The Comparison of Facial Emotion Recognition Ability in Women with and without Premenstrual Syndrome

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SUMMARY

Objective: It is emphasized that premenstrual syndrome (PMS) includes affective symptoms, such as depressed mood, anxiety, and irritability, all of which may influence the recognition of facial emotion expressions. Also it is known that menstrual cycling may effect facial emotion recognition in healthy females. In the present study, we aimed to investigate how menstrual cycling effects of facial emotion recognition in women with and without PMS.

Methods: Sixty healthy women were included to the study. They were divided two grou+ps labeled women with PMS (n=33) and without PMS (n=27), which is in accordance with the Premenstrual Assessment Form. Then, The Facial Emotion Recognition Test (56 mixed photos with happy, surprised, fearful, sad, angry, disgusted, and neutral facial expressions from Ekman & Friesen's series) was performed on each group in both the luteal and follicular phases.

Results: The women with PMS were significantly worse in recognizing sad (p=0.003) and surprised (p=0.019) faces in the luteal phase compared to the follicular phase, whereas women without PMS were significantly worse in recognizing sad faces (p=0.008) in the luteal phase compared to the follicular phase. There were no significant differences between women with and without PMS in either the luteal phases or in the follicular phases according to facial emotion recognition (for each, p>0.05).

Conclusion: The women with PMS do not differ from women without PMS in recognizing facial emotions accurately. The low accuracy rate in the recognition of sad and surprised facial emotions in the luteal phase may lead PMS women to have more social problems.

Keywords: premenstrual syndrome, facial emotions, menstrual cycle, sad

INTRODUCTION

The menstrual cycle can be studied in great detail to understand how the subtle fluctuations in ovarian hormone levels may influence emotional processing. It is well-known that premenstrual syndrome (PMS) associates with symptoms such as depressed mood, anxiety, and irritability. All of these occur in three out of four women during their reproductive years (Hoyer et al. 2013).

Increased amygdala reactivity to emotional stimuli has been reported either in the luteal or follicular phases of the premenstrual dysphoric disorder (PMDD), which is a severe form of PMS (Gingnell et al. 2012), The increased amygdala has been shown to be involved in facial emotion recognition (Adolphs et al. 2002). Symptom severity, male gender, and, to a lesser degree, education seem to be negatively associated with the ability of facial emotion recognition (Daliliet al. 2015). In addition, the ability of facial emotion recognition has been reported to be effected by menstrual cycle in women without PMS. The highest accuracy rate for identifying fearful facial emotions was found to be in the follicular phase, while the lowest accuracy rate was found in the luteal phase (Pearson et

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al. 2005). The most significant effect on misrecognizing fear and disgust faces in luteal phase have been observed in a previous report by Conway and colleagues (Conway et al. 2007). Interestingly, Derntl et al. found a phase effect on the ability of facial emotion recognition in healthy young females, and suggested a higher accuracy in the follicular phase than the luteal phase (Derntl et al. 2008). In another study, patients with PMDD had significantly misinterpreted neutral faces as sad during the luteal phase and the authors proposed that the finding was consistent with that observed for depression (Rubinow et al. 2007).

Facial emotion recognition difficulties may lead to some misinterpretations by others (Phillips et al. 2003) that may result in poor social interaction or poor functional outcome. As in cognitive theories of depression (Beck et al. 2008, Scher et al. 2005), we considered that mood congruent emotional processing, such as giving more importance to interpretations of negative emotions, might be present in the luteal phase of women with PMS. In this study, we have four hypotheses: i) women with PMS may more accurately recognize sad and fearful faces in the luteal phase; ii) the ability of recognizing sad and fearful faces might be decreased in the follicular phase; iii) they may need less time to recognize a sad and/or fear facial emotions in the luteal than the follicular phase; and iv) these abovementioned differences might not be present in women without PMS during the luteal or follicular phases. Thus, we aimed to investigate the alteration of facial emotion recognition ability during the luteal and follicular phases in women with PMS and compare these changes to women without PMS.

METHODS

Participants

Voluntary participants that had not been admitted to a hospital were included to the study. The inclusion criteria for the study were: i) having regular menstrual cycling; ii) completion of the Turkish version of the Premenstrual Symptom Assessment Form; and iii) between the ages of 18 to 45 years old. The exclusion criteria were as follows: i) younger than 18 years or older than 45 years old age; ii) by clinical assessment or self-disclosure of current or past comorbid psychiatric disorders as depression, psychosis, alcohol and/or substance abuse; iii) clinical mental retardation, or having neurological disease or head injury history; iv) visual problems; v) using drugs that may influence menstrual cycle as oral contraceptive or other hormone therapies, psychiatric drugs; and vi) being pregnant or breast feeding.

