et al., 2003). Studies have shown that women with PMDD may

* Corresponding authors at: Institute of Environmental Medicine, Karolinska Institutet, Nobels väg 13, Stockholm 17177, Sweden.
E-mail addresses: veronika.westermark@stud.ki.se (V. Westermark), donghao.lu@ki.se (D. Lu).

https://doi.org/10.1016/j.jad.2024.08.032
Received 9 April 2024; Received in revised form 5 July 2024; Accepted 11 August 2024
Available online 13 August 2024

experience problems in social interactions (Hardy and Hardie, 2017) and relationship interference in the workplace (Heinemann et al., 2012). One could postulate that impairments in social functioning are not confined to working life but may also affect intimate partner relationships.

Research consistently shows that major depression leads to an increase in negative communication behaviors (Rehman et al., 2008), decreased marital satisfaction (Kronmüller et al., 2011), and a higher risk of marital disruption (Bulloch et al., 2009). Depression has also been linked with a reduced likelihood of initiating romantic relationships over time (Leach and Butterworth, 2020). For women with PMDs, common symptoms, such as mood swings, preferring to be alone, and intense irritability may contribute to regular conflicts with an intimate partner. However, limited data exist on the impact of PMDs on romantic relationships. Women with PMDD experience higher perceived stress and lower levels of social connectedness compared to controls (Petersen et al., 2016), and severe PMS symptoms adversely affect relationships with family members (Jaber et al., 2022). Moreover, two cross-sectional studies found a negative association between marital satisfaction and premenstrual symptoms (Coughlin, 1990; Winter et al., 1991). However, given the nature of cross-sectional data, it is unclear whether marital dissatisfaction is a consequence of PMDs or a stressor contributing to PMDs (Coughlin, 1990). Moreover, no studies have investigated whether the chronic and cyclic symptoms of PMDs lead to relationship disruption. It is also unknown whether PMDs may impact relationship initiation.

Understanding the potential influence of PMDs on romantic relationships may help couples make more informed decisions on how to navigate challenges and coping strategies to build and maintain healthy relationships. Because the psychosocial dysfunction caused by mild/moderate PMS is generally less intense (Firoozi et al., 2012), we hypothesized that women with severe PMS and PMDD may face challenges in initiating and maintaining romantic relationships compared to women without these conditions. Here, utilizing a large prospective cohort in Sweden with a mean follow-up of 9.1 years, we examined the association between severe PMDs and relationship change, including relationship disruption and relationship initiation.

