No Menstrual Cyclicity in Mood and Interpersonal Behaviour in Nine Women with Self-Reported PMS

Short title: Mood and Interpersonal Behaviour in Self-Reported PMS

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Keywords

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Abstract

**Background/Aims:** Before diagnosing premenstrual dysphoric disorder (PMDD), two months of prospective assessment are required to confirm menstrual cyclicity in symptoms. For a diagnosis of premenstrual syndrome (PMS), this is not required. Women with PMDD and PMS often report that their symptoms interfere with mood and social functioning, and are said to show cyclical changes in interpersonal behaviour, but this has not been examined using a prospective approach. We sampled cyclicity in mood and interpersonal behaviour for two months in women with self-reported PMS.

**Methods:** Participants met criteria for PMS on the Premenstrual Symptoms Screening Tool (PSST), a retrospective questionnaire. For two menstrual cycles, after each social interaction, they used the online software TEMPEST to record on their smartphones how they felt and behaved. We examined within-person variability in negative affect, positive affect, quarrelsomeness, and agreeableness.

**Results:** Participants evaluated TEMPEST as positive. However, we found no evidence for menstrual cyclicity in mood and interpersonal behaviour in any of the individual women ($n = 9$).

**Conclusion:** Retrospective questionnaires such as the PSST may lead to oversampling of PMS. The diagnosis of PMS, like that of PMDD, might require two months of prospective assessment.
Introduction

Premenstrual dysphoric disorder (PMDD) is considered a depressive disorder [1]. The diagnosis requires at least one marked psychological symptom (e.g., affective lability, irritability, depressed mood) and at least four additional symptoms. Two months of daily symptom ratings are required to confirm that symptoms are cyclical (i.e., present during the premenstrual phase and otherwise absent) and interfere with daily life. A PMDD diagnosis is made prospectively because previous studies have shown this helps differentiate PMDD from other depressive disorders [2, 3]. Women with PMDD or premenstrual syndrome (PMS) frequently report that their symptoms interfere with social functioning [4] and are said to show cyclical changes in interpersonal behaviour, particularly quarrelsomeness [5]. While premenstrual mood symptoms might be associated with premenstrual increases in quarrelsomeness, this has not been examined prospectively in women with PMS.

Daily symptom ratings, or diaries, are less likely to overestimate symptom severity than measures considering the past month [5]. However, diaries remain subject to memory biases, as people are asked to reconstruct each day. Morning experiences may be remembered inaccurately at night [6] and symptoms may vary throughout the day [7]. The experience sampling method (ESM), also known as ecological momentary assessment (EMA), has been shown to complement diaries [6, 8]. Like diary data, ESM/EMA data provide insight into both within- and between person variability in momentary states. Unlike diaries, ESM/EMA can be used to detect within-day patterns [6]. Event-contingent recording (ECR) is a type of ESM/EMA that asks people to indicate their state following pre-specified events. A validated ECR method is available for assessing mood and interpersonal behaviour (e.g., negative affect, quarrelsomeness) during social interactions [9]. This method allows for the prospective assessment of how people feel and behave during interactions with others.

In the present ECR study, nine women with self-reported PMS reported on their everyday social interactions for two months. The online software TEMPEST [10] was used for administering the ECR questionnaires via participants’ smartphones. PMS was studied because prospective ratings are not currently a requirement for diagnosing PMS, while they are a requirement for diagnosing PMDD. We postulated that our results might show that prospective ratings may also aid in diagnosing PMS. Additionally, as past studies that employed ECR of social interactions have exclusively used paper questionnaires and lasted less than one month, we studied participant satisfaction with TEMPEST.

Method

Participants

Advertisements posted in public buildings around the city asked women with premenstrual complaints to participate in a smartphone diary study. Respondents (n=22) completed the
Premenstrual Symptoms Screening Tool (PSST) [11]. Inclusion criteria were scoring ‘moderate’ or ‘severe’ on at least 1 of the 4 core symptoms and on at least 4 other symptoms listed in part A of the PSST, and at least ‘mild’ on at least 1 of the items in part B; age 18-40 years; a regular menstrual cycle (28 ± 3 days); owning a suitable smartphone; no past or present diagnosis of a psychiatric disorder; not currently using psychotropic medication; not using hormonal contraceptives for at least 3 months prior to study entry; no current pregnancy; not breastfeeding for at least 9 months prior to study entry. Ten respondents met these criteria and provided written informed consent; 9 completed the study. The Ethics Committee of Psychology, University of Groningen, approved the study.