The study was approved by the Medical Faculty of Cerrahpasa Ethic Committee and 60 participants were included to the study upon giving written informed consent.

Tools

The Facial Emotion Recognition Test: That was constructed manually by using a set of photographs from Ekman and Friesen's "Pictures of Facial Affect". The test included the photos of four male and four female models (a total of 56 mixed photos) with happy, surprised, fearful, sad, angry, disgusted, and neutral facial expressions from Ekman & Friesen's series (Ekman et al. 1976). All photos were pressed on a white sheet (210 × 297mm) and the women subjects were asked to recognize facial emotions within a distance of 45-60 cm. At first, we had a trial section that was composed of the first seven photos, which included each facial expression (i.e., angry, sad, happy, neutral, fearful, disgusted, and surprised). A total of 49 photos were used for the data analyses. In these 49 photos, numbers of happy, sad, surprised, fearful, disgusted, angry, and neutral expressions were equal. Overall, this ensured that the participants did not become familiarized to one specific emotional category. All participants were tested individually in a quiet room. No feedback was given regarding the appropriateness of any response. In addition, the reaction time to each facial emotion had also been noted.

Premenstrual Symptom Assessment Form (PAF): It is a questionnaire designed to measure changes in mood, behavior, and physical condition during the premenstrual period. Symptoms were rated based on 95 questions, and on the severity of change from 'usual self' (from 1 not applicable to 6 extreme changes) during the last three premenstrual periods. Internal consistency coefficients of the unipolar scale scores revealed alphas of above 0.7 in 13 out of 18 scales (Halbreich et al. 1982). The Turkish adaptation was also performed and the internal consistency scores for each sub-scales were within 0.46-0.90 (Dereboy et al. 1994).

Procedure

After filling out the socio-demographic questionnaire and Premenstrual Symptom Assessment Form, all participants were asked to perform facial emotion recognition test. All participants were tested two times, first the luteal and then in the follicular phases (approximately 10 days after luteal phase). The participants were divided two groups as women with PMS (n=33) and without PMS (n=27) according to Premenstrual Assessment Form.

Statistical Analysis

All statistical analyses were conducted with the Statistical Package for Social Sciences for Windows (SPSS) version 21.0(SPSS Inc. Chicago, Illinois, USA). Demographic information was analyzed through descriptive statistics. Chi square test was used for categorical variables. Kolmogorov Smirnov test was used to test for normality. The frequency of accurate identifications and response time to each facial emotion

between women with PMS and without PMS were compared with Student's T test or Mann Whitney U test. Paired sample T test or Wilcoxon Signed Rank tests were used for comparing changes between the luteal and the follicular phase. The correlation analysis was performed by Pearson or Spearman correlation tests. A p-value of less than 0.05 was accepted as statistically significant.

RESULTS

The mean age was not significantly different between women with and without PMS (22.88±7.19 *vs* 23.63±8.65 years, respectively and p=0.715). There were no significant differences among occupational status (X^2=1.09 and p=0.779), marital status (X^2=1.24 and p=0.537), and education (X^2=2.05 and p=0.562) between the groups. The mean scores according to Premenstrual Assessment Form were significantly different between groups (302.94±32.71 *vs* 189.44±38.77 and p<0.0001) (Table 1).

The women with PMS were significantly worse in recognizing sad and surprised facial emotions in the luteal phase compared to those in the follicular phase (mean accuracy rate for sad faces were 4.85±1.28 *vs* 5.61±1.56 and p=0.003) and mean accuracy rate for surprised faces were 4.46±1.91 *vs* 6.09±1.10 and p=0.019). There were no significant changes according to happy (p=0.325), anger (p=0.893), fearful (p=0.915), disgust (p=0.737) and neutral (p=0.481) facial emotions between the luteal and follicular phase. The response times to each facial emotion between the luteal and follicular phase did not differ in women with PMS and the p-values were as follows: happy (p=0.722), sad (p=0.526), anger (p=0.052), fearful (p=0.186),

Table 1. Sociodemographical features of participants

	Women with PMS n=33	Women without PMS n=27	p
[1]Age (mean±SD years)	22.88±7.19	23.63±8.65	p=0.715
[2]Marital status			
Single	28	22	X^2=1.244
Married	5	4	p= 0.547
Divorced	-	1	
[2]Education			
University	24	21	X^2=2.049
High school	3	4	p= 0.562
Middle school	6	2	
[2]Occupation			
Student	25	21	
Employed	6	3	X^2=1.092
House wife	1	2	p= 0.779
Unemployed	1	1	
[1]Premenstrual Assessment Form	302.94±32.71	189.44±38.77	p<0.0001