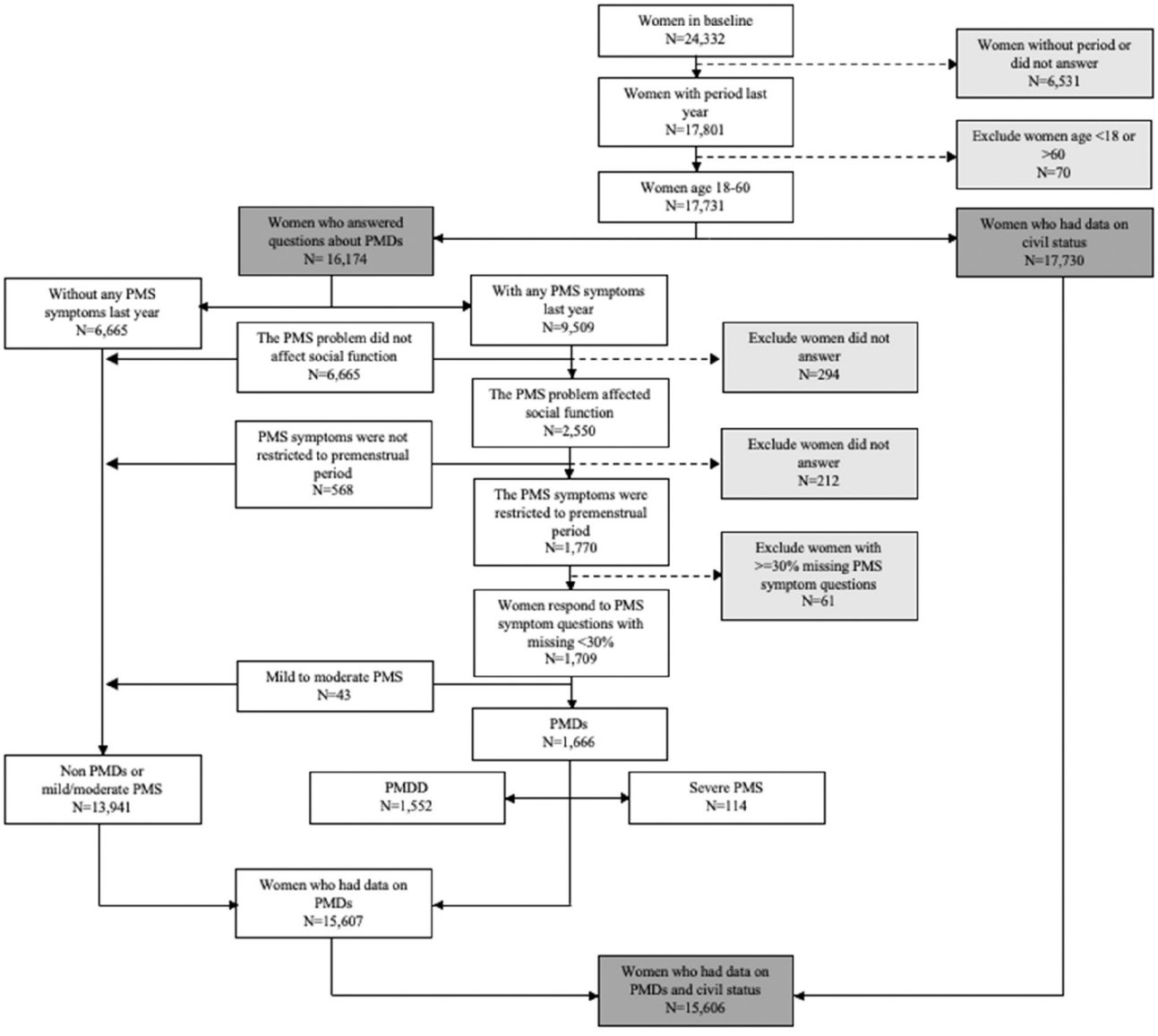

Fig. 1. Flow chart.

2. Materials and methods

2.1. Study design

The study leveraged data from LifeGene, a large prospective cohort study in Sweden with over 50,000 participants. Briefly, participants (index people) aged 18–45 were recruited through postal contact and spontaneous self-registration from 2009 to 2019. Upon registration, participants were given a detailed web-based questionnaire to collect information on their demographics (e.g. civil status), lifestyle, and physical and psychological well-being. Using a unique personal identification number, the female participants (n = 24,265) were linked to national registers for follow-up. Since 1990, the Longitudinal Integrated Database for Health Insurance and Labour Market Studies (LISA) completed an annual census of all residence over 16 to collect information on civil status and other demographics. The Total Population Register contains essential data on the Swedish population from 1968 and every year onwards, including information on death and emigration.

Participants were excluded from this analysis if they were younger than 18 or older than 60 years, did not have periods during the past year, or lacked information on PMDs or civil status at baseline (Fig. 1). Our prospective cohort study included 15,606 women. All individuals were followed from baseline until the first occurrence of relationship change, emigration, death, or December 31st, 2021, whichever came first.

Electronic consent was obtained from all participants upon online registration and written consent was obtained from those registering at the LifeGene test center. Some participants may have experienced discomfort when disclosing highly personal information about their mental and emotional state and its impact on daily life. Participants could withdraw participation at any time without further explanation and consequently have their personal information removed. Relationship status was obtained from population registers without recontacting the participants. The study was approved by the Swedish Ethical Review Authority (2021–02775).

2.2. Assessment of premenstrual disorders

PMDs were assessed at baseline by a modified version of the Premenstrual Symptom Screening Tool (PSST). The PSST is a retrospective screening tool designed to identify women who suffer from severe PMS/PMDD (Henz et al., 2018). It encompasses 19 questions regarding symptoms and symptom interference with relationships and daily activities, incorporating a severity-based rating scale (Hall and Steiner, 2015), and aligns with the Diagnostic and Statistical Manual of Mental Disorders, diagnostic criteria for PMDD (Hall and Steiner, 2015).

The questionnaire was modified to start with three screening questions: 1) “During most menstruation cycles during the past year, have you experienced mood changes and/or physical symptoms during the week before menstruation, commonly known as PMS?”; 2) “Have your premenstrual symptoms been so severe that they have affected your relationships with others or your ability to perform work or other activities?” Upon ‘yes’ to both questions, participants were prompted with 3) “Are you absolutely certain that the symptoms are limited to the premenstrual period, meaning that you are always completely symptom-free approximately a week after menstruation begins?” Because of these screening questions, PMDs identified in our study were primarily PMDD and severe PMS.

Participants endorsing all three screening questions were provided a list of 15 physical and affective symptoms (DSM-5., 2013) to rate the severity of each symptom from 1 (none) to 4 (severe). If a symptom was rated as moderate or severe, the participant was prompted with a follow-up question to specify whether this symptom affected psychosocial function.

An individual’s mean symptom severity was used to impute missing symptom scores if <30 % of symptoms were missing. The imputation was performed for 250 (<2 %) participants. Using the criteria established by the PSST, participants were classified as having severe PMDs if they had: (1) ≥1 out of 4 affective symptoms rated as moderate to severe; (2) ≥4 other symptoms rated as moderate to severe; and (3) ≥1 symptom moderately to severely impacting relationships or social activities. Participants were further classified as having PMDD if they had: (1) ≥1 out of 4 affective symptoms rated as severe; and (2) ≥1 symptom severely impacting relationships or social activities.

2.3. Assessment of relationship status and change

Relationship status was obtained from the LISA using a variable named ‘family status’. Using this variable, we categorized relationship status as married or registered partnership (note: partnerships could be legally registered in Sweden until 2009), cohabitating, or single. Married or registered partnerships include both opposite- and same-sex marriages. In LISA, cohabiting is defined as two adults of opposite sex who are not related, differ in age by <15 years, and are registered to the same residential address. In LISA, relationship status is updated annually on December 31st.