Measures
In addition to the PSST, the Premenstrual Assessment Form (PAF) [12] was used to assess the severity of premenstrual complaints. The Quick Inventory of Depressive Symptomatology (QIDS, range 0-27) [13] was used to measure depression severity in the past week. The System Usability Scale (SUS, range 0-100) [14] evaluated participants’ experiences with TEMPEST.

ECR questionnaires asked about the context of each social interaction (e.g., gender and role of the interaction partner), included items from the Dutch-language Social Behaviour Inventory [15] for assessing quarrelsomeness, agreeableness, dominance, and submissiveness, and sampled negative affect (NA) and positive affect (PA) using 5 and 4 adjectives, respectively [16].

A daily questionnaire was completed each morning for obtaining data on participants’ menstruation (absent vs. present).

Data Analysis
The data were analysed with longitudinal Bayesian MCMC models. Daily mean levels of NA, PA, quarrelsomeness, and agreeableness were created so the data could be analysed with time series models for measurements equidistant in time. These mean levels were transformed to lie within the interval (0, 1) and were subsequently modelled through beta-distributions (see https://osf.io/j7ngw/ for details).

Several increasingly complex group and individual models were fitted to the data. Analyses started with Model 1, which included the number of days ($N_i = 1, 2, ..., n$) for person $i$ ($i = A, ..., I$). In Model 2 the spread was dependent on the number of social interactions per day. Model 3 included a moving average, thus taking the score of the previous day into account to predict the value of the following day. Dummy variables for the menstrual phases were included in Model 4, at both a group level (all participants receiving the same estimates, Model 4A) and an individual level (all participants receiving person-specific estimates, Model 4B). Model selection was based on the Deviance Information Criterion (DIC) [17], a measure of model fit that penalises for complexity, with a lower
value indicating a better fit. When the difference in DIC value exceeded 10, a model was discarded for a less parsimonious one [18].

The menstrual phase, based on the days on which a participant reported menstruation, varied in duration (range: 5-8 days). The premenstrual phase was defined as the 5 days preceding the menstrual phase (i.e., late luteal phase). The postmenstrual phase was defined as the 7 days following the menstrual phase (i.e., late follicular phase). The intermenstrual phase entailed the remaining cycle days; these were typically the early luteal days.

Results

Retrospective measures
Table 1 provides individual responses on the PSST, PAF, and QIDS. According to the PSST, all participants except participant I had moderate-to-severe PMS. Participant I had the same PSST total score as participant H, but her symptoms interfered only mildly with her daily life. Nonetheless, her average PAF score across 3 consecutive months (PAF₁₋₃) was higher than that of 3 other participants.

The Spearman correlation r between the PSST and PAF₁₋₃ was .66 (n = 9, p = .054), confirming that both questionnaires tap into the same construct. The correlations between the PSST and the QIDS₁₋₃ and between the PAF₁₋₃ and QIDS₁₋₃ were r = .11 (p = .74) and r = -.14 (p = .72), respectively, indicating that, in our sample, PMS symptoms were mostly unrelated to depressive symptoms.

ECR data
Participants recorded their interactions for 61-77 days (M=65.56, SD=6.62). The mean number of missing days was 3.56 (SD=5.15, range 0-15). The mean total number of interactions was 248 (SD=92.59, range 114-360). The mean daily number of interactions was 3.91 (SD=1.10, range 0-16).

Mood and interpersonal behaviour across the menstrual cycle
Model 1 fitted the ECR data consistently much worse than the other models (see Table 2). As Model 3 had the best fit with the NA data, we found no evidence for menstrual cyclicity in NA. If there had been cyclicity in NA, then including the menstrual phases in Model 4 should have provided a substantial improvement in model fit compared to Model 3. We also found no evidence for cyclicity in PA, quarrelsomeness, and agreeableness. For all three variables, Model 2 had the best fit. We checked whether the fit would improve with median, minimum, or maximum daily scores, rather than daily averages. Results (see https://osf.io/j7ngw/) provided no indications for altered conclusions.

