Analysis of the Natural Variation of Women's Depressive Mood Across the Menstrual Cycle[*]

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Despite the widely known assumption that women's mood fluctuate across the menstrual cycle, the assumption has been poorly supported by empirical evidence, and the effect of the menstrual cycle on women's depressive symptoms remains controversial and unknown. One of the main reasons for the paucity of evidence is the lack of scientific research devoted to a systematic examination of this phenomenon in a representative community-based sample of women. The purpose of this study is to examine if women's depressive mood is associated with their menstrual cycles in a community-based sample that is systematically and randomly collected. Daily mood and symptom data and urine specimens data were derived from the Women's Wellness Study(WWS). 1,246 participants in the Midwestern United States between the ages of 13 to 55 who have menstruations were included in the analysis. After controlling for age, marital status, income, education, employment status, and oral contraceptive use, a linear mixed model analysis was used to analyze cyclic changes of depressive moods across the menstrual cycle. Statistically significant changes were found for women's depressive symptoms across the menstrual cycle, and the symptom level during the premenstrual (late luteal) phase was significantly higher than that of the postmenstrual phase. The findings suggest that there is a statistically significant depressive mood change across the menstrual cycle even though further studies need to investigate the clinical significance of this mood change. The results imply that information on the menstrual cycle needs to be considered for research and clinical purposes in promoting women's mental health when measuring women's mental health parameters. Assessments of women's mental health without considering menstrual cycle information may result in inappropriate diagnostic decisions.

Key words : Women's mental health, Depressive mood, Menstrual cycle

Human life is associated with various temporal cycles(Song, 2008). Circadian cycles occur in the secretion and excretion of hormones and in daily behaviors such as sleeping and waking(Rossi & Rossi, 1977; Song, 2008; Travis, 1988). Seasonal cycles modulate human physiological and psychological changes(Kasper, Wehr, Bartko, Gaist, & Rosenthal, 1989), and social cycles such as a 7-day week and a 12-month calendar year regulate human social behaviors(Rossi & Rossi, 1977). Among such cycles, the human menstrual cycle, a naturally occurring biological cycle, is an integral part of women's lives during the reproductive ages and a naturally occurring biological process involving a complex interaction among the hypothalamus-pituitary-ovary axis (Song, 2008), and menstrual experiences are closely linked with women's lives in many ways(Asso, 1983; Gehlert et al., 2009; Gold, 2006; Song, 2008; Ussher, 2004a; Walker, 1997).

Throughout history, an enormous amount of discourse about the menstrual cycle-related mood changes has been accumulated. Because the menstrual cycle is regulated by female hormones such as estrogen and progesterone(Gruhn & Kazer, 1989), extensive biomedical research from the biological perspective has been documented on the cyclic change of mood symptoms associated with the hormonal changes over the menstrual cycle(Hardie, 1997). In modern medicine, the origin of the biomedical model of menstrual cycle-related mood changes is credited to Frank(Walker, 1995). When he coined the term Premenstrual Tension(PMT) in 1931 and introduced the concept of mood changes during the premenstrual phase, he attributed the cause of the problem to abnormal secretions of the female hormones(Adesso, Reddy, & Fleming, 1994; Frank, 1931; Lee, 1998; Walker, 1995). Since then, there has been an extensive body of research based on the basic assumption that biological changes, especially hormonal changes, over the menstrual cycle affect women's mood. a biomedical theory is currently dominant in explaining the mechanism of this menstrual cycle research(Steiner & Born, 2002a). Biological models explain menstrual cycle-related mood changes as a consequence of brain's biochemical changes to the changing levels of female hormones, such as estrogen, progesterone, follicle stimulating hormone, and luteinizing hormone (Kohen, 2000), or a consequence of changes in neurotransmitter over the menstrual cycle (Eriksson et al., 2006; Steiner, 1996; Steiner, 1998; Steiner & Born, 2000).