We followed individuals who were married or cohabiting at baseline for the first occurrence of relationship disruption, i.e. status change from married to single or cohabiting, or from cohabiting to single. We considered a change from being married to cohabitation as an event assuming that this change involved a new partner and, thus, represented a disruption from the previous relationship. We followed individuals who were single at baseline for the first record of starting a relationship, i.e., from single to married or cohabitation.

2.4. Covariates

Information on demographics such as age, income, and educational level was collected from LISA, and country of birth from the Total Population Register. Data on alcohol consumption, experience of childhood abuse, and height and weight (for calculation of body mass index) were collected through the baseline questionnaire. Parity and history of depression/anxiety were obtained from registers (Supplementary Methods). Categorical covariates were classified into levels as shown in Table 1.

2.5. Statistical analysis

To compare characteristics between women with and without PMDs at baseline, we used t-test for continuous variables, which tests whether the population mean is equal between two groups, and $\chi 2$ test for categorical variables, which tests whether the distribution of a variable is equal between two groups.

To estimate the absolute risk, we calculated incidence rate in women with and without severe PMDs separately. To account for the different follow-up lengths between individuals, we employed Poisson regression to estimate the Incidence risk ratio (IRR) and 95 % confidence intervals (CIs) for relative risk of changes in relationship status. Poisson regression is a generalized linear model which can regress event rate in time-to-event data. We built 3 models. Model 1 was a crude model. Model 2 was adjusted for demographics at baseline, including age, income, education, and country of birth. Model 3 was additionally adjusted for potential confounders, including alcohol consumption, parity, and childhood abuse.

To shed light on PMD subtypes, we examined the associations for PMDD and severe PMS separately. Moreover, depression and anxiety are commonly comorbid with PMDs (Hsiao et al., 2004) and may lead to a higher risk of marital disruption (Rehman et al., 2008; Bulloch et al., 2009; Kronmüller et al., 2011; Mojtabai et al., 2017). Therefore, we performed stratified analysis by depression/anxiety to assess potential risk modification. In addition, we conducted a stratified analysis by age group as relationship status changes over age. We also performed a

Table 1
Baseline characteristics of women with and without premenstrual disorders, N (%) or mean ± SD.

	No PMDs	PMDs	P value
Total number	13,940	1666	
	mean ± SD	mean ± SD	
Age at survey, year	32.3 ± 8.5	33.5 ± 7.9	<0.05
	N (%)	N (%)	
Baseline relationship status			
Married	3191 (22.8)	408 (24.4)	0.06
Cohabiting	1215 (8.7)	164 (9.8)	
Single	9534 (68.3)	1094 (65.6)	
Income			
Q1	3387 (24.2)	447 (26.8)	<0.05
Q2	3463 (24.8)	433 (25.9)	
Q3	3482 (24.9)	407 (24.4)	
Q4	3608 (25.8)	379 (22.7)	
Educational level			
Nine-year primary school	687 (4.9)	70 (4.2)	0.11
Gymnasium	3596 (25.7)	463 (27.7)	
University	9657 (69.2)	1133 (68.0)	
Country of birth			
Sweden	12,551 (90.0)	1442 (86.5)	<0.05
Other	1389 (9.9)	224 (13.4)	
Alcohol drinking			
Never	460 (3.2)	55 (3.3)	0.94
Weekly	5906 (42.3)	718 (43.0)	
Monthly	7336 (52.6)	864 (51.8)	
Unknown	238 (1.7)	29 (1.7)	
Body mass index (kg/m^2)			
<19	457 (3.2)	30 (1.8)	<0.05
19–24	9896 (70.9)	1162 (69.7)	
25–29	2217 (15.9)	296 (17.7)	
>30	424 (3.0)	50 (3.0)	
Unknown	946 (6.7)	128 (7.6)	
Parity			
0	9126 (65.4)	994 (59.6)	<0.05
1–2	3953 (28.3)	540 (32.4)	
3+	861 (6.1)	132 (7.9)	
Childhood abuse[a]			
No	8927 (64.0)	892 (53.5)	<0.05
Yes	5013 (35.9)	774 (46.4)	
Depression			
No	12,686 (91.0)	1440 (86.4)	<0.05
Yes	1254 (8.9)	226 (13.5)	
Anxiety			
No	12,907 (92.5)	1457 (87.4)	<0.05
Yes	1033 (7.4)	209 (12.5)	

BMI, body mass index; PMD, severe premenstrual disorder; N, number of events; SD, standard deviation.

[a] Because of non-events, participants with unknown status of childhood abuse are coded as no.

sensitivity analysis by additionally controlling for body mass index (BMI, kg/m^2). High BMI is a risk factor for PMDs (Bertone-Johnson et al., 2010; Lu et al., 2022), yet, to our knowledge, it has not been associated with relationship change. To alleviate the concern of non-random missing, we conducted a complete-case analysis by restricting to women who responded to all PMD symptom items.

The data were prepared and analyzed in R (version: 4.2.2). *P* value <0.05 was considered statistical significance.