When the analyses were repeated in the 3 participants (A-C) who reported the most severe PMS symptoms and the most interference in daily life on the PSST, and the most severe cyclical change in symptoms on the PAF, the pattern was similar to that of all 9 participants (see Table 2). In sum, we found no evidence for menstrual phase differences in mood and interpersonal behaviour.
As the dependent variables were aggregated into daily means, it is possible that cyclicity of NA, PA, quarrelsomeness, and agreeableness was confounded by menstrual cyclicality in the occurrence of a specific social context. However, when we investigated whether this was the case, the additional analyses provided no indications for altered conclusions (also see https://osf.io/j7ngw/).

**User experiences with TEMPEST**

Participants occasionally reported issues with the software not responding, or responding slowly. Nonetheless, their mean SUS score was 84.17 (SD = 7.60), indicating an overall positive experience.

**Discussion**

In nine women with self-reported PMS we found no evidence for variation in mood (NA, PA) and interpersonal behaviour (quarrelsomeness, agreeableness) across the menstrual cycle. Thus, according to our prospective ECR data, the premenstrual phase of our participants did not appear to be characterized by three core symptoms of PMS, namely depressed mood, anxiety/tension, and irritability. However, on the PSST, participants reported these symptoms retrospectively, thereby indicating they had PMS. This inconsistency suggests that prospective methods may be needed for diagnosing PMS in individual women, similar to what is currently required for PMDD [1].

Discrepant retrospective and prospective mood assessments have been reported previously. Ainscough [19] used the Moos Menstrual Distress Questionnaire (MMDQ) to assess NA daily for 8 weeks in 51 women. Most participants retrospectively reported having experienced premenstrual mood symptoms, however the MMDQ data provided no indication of menstrual cyclicity in NA. Our study adds that retrospectively reported PMS may also not be reflected in prospectively measured PA, nor in prospective measures of interpersonal behaviour rather than mood.

Our results suggest the PSST, a retrospective measure, may be invalid for diagnosing PMS. Other retrospective measures have also been found to result in symptom overestimation [5]. Nonetheless, it has also been reported that the PSST yields prevalence rates of PMDD and PMS that are comparable to rates reported in prospective studies [11], and that retrospective and prospective assessment of premenstrual symptoms are positively correlated [20]. Thus, also given our small sample size, more research on the validity of the PSST is warranted.

An additional aim of our study was to evaluate the TEMPEST software for data collection [10]. Offering the ECR questionnaires online had several advantages. First, while previous paper-based studies provided participants with 10 questionnaires per day, in the present study participants could complete as many questionnaires as they wished (the daily maximum was 15). Second, there was no need to return the completed questionnaires by post, which reduced study burden and missing data. Third, we could monitor whether participants completed the ECR questionnaires
regularly. This was communicated beforehand, to prevent backfilling questionnaires, for example when participants forgot to carry or charge their phone, which occurred infrequently. Importantly, participants evaluated their overall experience with TEMPEST as positive.

In our study, the premenstrual phase was defined as the five days preceding menstruation. However, the number of days during which symptoms are reported can vary between women, as well as within women between menstrual cycles [21]. We also fitted models in which the length of the premenstrual and postmenstrual phases were data-driven, but again no cyclicity was found (model outcomes available on https://osf.io/j7ngw/). Nonetheless, to gain more insight into cycle phases, daily measures of hormone levels or body temperature could have been included.

The small sample size may be considered another limitation. However, we were interested in menstrual cyclicity in mood and interpersonal behaviour in individual women. Clinically, these are more relevant than group effects. Nonetheless, replication in larger samples is recommended.

In conclusion, women who report having PMS on the PSST, a retrospective measure, may prospectively show no menstrual cyclicity in mood and interpersonal behaviour. This conclusion is preliminary in light of the study’s limitations but supports the idea that a PMS diagnosis cannot be made using retrospective measures alone and, like for PMDD, should include prospective measures.

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