While the biomedical perspective generally explains menstrual cycle-related mood changes as a result of the cyclic fluctuations in hormones during the menstrual cycle, psychological theories have to do with how women perceive and attribute the negative mood to the menstrual cycle. Some investigators suggest that this premenstrual-related mood change may be "a monthly excuse for stress reactions"(Thayer, 1996, p.44) and that it may be used to

"discriminate against women in the workplace" (Ibid., p.44). This perspective differs from the biological perspective in that this does not support the idea of existence of menstrual-related mood changes. Another psychological perspective is the social psychological model suggesting negative social stereotypes of menstruation from cultural beliefs and social contexts develop negative expectations about menstrual experience, and the combination between the negative expectations and the cyclical arousal from the normal cyclical hormonal changes result in menstrual-related mood changes(Walker, 1995). This perspective focuses on external factors reflecting social expectations and stereotypical beliefs about the mood changes in relation to the menstrual cycle(Adesso, Reddy, & Fleming, 1994; Graham & Bancroft, 1993; Ruble & Brooks-Gunn, 1979).

And, social scientists generally give sociological explanations for the menstrual cycle-related mood fluctuation and claim that it is due to negative symbolisms, attitudes, and values toward menstruation and femininity that have been negatively constructed in many cultures(Figert, 1996; Ussher, 2004a).

However, despite these widely known assumptions that change in women's depressive mood is associated with the menstrual cycle, the assumptions have been poorly supported by empirical evidence, and the effect of the menstrual cycle on women's depressive symptoms remains controversial and unknown(Asso, 1983;

Dan, 2004; Graham & Bancroft, 1993; Walker, 1997). The nature of women's mood change over the menstrual cycle remains ill-understood, and there is little consensus as to the variation in women's mood and menstrual cycle-related symptomatology(Steiner & Born, 2002b; Walker, 1994, 1997). The research findings have been inconsistent, so that to some, even the existence of menstrual cycle-related mood changes is unclear and controversial(Dan, 2004; Graham & Bancroft, 1993; Walker, 1997).

The reason that existing studies of menstrual cycle-related mood change, including prevalence studies of premenstrual-related disorders have yielded inconsistent results, is mainly due to methodological problems in menstrual cycle research(Gehlert & Hartlage, 1997; Gehlert, Song, Chang, & Hartlage, 2009; Gehlert, Song, & Chang, 2010). First, the limitation was due to sample selection(Gehlert & Hartlage, 1997; Song, 2008; Travis, 1988). Some published prevalence rates almost certainly are biased, owing to their not being obtained by probability sampling. Samples using restricted age ranges, convenience sample in medical settings, or consisting exclusively of women seeking treatment for premenstrual symptoms in clinics, yield prevalence estimates that fail to represent the entire range of women of reproductive age. Another point to consider is the limited availability of data for minority women. Data in most menstrual-related studies have been collected primarily from white women.

Second, the inconsistency of research results can be attributed to lack of an accurate examination of human menstruation(Gold, 1997). So far, there had existed no specific community -based study to measure the accurate timing of women's menstruation, and the previous studies depened on women's self-report so that their menstrual information may be inaccurate and unreliable(Gehlert, Chang, & Hartlage, 1999; Schnurr, 1989).

Third, the reliability of recall of past mood states is problematic(Travis, 1988), and this has been one of the major criticisms of the menstrual cycle studies(Graham & Bancroft, 1993). Symptom data can be collected retrospectively or prospectively. Retrospective methods ask participants if they experienced cyclical changes in the past cycle, or sometimes ask them if they ever experienced mood changes before. In prospective methods, participants rate their mood and symptoms on a daily basis. Retrospective methods are often used because of their convenience, but reliance on retrospective self-report of participants' subjective mood is often criticized as a problematic limitation, and there is a considerable evidence that the results from retrospective and prospective methods are not correlated very well(Graham & Bancroft, 1993). Prospective methods are generally considered better and more accurate. Their low compliance could be a limitation, because they requires participants to rate their moods every day.

This study has a clear and straightforward purpose to overcome those above methodological limitations in menstural cycle research on women's psychological mood, this study attempted to analyze the large-sized community -based data which is randomly and systematically selected from a community population, with the method of prospective reports of their mood symptoms everyday for at least 60 days, with an accurate hormonal examination to detect their menstrual cycles, in order to understand what is actually being experienced in a community population of women.