3. Results

3.1. Baseline characteristics

Among the participants, 1666 (10.6 %) met the criteria for severe PMDs (1552 PMDD and 114 severe PMS). At baseline, the mean age of women with PMDs was 1.2 years older than women without PMDs (33.5 vs. 32.3 years, $p < 0.05$; Table 1). Women with PMDs also had a slightly increased probability of being either married or cohabiting, while showing decreased likelihood of being single. Compared to women without severe PMDs, women with severe PMDs were more likely to be born abroad, have a higher BMI and parity, have experienced childhood abuse, and have a history of depression/anxiety.

3.2. PMDs and relationship change

During a mean follow-up of 9.1 years, among those married/cohabitating at baseline, we observed 150 events of relationship disruption among severe PMD and 955 events among women without severe PMD. After controlling for demographics and potential confounders, severe PMDs were associated with an increased risk of relationship disruption (fully-adjusted IRR =1.21, 95 % CI: 1.01–1.43, $p = 0.03$; Table 2). Specifically, an increased risk of relationship disruption was indicated for both married women with PMDs and cohabitating women with PMDs, although the associations were not statistically significant. On the other hand, single women with severe PMDs did not appear to have a lower chance of entering a relationship (IRR = 1.05, 95 % CI: 0.95–1.15, $p = 0.32$; Table 2) than women without such conditions.

3.3. Additional analyses

Given the findings in the primary analysis, we focused on the association between severe PMDs and the risk of relationship disruption for married or cohabiting women in the subsequent analyses. Compared to women without severe PMDs, a higher risk of relationship disruption was observed among women with PMDD (IRR = 1.22, 95 % CI: 1.01–1.45, p = 0.03; Table 3) but not among women with severe PMS (IRR = 1.01, 95 % CI: 0.43–1.96, $p = 0.98$; Table 3). In stratified analysis, the risk of relationship disruption appeared more pronounced among women without a history of depression (IRR = 1.22, 95 % CI: 1.00–1.47, $p = 0.01$; Table 4) or anxiety (IRR = 1.21, 95 % CI: 1.00–1.45, $p = 0.04$; Table 4) than women with depression or anxiety. In addition, a stronger association was suggested for women aged 30–40 years at baseline (IRR = 1.31, 95 % CI: 1.02–1.65, $p = 0.02$; Table S1, Supplementary material) compared to younger and older women. In a sensitivity analysis, additional adjustment for BMI did not alter the association between PMDs and relationship disruption (Table S2, Supplementary material). Finally, in a complete-case analysis of women who responded to all PMD questions, the associations with relationship disruption and initiation were materially unchanged.

4. Discussion

To the best of our knowledge, the present study is the first prospective cohort study to suggest a positive association between severe PMDs and the risk of relationship disruption and is not explained by comorbid depression/anxiety. The association appears more pronounced for PMDD than severe PMS, although with overlapping CIs, and is not explained by comorbid depression/anxiety. Reassuringly, we found a null association between severe PMDs and a change from being single to report a relationship. Together, our data suggested that women with severe PMDs have difficulties in maintaining rather than initiating a romantic relationship.

4.1. Relationship disruption

It is well-documented that depression can impact relationship stability (Rehman et al., 2008; Kronmüller et al., 2011; Bulloch et al., 2009). A large population-based study from Canada found that depression is associated with a doubled risk of relationship disruption, regardless of sex (Bulloch et al., 2009). A prospective study from Germany following 50 couples for 10 years showed that the quality of marital relationships was significantly worse for patients with major depression (Kronmüller et al., 2011). In addition to depression, other psychiatric disorders such as anxiety and bipolar disorder have also been linked to a higher risk of divorce (Mojtabai et al., 2017). However, we

Table 2
Association of premenstrual disorders with risk of relationship change, IRR (95 % CI);

	PYs	Events N (IR)	Model 1 IRR (95 % CI) [a]	Model 2 IRR (95 % CI) [b]	Model 3 IRR (95 % CI) [c]	Model 3 *p*-value
From married/cohabiting at baseline to relationship disruption						
No PMDs	35,785.0	955 (26.6)	Ref.	Ref.	Ref.	
PMDs	4404.5	150 (34.0)	1.28 (1.07–1.51)*	1.23 (1.03–1.46)*	1.21 (1.01–1.43)*	0.03
Married						
No PMDs	27,829.9	671 (24.1)	Ref.	Ref.	Ref.	
PMDs	3382.2	103 (30.4)	1.26 (1.02–1.55)*	1.22 (0.98–1.49)	1.17 (0.94–1.44)	0.14
Cohabiting						
No PMDs	7955.1	284 (35.7)	Ref.	Ref.	Ref.	
PMDs	1022.3	47 (45.9)	1.29 (0.93–1.73)	1.24 (0.90–1.67)	1.33 (0.95–1.80)	0.08
From single at baseline to entering a relationship						
No PMDs	52,455.5	4131 (78.7)	Ref.	Ref.	Ref.	
PMDs	6124.2	466 (76.0)	0.97 (0.88–1.06)	1.04 (0.94–1.14)	1.05 (0.95–1.15)	0.32

CI, confidence interval; IR, incidence rate per 1000 person-years; N, number of events; IRR, incidence risk ratio; PMD, severe premenstrual disorder; PYs, person years; Ref., reference.
[a] Crude model.
[b] The estimates were adjusted for age, category of income, education and country of birth.
[c] The estimates were additionally adjusted for alcohol consumption, parity, and childhood abuse.
* $P < 0.05$.