[1]with student's T and [2]with Chi square tests

Table 2. Follicular vs luteal phases according to mean accuracy rate for each facial emotion within groups

Facial emotions		Women with PMS n=33	p^1	Women without PMS n=27	p^2
Happy	Folular phase	6.97±0.17	0.325	6.96±0.19	0.327
	Luteal phase	7.00±0.00		7.00±0.00	
Sad	Follicular phase	5.61±1.56	0.003**	4.70±1.43	0.008**
	Luteal phase	4.85±1.28		5.70±1.64	
Fear	Follicular phase	4.24±1.68	0.915	3.81±1.96	0.795
	Luteal phase	4.27±1.79		3.74±2.07	
Anger	Follicular phase	6.18±1.18	0.893	6.00±1.04	0.691
	Luteal phase	6.21±0.89		6.07±1.27	
Disgust	Follicular phase	6.27±0.88	0.737	6.11±0.85	0.107
	Luteal phase	6.21±0.89		6.44±0.70	
Surprise	Follicular phase	6.09±1.10	0.019*	6.30±1.10	0.403
	Luteal phase	4.46±1.91		6.19±0.96	
Neutral	Follicular phase	6.47±0.68	0.765	6.31±0.75	0.137
	Luteal phase	6.41±0.79		6.64±0.60	

Tested with Paired Sample T test. *p<0.05, **p<0.01
p^1, comparison between follicular and luteal phase data within women with PMS and p^2, within women without PMS.

Table 3. Comparison between groups according to mean accuracy rates for each facial emotion in each phase

Facial emotions		Follicular phase	p^1	Luteal phase	p^2
Happy	with PMS	6.97±0.17	0.887	7.00±0.00	n.a.
	without PMS	6.96±0.19		7.00±0.00	
Sad	with PMS	5.61±1.56	0.681	4.85±1.28	0.274
	without PMS	4.70±1.43		5.70±1.64	
Fear	with PMS	4.24±1.68	0.367	4.27±1.79	0.290
	without PMS	3.81±1.96		3.74±2.07	
Anger	with PMS	6.18±1.18	0.534	6.21±0.89	0.623
	without PMS	6.00±1.04		6.07±1.27	
Disgust	with PMS	6.27±0.88	0.473	6.21±0.89	0.274
	without PMS	6.11±0.85		6.44±0.70	
Surprise	with PMS	6.09±1.10	0.547	4.46±1.91	0.854
	without PMS	6.30±1.10		6.19±0.96	
Neutral	with PMS	6.47±0.68	0.481	6.41±0.79	0.298
	without PMS	6.31±0.75		6.64±0.60	

Tested with Student's T test; p^1, comparison of follicular phase data between women with and without PMS and p^2, comparison of luteal phase data between with and without PMS; n.a., not applicable.

disgust (p=0.396), surprised (p=0.793) and neutral (p=0.765) (Table 2). Additionally, there were no significant correlations between PAF score and accuracy of facial expression recognition ability (for each facial expression, p>0.05).

The women without PMS were also significantly worse in recognizing sad facial emotions in the luteal phase than the follicular phase (mean accuracy rate for sad faces were 4.70±1.43 *vs*5.70±1.64 and p=0.008). Otherwise there were no significant changes according to happy (p=0.327), anger (p=0.691), fearful (p=0.795), disgust (p=0.107), surprised (p=0.403) and neutral (p=0.137) facial emotions between the luteal and the follicular phase. Recognizing sad (p=0.038), anger (p=0.022) and surprised (p=0.028) faces in the luteal phase were needed significantly more time while the response times to happy (p=0.228), fearful (p=0.435), disgust (p=0.124), and neutral (p=0.537) facial emotions between luteal and follicular phase did not differ (Table 2).

There were no significant differences between women with and without PMS in the luteal phase according to mean accuracy rates of facial emotions. The p-values were as follows: happy (p=0.887), sad (p=0.681), anger (p=0.534), fearful (p=0.367), disgust (p=0.473), surprised (p=0.547) and neutral (p=0.298) (Table 3). There were no significant differences between women with and without PMS in the luteal phase according to the mean response time to each of the facial emotions.

There were no significant differences between women with and without PMS in the follicular phase according to the mean accuracy rates of the facial emotions. The p-values were as follows: 7 in 7 in accuracy for happy, sad (p=0.814), anger (p=0.623), fearful (p=0.290), disgust (p=0.274), surprised (p=0.854) and neutral (p=0.481) faces in both groups (Table 3).