Method

Data

The data of the Women's Wellness Study (WWS) was used for this research. Participants were selected according to the following procedures. First, to achieve usable data from 2,600 women, 12,800 housing units were randomly selected by the National Opinion Research Center(NORC) at the University of Chicago with the selection probability proportional to the 1990 US Census count of housing units in four geographic areas: Chicago, Illinois and St. Louis, Missouri, as urban areas, and DeKalb County, Illinois and Franklin County, Missouri, as rural areas. The two rural sites(DeKalb County and Franklin County) are equidistant from their urban counterparts(Chicago

and St. Louis)(Gehlert & Chang, 1998; Gehlert, Chang, Bock, & Hartlage, 2006; Gehlert, Chang, & Hartlage, 1997, 1999; Gehlert & Hartlage, 1997; Gehlert, Song, Chang, & Hartlage, 2009).

Introductory letters explaining the study and asking for participation were mailed to each selected housing unit selected by the procedure developed by NORC. Because only addresses were selcted, it was necessary for WWS staff to screen at each housing unit for eligible women. Intensively trained interviewers by NORC and the principal investigators went to each unit to screen for eligible participants. Eligibility criteria included women, ages 13-55 years, who had had at least one menstrual cycle, and were neither naturally nor surgically menopausal or pregnant (Gehlert & Hartlage, 1997).

The target was the same number of women from the four sites, with weighting procedures to be used once the overall sample was obtained. Participants enrolled in the WWS study represented a range of demographic variables, including race, socioeconomic status, and age, reflecting characteristics similar to those found in the 2000 Decennial Census data(US Department of Commerce US Census Bureau, 2002). The four geographic sites were selected to ensure inclusion of rural and urban women. Based on data from the 2000 US Census, both Chicago, IL and St. Louis, MO fit the US Census Bureau's definition of an urbanized area(US Department of Commerce US Census

Bureau, 1995). Both DeKalb County, IL and Franklin County, MO can be considered rural because none of their population resides within urbanized areas(Ibid.). Women were enrolled on the first day of a menstrual cycle, based on information obtained during recruitment and orientation to the study. After being oriented to the study in their homes, participants completed daily questionnaires and provided daily urine samples. These were retrieved from women's homes every two weeks by research assistants assigned to specific participants(Gehlert, Song, Chang, & Hartlage, 2008).

Of the 12,800 addresses systematically selected by the NORC, 9,867 were determined to be valid housing units, and the screener response rate among those units was 78.85%. Women meeting eligibility for the study were found in 2,696 housing units, and 1,784 agreed to participate in the study(66.17%). During the study, 378 participants dropped out(21.2%), 116(6.5%) became ineligible(e.g., because of absence of menstruation, pregnancy, moving from the area), and 44 (2.5%) subjects' data were unusable due to significantly missing responses in daily ratings(Gehlert, Song, Chang, & Hartlage, 2008). These 1,246 cases were used in the final analysis.

Measures

Depressive Mood Severity: Participants completed a daily checklist, Daily Symptoms

and Mood Questionnaire(DSMQ) for 2 consecutive menstrual cycles, that is at least 60 days, derived from the 11 symptoms of Premenstrual Dysphoric Disorder(PMDD) listed in DSM-IV at the same time each morning. Compound symptoms(e.g., "hypersomnia or insomnia") were separated into sub-symptoms, yielding 24 sub-symptoms or items. Positive items(e.g., "felt energetic") were added to discourage a response set(Sudman & Bradburn, 1982), resulting in a total of 33 items in the checklist. Out of 33 items, 3 items were regarding depressive symptoms, and the mean score of the items were used in this analysis. A Likert scale was used to measure daily mood and symptoms, with 6 categories(0 = not at all, 1 = very mildly, 2 = mildly, 3 = moderately, 4 = severely, 5 = very severely).

Menstrual Cycle Phase: Daily urine samples were collected to provide an objective marker of the phase of the menstrual cycle in women not taking oral contraceptives, including day of menses onset and luteinizing hormone surge. The first day that a urine enzyme immunoassay kit for luteinizing hormone(Ovukit; Quidel, San Diego; LH detection threshold 35-40 mIU/ml) detected a positive result was considered the onset of the preovulatory luteinizing hormone surge. For women who were taking oral contraceptives, the premenstrual phase was defined by determining the week prior to the onset of menses(Gehlert, Song, Chang, & Hartlage, 2009).