Table 3
Associations of PMDD and severe PMS with risk of relationship change among women married/cohabiting at baseline, IRR (95 % CI).

	PYs	Events, N (IR)	IRR (95 % CI) [a]	p-value
No PMDs	35,785.0	955 (26.6)	Ref.	
PMDD	4122.6	142 (34.4)	1.22 (1.01–1.45)*	0.03
Severe PMS	281.8	8 (28.3)	1.01 (0.43–1.96)	0.98

CI, confidence interval; IR, incidence rate per 1000 person-years; N, number of events; PMD, premenstrual disorder; PMS, premenstrual syndrome; PMDD, premenstrual dysphoric disorder; PYs, person years; IRR, incidence risk ratio; Ref., reference.
[a] The estimates were adjusted for age, category of income, education, country of birth, alcohol drinking, parity and childhood abuse.
* $P < 0.05$.

Table 4
Association of premenstrual disorders with risk of relationship disruption among women married/cohabiting at baseline, by comorbid depression/anxiety, IRR (95 % CI).

	PYs	Events, N (IR)	IRR (95 % CI) [a]	p-value
By depression [a]				
No				
No PMDs	33,277.3	856 (25.7)	Ref.	
PMDs	3846.2	127 (33.0)	1.22 (1.00–1.47)*	0.01
Yes				
No PMDs	2507.7	99 (39.4)	Ref.	
PMDs	558.2	23 (41.1)	0.99 (0.61–1.54)	0.96
By anxiety [a]				
No				
No PMDs	33,880.2	888 (26.2)	Ref.	
PMDs	3968.9	130 (32.7)	1.21 (1.00–1.45)*	0.04
Yes				
No PMDs	1904.7	67 (35.1)	Ref.	
PMDs	435.6	20 (45.9)	1.01 (0.57–1.72)	0.97

CI, confidence interval; IR, incidence rate per 1000 person-years; N, number of events; PMD, severe premenstrual disorder; PYs, person years; IRR, incidence risk ratio; Ref., reference.
[a] The estimates were adjusted for age, category of income, education, country of birth, alcohol drinking, parity and childhood abuse.
* $P < 0.05$.

are not aware of any reports on PMDs and relationship disruption. Our study, which benefits from a validated assessment of PMDs and prospectively collected data on romantic relationships, is the first to illustrate that women with severe PMDs have an increased risk of experiencing relationship disruption.

The association appeared somewhat more pronounced among cohabiting compared to married women, likely due to a variety of factors related to differences in the relationships. Swedish government data indicate that almost half of first-time married couples have cohabited for over five years before marriage (SCB, 2022a). In Sweden, 51 % of cohabiting couples separate within a decade (SCB, 2022b), whereas married couples who divorced in 2022 had an average marriage length of 12.2 years (SCB, 2023). These data suggest that married couples are in more stable relationships compared to cohabiting individuals, which may explain the higher risk of relationship disruption observed in cohabiting women.

Modern theories propose that an abnormal sensitivity to normal cyclical changes in hormones (Eisenlohr-Moul, 2019) is a key factor in the occurrence and severity of affective symptoms in PMDs. This suggests a potential biological mechanism contributing to the observed difficulties in relationship maintenance. The core symptoms of PMDs, including irritability, depression, anxiety, and impulsivity (Halbreich, 2003), combined with the cyclical nature of PMDs (O'Brien et al., 2011), may introduce recurring stress into the relationship, further supporting the noted associations in our study. It is also plausible that psychiatric comorbidities (e.g., depression and anxiety), which are common among women with PMDs (Kim et al., 2004), may explain our findings. These disorders share symptomatology such as depressed mood, decreased interest, and irritability (DSM-5., 2013). The significance of these symptoms may further worsen the relationship. However, we observed a pronounced association among women without depression/anxiety, indicating that the increased risk of relationship disruption cannot be entirely explained by comorbid depression/anxiety. Alternatively, a bidirectionality between PMDs and relationship issues may underlie the noted link as high perceived stress including marital distress may result in moderate/severe premenstrual symptoms (Coughlin, 1990; Gollenberg et al., 2010). On the other hand, it has been reported that women with PMS endorsed higher levels of dissatisfaction in their marriages, because of feelings of powerlessness, low self-esteem, and an inability to control and recognize themselves during the premenstrual period (Winter et al., 1991). It is therefore possible that marital distress and PMD symptoms are intertwined and catalyze relationship issues leading to a relationship disruption. A supportive spouse may help mitigate premenstrual symptoms (Morowatisharifabad et al., 2014; Rezaee et al., 2015; Frank et al., 1993; Reberte et al., 2014) and their role is an important aspect to be considered in a clinical setting when treating women with PMDs.

4.2. Relationship initiation

An Australian study of young adults aged 20–24 (45 % female) found that depression was associated with lower odds of entering a romantic relationship during a 12-year follow-up period (Leach and Butterworth, 2020). Given the high prevalence of depression among women with PMDs, one might anticipate an inverse association with relationship initiation, which can be hampered by symptoms such as decreased interest and fatigue. However, for some, the depressive symptoms may fluctuate across the menstrual cycle – worsening before menses but mitigating in follicular phase (Kuehner and Nayman, 2021). Interestingly, our analysis found no association between severe PMDs and the initiation of a romantic relationship. It is not implausible that women with PMDs make significant progress on relationship initiation during the symptom-free period yet control or avoid social interactions when experiencing symptoms. However, more research is required to confirm our results.