DISCUSSION

In the current study, we unexpectedly found more a accurate response rate to sad facial emotions in women with PMS in the follicular phase than the luteal phase. For the first time in the literature, we observed that more accurate response rate to surprised facial emotions in the follicular phase compared to the luteal phase. In addition, we could not find any differences between women with and without PMS according to accuracy rate to each facial emotion either in the luteal or the follicular phases. Generally, rather than specific differences among phases of the menstrual cycle by means of facial emotion recognition, revealed a global increase in the ability to all emotional faces by women at the follicular phase (Derntl et al. 2008, Derntl et al. 2013). It is well known that females in the luteal phase behave more reactively to social stresses (Kirschbaum et al. 1999), higher depressive scores (Reedet al. 2008), and have more intrusive recalls about negative events in past (Ferreeet al. 2009). Recently, more interference effect to emotional facial stimuli and pictures was found in the luteal phase in women with PMS by using an emotional online STROOP test (Eggertet al. 2016). Mood congruent errors in recognizing facial emotions are frequently reported in patients with depression (Bourke et al. 2010) and in people with high risk depression (Watters et al. 2011). Recently, biased recognition of the facial affect in patients with major depressive disorder has been found to be related with the clinical state. In this study, patients with a major depression required a greater enhancement of a happy expression to recognize that particular emotion as compared to controls. Interestingly, this decreased after three months and was directly proportional to the reduction in depressive symptoms (Münkleret al. 2015). Additionally, these mood congruent emotion recognition biases have been mentioned in premenstrual dysphoric disorder (Rubinow et al. 2007) which is a severe form of PMS. Ovarian hormone cycling is informed to have strong effects on emotion recognition. In a seminal review, it is mentioned that estrogen and progesterone receptors are co-localized in brain regions involved in emotional and cognitive regulation (Toffoletto et al. 2014). Lower progesterone and estradiol levels have been associated with higher accuracy rate in the early follicular phase (Derntl et al. 2008). We have investigated the facial emotion recognition ability in the late follicular and the late luteal phases. Thus, high estradiol levels in the late follicular phase and/or higher progesterone levels in the late luteal phase might be related to better recognition in sad faces of the follicular phase or worse recognition of sad facial emotion in the luteal phase. Therefore, measuring the phase specific ovarian hormone levels would be more explanatory.

Macrae et al. have suggested that females are more prone to social stimulations and interactions during the follicular phase and have a more positive mood than during the luteal phase (Macrae et al. 2002). Interestingly, females may show more attention to the cues of emotional expressions in the follicular phase (Derntl et al. 2013, Guapo et al. 2009). In our study, all participants were able to recognize sad emotions better in the follicular phase than the luteal phase. Furthermore, women with PMS had higher accurate performance for recognizing surprised facial emotions in the follicular phase than in the luteal phase. Surprise is one of the briefest facial emotions (Dursun et al. 2010) and there has been a debate on the emotion of surprised to determine whether it is a positive or negative emotion (Dursun et al. 2010). It is considered that females are in a better mood and socially competent when they are fertile in the follicular phase (Macrae et al. 2002). In addition to literature, we speculate that females with PMS who have better recognition in the sad and surprised faces during the follicular phase may have enhanced chance for mating (Derntl et al. 2008)

There are fewer dealing with relation between reaction times to emotions and menstrual cycling data in the literature. Again, we could not find any differences according to reaction times for identifying facial emotions in the luteal or the follicular phase between women with and without PMS. PMS has been observed in up to 75% of females in their productive life (Hoyer et al. 2013), which means that 25% of females are normal when they have had no premenstrual symptoms. Thus, there would be significant differences if we had premenstrual dysphoric disorder as a third group. In healthy females, independent from menstrual phases, they show faster reaction times for happy facial expression (Derntl et al. 2008). In another study, as in our hypothesis, the healthy females in the luteal phase had faster reactions to negative facial emotions, especially to sad and angry faces (Derntl et al. 2013). Interestingly, women with PMS had a trend of reacting slowly in recognizing angry faces (p=0.052), while women without PMS had spent significantly more time in recognizing sad, angry, and surprised faces in the luteal phase. It is thought that requiring more time to recognize facial emotions in the luteal phase in females might be responsible for being less interested in social stimulations in the luteal phase.

The current study has several limitations. First, the relatively small sample size is an important issue while interpreting our findings. Second, the measurement of ovarian hormone levels in each menstrual phase would be more informative. Third, adding a third comparison group as premenstrual dysphoric disorder or females in their menopause stage would be valuable. Lastly, specific inventories on mood and anxiety symptoms might be more informative, although the PMS questionnaire inquires anxiety and mood symptoms in the luteal phase.

In conclusion, women with PMS do not differ from women without PMS in recognizing facial emotions accurately. However, women with PMS seem to perform better and faster in the follicular phase than the luteal phase in recognizing facial expressions. This may contribute to why females have some social problems in the luteal phase.

Disclosure

We do not have any conflict of interest to declare this paper.

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