One menstrual cycle was divided into four phases by anchoring the onset of menstruation to day 0, day 0 to day 6 to the menstrual phase, day 7 to day 13 to the postmenstrual phase, day -7 to day -1 to the premenstrual phase, and day -14 to day -8 to the early luteal phase.

Explanatory variables: Data on age, race, education, income, employment, and marital status were collected by the screening questionnaire at the beginning of the study and by the exit questionnaire at the end of the study.

For the explanatory variables, because there is no single agreed-upon causal factor associated with menstrual cycle-related mood change, variable selection was made mainly based on accumulated knowledge from the existing literature. Gehlert, Song, Chang, and Hartlage 's (2009) epidemiologic study on PMDD found that race, marital status, and age are associated with premenstrual-related mood changes.

In the study, non-white participants were 9.2 times more likely to have premenstrual mood changes than were white participants. Other studies on premenstrual symptoms identified the association between race and PMS, but the findings were inconsistent(Woods, Most, & Dery, 1982). Non-married women were less likely to have premenstrual symptom changes(odds ratio =0.03) than were married women(Gehlert, Song, Chang, & Hartlage, 2008), and other studies explored the association between marital

relationship and premenstrual symptoms(Jones, Theodos, Canar, Sher, & Young, 2000). At a marginal statistical significance, women aged 35-55 years had a lower association(0.33 times; p = 0.061) with premenstrual dysphoric disorder than did women ages 13-34 years(Gehlert, Song, Chang, & Hartlage, 2008). Similar results were found in other studies that women who were older had fewer premenstrual symptoms(Johnson, 1987; Johnson, McChesney, & Bean, 1988; Woods, Most, & Dery, 1982). Age is considered as a biological factor as well as a demographic factor: age 35 seems to be the turning point in the biological aging process as a loss of follicles is accelerated after age 35(Spencer, Gehlert, & McClintock, 2007). A positive association between severity of premenstrual symptoms and educational level was reported(Marvan & Escobedo, 1999). Employment status also was included as a variable in the model, which was found to be a predictor for premenstrual symptoms(Schnurr, 1988). Psychosocial stressors, such as major life events and social support, were reported to be associated with premenstrual symptoms(Fontana & Palfai, 1994), and it was found that women with greater incomes were less likely to experience premenstrual symptoms (Woods, Most, & Dery, 1982). Many investigators have argued for a possible association between premenstrual symptoms and the use of oral contraceptive. The results were controversial; some reported that OC use does not influence premenstrual mood change(Joffe,

Cohen, & Harlow, 2003; Sveinsdottir & Backstrom, 2000) while others found mood changes(Almagor & Ben-Porath, 1991).

Statistical Methods

Changes in depressive symptoms across the menstrual cycle phases were analyzed with linear mixed models controlling for race, age, marital status, level of income, level of education, employment status, and use of oral contraceptives(OC). This was done, because linear mixed models, also known as hierarchical linear modeling, can appropriately handle a time-series repeated measurement and allow multilevel analysis(Verbeke & Molenberghs, 2000). The model for depressive symptom was constructed as a composite of categorical variables that include menstrual cycle phase effects, socio-demographic variables(age, race, marital status, income level, education level, and employment status) and a biological variable(oral contraceptive use).

To carry out the linear mixed model analysis, the researcher employed SAS Version 9.13, specifically the PROC MIXED command. The linear mixed model included symptom severity scores as a response variable and menstrual cycle phase as a repeated variable. Race, age, marital status, level of income, level of education, employment status, and use of OC were entered into models of each symptom as covariates. As a covariance structure, the first order autoregressive

Table 1. Linear Mixed Model Design

Response Variables	Repeated Variable	Explanatory Variables
Symptom Scores of Depressive Mood	Menstrual Cycle Phase	Race Age Income Education Marital status Employment OCP use
Covariance Structure: AR(1) First Order Autoregressive Estimating Method: Restricted maximum likelihood		

(AR1) was selected, and restricted maximum likelihood(REML) was used as an estimating model(Table 1). Changes in symptoms between the premenstrual phase and the postmenstrual phase were compared by the CONTRAST command in SAS.

Results

Characteristics of the participants

Characteristics of the participantsare presented in Table 2. Taken together in the weighted sample by the US Census data(US Department of Commerce US Census Bureau, 2002), participants tended to be white(41.7%), married (42.3%), employed(60.8%), educated(some college or more; 60.2%), in the range of 25-44 years of age(53.9%), had an annual family income between $20,000 and $59,999(49.8%), and did not use oral contraceptives(76.4%)(Table 2).