4.3. Strengths and limitations

The major strengths of our study are the large sample size, prospectively collected data, and complete follow-up through register linkage. However, the study has some limitations. First, we did not assess severe PMDs using prospective symptom charting, which is difficult to implement in large population-based cohorts. The diagnostic criteria for PMDD in DMS-5 require symptoms to be confirmed by prospective daily ratings over a minimum of 2 symptomatic cycle (DSM-5., 2013). Therefore, retrospective-based diagnostics using screening tools like the PSST, are considered provisional (DSM-5., 2013). A recent systematic review and meta-analysis investigating the point prevalence of PMDD found a higher pooled prevalence (7.7 %) for provisional diagnoses compared to confirmed diagnoses (3.2 %) (Reilly et al., 2024). Consequently, the number of PMDD and severe PMS in our study may be overestimated, with the diagnosis being probable rather than confirmed. Although PSST is a validated screening tool that aligns with the clinical diagnostic criteria for PMDs and provides for evaluation of both the severity and impact of premenstrual symptoms (O'Brien et al., 2011; Hall and Steiner, 2015; Steiner et al., 2003), future studies based on prospectively confirmed PMDs are needed. Moreover, the modified version of PSST exclusively screens for severe PMS and PMDD, namely classifying mild/moderate PMS into the reference group. This could account for the lower prevalence of PMDs in our study (10.6 %) compared to the general population (Pilver et al., 2011; Hantsoo and Epperson, 2015; Morowatisharifabad et al., 2014; Direkvand-Moghadam et al., 2014). Such misclassification is likely non-differential in terms of the outcome and may have weakened the observed association. On the other hand, to qualify severe PMDs, the symptoms need to have a significant impact on the woman's psychosocial functioning, including romantic relationships. Such impact was screened during the assessment of premenstrual symptoms at baseline, whereas it focused on the temporary influence and was not specific to romantic relationships. Although some relationships might have been already drained at baseline, it is less likely to explain all relationship changes observed over a mean follow-up of 9.1 years. Second, we only have annual census data on relationship status. Multiple changes within a year were not captured, likely leading to underreporting of relationship changes. However, such misclassification is also likely non-differential between women with and without PMDs. In particular, cohabitation may be subject to misclassification, as it is defined based on registered postal addresses with the assumption that opposite-sex individuals live together due to a romantic relationship. This could potentially result in misclassification of individuals living together for reasons other than romantic relationships. Nonetheless, such misclassification appears to be infrequent, with data suggesting that only 6.3 % of women aged 25–39 cohabit with individuals who are not their partner, parent, or child (SCB, 2019). Additionally, we were unable to capture non-heterosexual cohabiting relationships. Although our study showed significant associations with relationship disruption, the estimates are limited by statistical power. Given the wide confidence interval, future studies with larger sample sizes are needed to improve the statistical estimation. Third, although we have adjusted for several known confounders, we cannot rule out residual confounding by stressful life events and other factors (Coughlin, 1990). Compared to the general Swedish population, LifeGene participants are more likely to be younger and have obtained a higher education level (Rissanen, 2022). However, such selection has been accounted for in the analysis. Last, Sweden/Nordic countries have high cohabitation and divorce rates in contrast with rates in Eastern/Southern Europe (Eurofound., 2019). Our findings may not be generalized to populations with different cultures. Taken together, future studies using prospective symptom charting to verify PMDs and timely assessment of multiple relationship changes during follow-up may help minimize misclassification. Moreover, future studies exploring non-heterosexual relationships and examining the impact of PMDs in diverse cultural contexts could enhance the understanding of PMDs and relationship dynamics.

5. Conclusions

Our findings based on a prospective cohort with an average follow-up of 9.1 years suggest that married or cohabiting women with probable severe PMDs have an increased risk of relationship disruption, whereas single women with probable severe PMDs do not differ in their rate of relationship initiation compared to women without PMDs. Healthcare providers and social professionals may explore and enquire about how premenstrual symptoms influence the patient's psychosocial function, including romantic relationships. Partnered women with severe PMDs may require more substantial professional support than currently recognized and their partners and families may also benefit from additional assistance, such as couples counseling. Enhancing our understanding of how PMDs affect many aspects of women's lives may lead to greater screening for these "invisible" conditions and may encourage providers to take a holistic approach by tailoring care plans according to individual patient needs.

Funding

The work is supported by the scholarship from the China Scholarship Council (No. 202106100010 to Dr. Yang), grant 2020–01003 and from the Swedish Research Council (Vetenskapsrådet) (to Dr. Lu), grant 2020–00971 and 2023–00399 from the Swedish Research Council for Health, Working Life, and Welfare (FORTE) (to Dr. Lu).

Role of the funder

The funders had no role in the design and performance of the study; preparation or review of the manuscript; or decision to submit the manuscript.