Depressive Mood Symptom Change across the Menstrual Cycle

The linear mixed models(LMM) analysis were used to measure the longitudinal data of symptom changes across the menstrual cycle phase. The results show that significant menstrual cycle phase effects were seen on symptoms as were significant differences between the premenstrual and postmenstrual phases, mainly at the level of $p<.0001$. Comparison between the premenstrual and postmenstrual phases is important, because, by DSM-IV PMDD definition(American Psychiatric Association, 1994), symptoms must be present during the last week of menstruation and absent in the postmenstrual week(American Psychiatric Association, 1994).

Figure 1 presents the daily symptom change pattern in depressed mood over two menstrual cycles, as well as a cyclical change pattern related to the menstrual cycle. Variability of women's menstrual cycle lengths was

Table 2. Characteristics of the Participants[1]   (n = 1,246)

		Unweighted Sample		Weighted Sample	
		N	(%)	N	(%)
Race	Black	170	(13.7)	429	(34.5)
	White	977	(78.6)	519	(41.7)
	Hispanic	74	(6.0)	264	(21.2)
	Native American	7	(0.6)	4	(0.3)
	Asian/Pacific	13	(1.0)	26	(2.1)
	Other	2	(0.2)	3	(0.2)
Marital Status	Married	719	(59.6)	516	(42.3)
	W/D/S	117	(9.7)	132	(10.8)
	Single	285	(23.6)	475	(38.9)
	Living w/someone	85	(7.0)	98	(8.0)
Age group	13 – 24	204	(16.4)	295	(23.7)
	25 – 34	428	(34.5)	375	(30.2)
	35 – 44	463	(37.3)	395	(31.8)
	45 – 55	147	(11.8)	176	(14.2)
	Mean(SD)	33.77	(8.96)	32.77	(10.39)
Annual Family Income	$19,999 or lower	195	(17.3)	345	(30.6)
	$20,000 – 59,999	632	(56.1)	561	(49.8)
	$60,000 or higher	300	(26.6)	220	(19.5)
Employment Status	Student	148	(12.6)	228	(18.8)
	Unemployed	36	(3.1)	54	(4.4)
	Employed	826	(70.1)	737	(60.8)
	Homemaker	168	(14.3)	194	(16.0)
Education	Less than High School	162	(13.4)	303	(24.8)
	High School Graduates	212	(17.6)	183	(15.0)
	Some College	431	(35.7)	349	(28.6)
	College Grad or more	401	(33.3)	386	(31.6)
Oral Contraceptive Use	Non User	905	(72.7)	951	(76.4)
	OC User	339	(27.3)	293	(23.6)

standardized to a 28-day cycle. Day-28 was adjusted to the onset of the first menstrual cycle, day 0 to the onset the 2nd menstrual cycle, and day 28 to the onset of the 3rd menstrual cycle. As a result, the first menstrual cycle is from day -28 to day 0, and the second
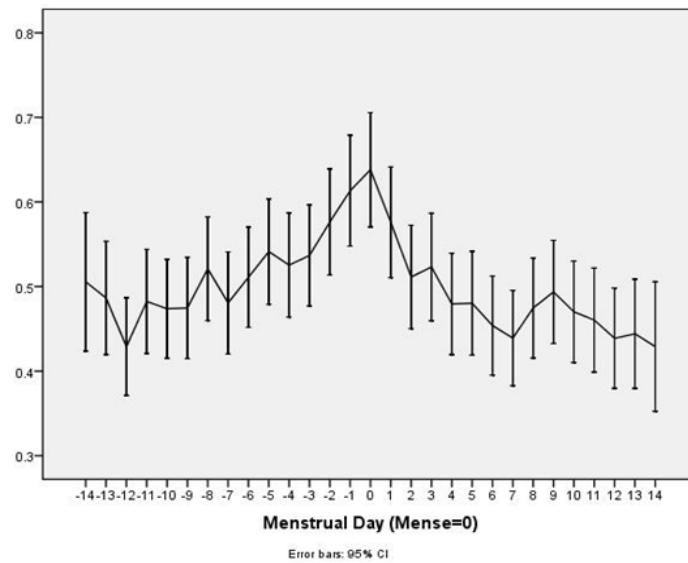
Figure 1. Daily Symptom Change Pattern in Depressed Mood across the Menstrual Cycle

menstrual cycle is from day 0 to day 28.

The results indicate that there was a significant change in depressed mood across the menstrual cycle phases(F_{2982}=11.16, p<.001), and the level was significantly higher during the premenstrual phase(estimate = 0.8545), as compared to the postmenstrual phase (estimate= 0.7176; F_{2982}=26.12, p<.001) (Table 3 and Figure 2).

Depressive Mood Symptom and the Explanatory Variables

As shown in Table 3, the severity of depressed mood was associated with education (F_{994}=14.04, p<.001), and marital status

(F_{994}=4.31, p<.01). Across the menstrual cycle phases, the overall scores of depressive mood were higher among those who are widowed, diverced, or separated(estimates=.9108) than those who are married(estimates=.6580) statistically significantly at the level of p<.01. Less educated participants with high school education or less reported higher scores for depressed mood, and the score difference was statistically significant between those with high school education or less and those with college education or more(Table 3).

In contrast, depressed mood was not associated with race, age, income, employment status, or OCP use, when controlling for the variables included in the models, at the level of p<.05 as shown in Table 3.

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1) The sum does not add up to the total (1,246) because of missing responses

Table 3. Fixed Effects of Menstrual Cycle Phase on Depressed Mood.

| Variables	Num df	Den df	F Value	Estimates
Repeated Variable (Time)				
Menstrual Cycle Phase	3	2982	11.16[***]	
Early Luteal				0.8107
Premenstrual				0.8545
Menstrual				0.8238
Postmenstrual				0.7176
Control Variables				
Race	1	994	2.63	
White				0.8574
Other than White				0.7459
Marital Status	3	994	4.31[**]	
Married				0.6580
Widowed/Divorced/Separated				0.9108
Single				0.7841
Living with someone				0.8538
Age	3	994	0.39	
13-24				0.7817
25-34				0.7907
35-44				0.7311
45-55				0.9032
Annual Family Income	2	994	2.77	
$19,999 or less				0.9104
$20,000 – 59,999				0.7643
$60,000 or more				0.7303
Employment Status	3	994	1.29	
Student				0.7628
Unemployed				0.9148
Employed				0.7201
Homemaker				0.8090
Education	1	994	14.04[***]	
High School or less				0.8974
Some College or more				0.7060
OC Use	1	994	0.39	
Non-user				0.8177
User				0.7856
CONTRAST test between				
Pre & Postmenstrual Phase	1	2982	26.12[***]	

* $p<.05$, ** $p<.01$, *** $p<.001$
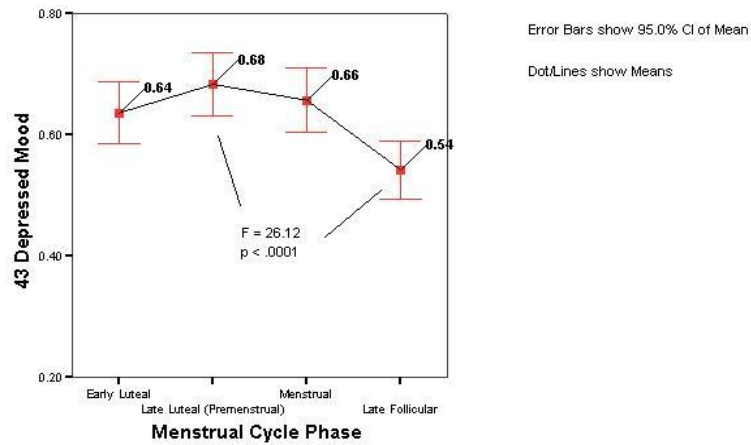
Figure 2. Changes of Depressed Mood across the Menstrual Cycle Phases

Discussion and Conclusion

The purpose of this study was clear and straightforward. The intent of analyzing changes in women's moods across the menstrual cycle in the community-based data was to determine if women's moods and symptoms change across the phases of the menstrual cycle, and to examine if the severity of the moods and symptoms is greater during the premenstrual phase than the postmenstrual phase. The results show that: (1) there are statistically significant changes in moods and symptoms across the menstrual cycle phase in depressive symptoms; (2) there are significant differences in the symptom levels between pre- and post-menstrual phases, (3) the severities during the premenstrual phase are significantly higher as compared to the postmenstrual phase.