CRediT authorship contribution statement

Veronika Westermark: Writing – original draft, Methodology, Formal analysis. **Yihui Yang:** Writing – review & editing, Supervision, Methodology, Funding acquisition, Formal analysis. **Elizabeth Bertone-Johnson:** Writing – review & editing. **Emma Bränn:** Writing – review & editing, Data curation. **Marion Opatowski:** Writing – review & editing, Data curation. **Nancy Pedersen:** Writing – review & editing, Project administration. **Unnur A. Valdimarsdóttir:** Writing – review & editing, Conceptualization. **Donghao Lu:** Writing – review & editing, Supervision, Project administration, Methodology, Funding acquisition, Data curation, Conceptualization.

Declaration of competing interest

None reported

Acknowledgments

We thank the participants of the LifeGene study.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jad.2024.08.032.

References

Bertone-Johnson, E.R., Hankinson, S.E., Willett, W.C., Johnson, S.R., Manson, J.E., 2010. Adiposity and the development of premenstrual syndrome. J Womens Health (Larchmt) 19, 1955–1962.
Bulloch, A.G., Williams, J.V., Lavorato, D.H., Patten, S.B., 2009. The relationship between major depression and marital disruption is bidirectional. Depress. Anxiety 26, 1172–1177.
Coughlin, P.C., 1990. Premenstrual syndrome: how marital satisfaction and role choice affect symptom severity. Social work (New York) 35, 351–355.
Direkvand-Moghadam, S.K., D., A., Sattar, K., 2014. Epidemiology of premenstrual syndrome (PMS)-a systematic review and Meta-analysis study. J. Clin. Diagn. Res. 8, 106–109.
DSM-5, 2013. Diagnostic and Statistical Manual of Mental Disorders, Fifth edition. American Psychiatric Association, Arlington, VA.
Eisenlohr-Moul, T., 2019. Premenstrual disorders: a primer and research agenda for psychologists. Clin. Psychol. 72, 5–17.
Epperson, C.N., Steiner, M., Hartlage, S.A., Eriksson, E., Schmidt, P.J., Jones, I., Yonkers, K.A., 2012. Premenstrual dysphoric disorder: evidence for a new category for DSM-5. Am. J. Psychiatry 169, 465–475.
Eurofound, 2019. Household Composition and Well-Being. Publication Office of the European Union, Luxembourg.
Firoozi, R., Kafi, M., Salehi, I., Shirmohammadi, M., 2012. The relationship between severity of premenstrual syndrome and psychiatric symptoms. Iran. J. Psychiatry 7, 36–40.
Frank, B., Dixon, D.N., Grosz, H.J., 1993. Conjoint monitoring of symptoms of premenstrual syndrome: impact on marital satisfaction. J. Couns. Psychol. 40, 109–114.
Gollenberg, A.L., Hediger, M.L., Mumford, S.L., Whitcomb, B.W., Hovey, K.M., Wactawski-Wende, J., Schisterman, E.F., 2010. Perceived stress and severity of perimenstrual symptoms: the BioCycle study. J Womens Health (Larchmt) 19, 959–967.
Halbreich, U., 2003. The etiology, biology, and evolving pathology of premenstrual syndromes. Psychoneuroendocrinology 28 (Suppl. 3), 55–99.
Halbreich, U., Borenstein, J., Pearlstein, T., Kahn, L.S., 2003. The prevalence, impairment, impact, and burden of premenstrual dysphoric disorder (PMS/PMDD). Psychoneuroendocrinology 28 (Suppl. 3), 1–23.
Hall, E., Steiner, M., 2015. Psychiatric symptoms and disorders associated with reproductive cyclicity in women: advances in screening tools. Womens Health (Lond) 11, 397–415.
Hantsoo, L., Epperson, C.N., 2015. Premenstrual dysphoric disorder: epidemiology and treatment. Curr. Psychiatry Rep. 17, 87.
Hardy, C., Hardie, J., 2017. Exploring premenstrual dysphoric disorder (PMDD) in the work context: a qualitative study. J. Psychosom. Obstet. Gynaecol. 38, 292–300.
Heinemann, L.A., Minh, T.D., Heinemann, K., Lindemann, M., Filonenko, A., 2012. Intercountry assessment of the impact of severe premenstrual disorders on work and daily activities. Health Care Women Int. 33, 109–124.
Henz, A., Ferreira, C.F., Oderich, C.L., Gallon, C.W., Castro, J.R.S., Conzatti, M., Fleck, M. P.A., Wender, M.C.O., 2018. Premenstrual syndrome diagnosis: a comparative study between the daily record of severity of problems (DRSP) and the premenstrual symptoms screening tool (PSST). Rev. Bras. Ginecol. Obstet. 40, 20–25.
Hsiao, M.C., Hsiao, C.C., Liu, C.Y., 2004. Premenstrual symptoms and premenstrual exacerbation in patients with psychiatric disorders. Psychiatry Clin. Neurosci. 58, 186–190.
Jaber, R.M., Alghzawi, A.O., Salameh, H.H., 2022. Premenstrual syndrome: consultation sources and the impact on women's quality of life. Afr. Health Sci. 22, 80–87.