The statistical findings indicate that women's depressive moods are affected by their menstrual cycles and that the severity of symptoms is greater during the premenstrual than the postmenstrual phase. Given that premenstrual changes have been widely acknowledged since ancient times, it might not be particularly striking that this study found greater severity of women's emotional and physical symptoms associated with the premenstrual phase. However, this study is particularly meaningful in confirming the inconsistent results of previous studies about the existence of menstrual cycle-related mood changes, using community-based data.

The results of this study corroborate some observations from existing studies. Although premenstrual mood change is accepted as occurring, there have been inconsistent and controversial reports on mood change across the menstrual cycle. These inconsistencies and controversies, however, are partially due to methodological difficulties, including sample

selection(Asso, 1983). For example, studies on depressed mood and the menstrual cycle have shown quite different results. Moos(1969) and Silbergeld, Brast, and Noble(1971) reported no change in mood, while some others found significant changes in mood across the menstrual cycle(Almagor & Ben-Porath, 1991; Metcalf, Livesey, Wells, & Braiden, 1989, 1990; Woods, Most, & Dery, 1982). Indeed, the dataset used in this study supports previous studies that demonstrated the association between mood changes and the menstrual cycle, as well as corroborates the commonly held assumption that the emotional changes are associated with women's menstrual cycle.

However, although the changes actually exist in regard to statistical significance, the results of this research should be interpreted with caution. Symptom change in mood over time was determined to be statistically significant, but the estimate for the premenstrual phase was 0.8545 and that of the postmenstrual phase was 0.7176 on a 0-5 scale. As such, the estimates lie between "0: not at all" and "1: very mildly." Even though this study's results support the existence of premenstrual symptom changes, they should not be interpreted as evidence of the existence of women's cyclic "mental problem", nor should they be interpreted as all women having mood fluctuations over the menstrual cycle.

Another point to be considered, as noted above, is that the results should not be interpreted as all women having emotional and physical symptoms that fluctuate across the menstrual cycle. In interpreting the results, we need to consider that these estimates may reflect symptom changes of a small number of women in a population. Failing to distinguish non-clinical premenstrual changes from clinically significant symptoms may result in medicalizing a normal female experience and making it a misdiagnosed disorder, as many investigators have pointed out(Brooks-Gunn & Ruble, 1980; Hardie, 1997). Feminists also criticize the notion that normal female changes might be stigmatized as a mental illness(Figert, 1996; Ussher, 2003). In this regard, the next step should be to distinguish women with significant changes from those without such changes.

How much change is significant? The National Institute of Mental Health(1983) suggested that at least a 30% increase in symptom severity during the premenstrual week, as compared with the postmenstrual week, should be used to make the diagnosis of premenstrual symptoms. However, strictly and mathematically speaking, percentage calculation is restricted to ratio scales, while most mood questionnaires employ ordinal or interval scales(the Likert scale is strictly an ordinal scale, but is often used as an interval scale in social science). Thus, it would be theoretically impossible to employ percentage change methods in measuring mood scores. To date, there is no consensus among researchers and clinicians as to

the best measuring instruments for confirming the menstrual cycle-related mood changes, nor is there an agreement as to the measuring instruments most appropriate to examining treatment effects in clinical trials(Steiner & Born, 2002b). Because no single method is superior to another, Schnurr(1989) suggested that "the choice of a method probably should depend on the investigator's circumstances rather than on the method itself"(p.277).

Depending on the change measurements, researchers obtain different results. For example, in a premenstrual dysphoric disorder prevalence study, Gehlert and Hartlage(1997) determined that the method of symptom change analysis made the prevalence different, with 1.0% by percentage change, 4.0% by effect size, 1.0 by absolute severity, and 7.1% by trend analysis (Gehlert & Hartlage, 1997). Gehlert, Song, Chang, and Hartlage(2009) found that, in a large population(N = 1,246), the prevalence of PMDD was 1.3%(N=17) by effect size and 1.6%(N=20) by absolute severity. What is surprising was that only two cases were confirmed to have changes in mood by both effect size and absolute severity methods. This suggests that researchers should be cautious in selecting change measurement methods for valid and reliable measurement of menstrual cycle-related mood changes.