Kim, D.R., Gyulai, L., Freeman, E.W., Morrison, M.F., Baldassano, C., Dubé, B., 2004. Premenstrual dysphoric disorder and psychiatric co-morbidity. Arch. Womens Ment. Health 7, 37–47.
Kronmüller, K.T., Backenstrass, M., Victor, D., Postelnicu, I., Schenkenbach, C., Joest, K., Fiedler, P., Mundt, C., 2011. Quality of marital relationship and depression: results of a 10-year prospective follow-up study. J. Affect. Disord. 128, 64–71.
Kuehner, C., Nayman, S., 2021. Premenstrual exacerbations of mood disorders: findings and knowledge gaps. Curr. Psychiatry Rep. 23, 78.
Leach, L.S., Butterworth, P., 2020. Depression and anxiety in early adulthood: consequences for finding a partner, and relationship support and conflict. Epidemiol. Psychiatr. Sci. 29, e141.
Lu, D., Aleknaviciute, J., Kamperman, A.M., Tamimi, R.M., Ludvigsson, J.F., Valdimarsdóttir, U.A., Bertone-Johnson, E.R., 2022. Association between childhood body size and premenstrual disorders in young adulthood. JAMA Netw. Open 5, e221256.
Mojtabai, R., Stuart, E.A., Hwang, I., Eaton, W.W., Sampson, N., Kessler, R.C., 2017. Long-term effects of mental disorders on marital outcomes in the National Comorbidity Survey ten-year follow-up. Soc. Psychiatry Psychiatr. Epidemiol. 52, 1217–1226.
Morowatisharifabad, M.A., Karimiankakolaki, Z., Bokaie, M., Fallahzadeh, H., Gerayllo, S., 2014. The effects of training married men about premenstrual syndrome by pamphlets and short messages on marital satisfaction. Health Educ. Res. 29, 1005–1014.
O'Brien, P.M., Bäckström, T., Brown, C., Dennerstein, L., Endicott, J., Epperson, C.N., Eriksson, E., Freeman, E., Halbreich, U., Ismail, K.M., Panay, N., Pearlstein, T., Rapkin, A., Reid, R., Schmidt, P., Steiner, M., Studd, J., Yonkers, K., 2011. Towards a consensus on diagnostic criteria, measurement and trial design of the premenstrual disorders: the ISPMD Montreal consensus. Arch. Womens Ment. Health 14, 13–21.
Petersen, N., London, E.D., Liang, L., Ghahremani, D.G., Gerards, R., Goldman, L., Rapkin, A.J., 2016. Emotion regulation in women with premenstrual dysphoric disorder. Arch. Womens Ment. Health 19, 891–898.
Pilver, C.E., Kasl, S., Desai, R., Levy, B.R., 2011. Health advantage for black women: patterns in pre-menstrual dysphoric disorder. Psychol. Med. 41, 1741–1750.
Rapkin, A.J., Winer, S.A., 2009. Premenstrual syndrome and premenstrual dysphoric disorder: quality of life and burden of illness. Expert Rev. Pharmacoecon. Outcomes Res. 9, 157–170.
Reberte, L.M., de Andrade, J.H., Hoga, L.A., Rudge, T., Rodolpho, J.R., 2014. Men's perceptions and attitudes toward the partner with premenstrual syndrome. Am. J. Mens Health 8, 137–147.
Rehman, U.S., Gollan, J., Mortimer, A.R., 2008. The marital context of depression: research, limitations, and new directions. Clin. Psychol. Rev. 28, 179–198.
Reilly, T.J., Patel, S., Unachukwu, I.C., Knox, C.L., Wilson, C.A., Craig, M.C., Schmalenberger, K.M., Eisenlohr-Moul, T.A., Cullen, A.E., 2024. The prevalence of premenstrual dysphoric disorder: systematic review and meta-analysis. J. Affect. Disord. 349, 534–540.
Rezaee, H., Mahamed, F., Amidi Mazaheri, M., 2015. Does spousal support can decrease Women's premenstrual syndrome symptoms? Glob J Health Sci 8, 19–26.
Rissanen, R., 2022. A snapshot of an eCohort: a comparison of the LifeGene population at baseline with the Swedish general population. Scand. J. Public Health 50, 930–934.
SCB, 2019. Statistics Sweden, living alone, with a partner or with friends? Findings from the register on households 1, 35.
SCB, 2022a. Nygifta har ofta bott ihop lång tid före bröllopet. Statistics Sweden. www.scb.se.
SCB, S.S., 2022b. Vartannat sambopar bor fortfarande ihop efter 10 år. Statistics Sweden. www.scb.se.
SCB, 2023. Skilsmässor i Sverige. Statistics Sweden. www.scb.se.
Steiner, M., Macdougall, M., Brown, E., 2003. The premenstrual symptoms screening tool (PSST) for clinicians. Arch. Womens Ment. Health 6, 203–209.
Steiner, M., Pearlstein, T., Cohen, L.S., Endicott, J., Kornstein, S.G., Roberts, C., Roberts, D.L., Yonkers, K., 2006. Expert guidelines for the treatment of severe PMS, PMDD, and comorbidities: the role of SSRIs. J Womens Health (Larchmt) 15, 57–69.
Winter, E.J., Ashton, D.J., Moore, D.L., 1991. Dispelling myths: a study of PMS and relationship satisfaction. Nurse Pract. 16, 34, 37–40, 45.