The findings of this study present important implications for women's mental health in research and clinical settings. First, because a significant change across the menstrual cycle was found in a community-based sample of women, information on the menstrual cycle needs to be considered when measuring women's mental health parameters. For example, depressed mood can be overestimated during the premenstrual phase, but underestimated during the postmenstrual phase. In a cross-sectional study of mental health, unless the phase of the menstrual cycle is controlled for, estimates of mental health may be misleading. This implication also can be applied to clinical settings. Assessments of women's mental health without considering menstrual cycle information may result in inappropriate diagnostic decisions.

This study suggests the following implications: Insofar as proper attention has not been given to women's mental health, ignorance of women's mental health is a matter of social injustice, and this gender discrimination should be resolved. In addition, clinically speaking, based on the large number of women suffering from premenstrual-related symptoms, mental health practitioners should possess a proper understanding of its mechanism and importance of menstrual-related problems for women. A better understanding of menstrual cycle-related mood change is beneficial to our society because the menstrual cycle is a natural biological process affecting women's lives and well-being. Proper clinical interventions are always guided by better scientific knowledge, which in turn can promote women's health, mental health, and quality of life.

Limitations of the Study and the Direction for Future Study

The quality of this study depends on the quality of the WWS data. As previously stated, the WWS research design provided certain methodological strengths. The sample selection, made by the National Opinion and Research Center, based on the US Census data, provided a systematic representation of the community population in the Midwestern United States, while many existing studies of this topic have conveniently selected small samples from clinics and colleges. In addition, the WWS has another methodological strength in its obtaining of daily symptom scores using prospective instruments and in its consideration of psychiatric information, health information, and information on the participants' quality of life. To the best of this researcher's knowledge, to date, these data are the first available large community-based data on the menstrual cycle-related studies.

One of this study's weaknesses is the daily reported mood symptom scores; it is an inherent limitation that the emotional and physical symptom scores are based on the participants' self-reported information. Another limitation, due to the nature of a community-based premenstrual symptom study, is the complexity of determining environmental influences on psychological symptoms. In a community setting, there are many other factors that affect women's mood, such as environmental stress, work stress, unexpected accidents, or relationship conflicts, but it is impossible to absolutely control for the external influences. Moreover, when considering social constructionist theory, one has to take into consideration certain cultural values that affect women's attitude towards menstruation and, as a result, affect the perception of premenstrual symptoms. However, this is beyond the scope of this quantitative epidemiologic study, and the analysis was limited to the variables that were obtained from the WWS data. Another limitation of this study is that the results from data collected in US Midwestern sites may not be generalizable to the entire women, even though the sample in this study represents the women population in two urban and two rural sites in the Midwestern United States. This community-based sample has its strengths in that most of previous studies used convenient samples from clinics where women seeking medical services were collected or colleges where the sample ages were biased. However, the data which was used in this study still lack of detailed information about minority women such as Asian-origin women by nature of the geographical limitation. Thus, it has limitations in providing information and implications for minority women including Korean women. Future research applying this systematic research protocol is warranted in Korea to fully understand the nature of the menstrual cycle-related psychological mood changes across

the nations and the cultures.

Finally, although the overall level of the symptoms were statistically significantly high, this study does not provide information on whether this greater severity is due to female-hormonal changes, negative attitudes toward menstruation, socially constructed values of menstruation, or the complexity of bio-psycho-social factors, while the empirical evidence found here supports the notion that the menstrual cycle is associated with women's depressive symptoms.

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생리주기에 따른 여성 우울감정의 자연적 변화 분석

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광범위하게 퍼져있는 생리주기에 따라 여성의 감정이 변한다는 가정에도 불구하고, 그러한 가정은 실증적 연구에 의해 충분히 지지되지 않으며, 생리주기가 여성의 우울증상에 미치는 영향은 여전히 논쟁중이고 밝혀지지 않은 상태로 남아있다. 실증적 증거 부족의 주된 이유는, 체계적이고 무작위적으로 표집된 지역 사회 기반의 데이터를 통해 현상을 체계적으로 설명하는 과학적 연구의 부재에 있다. 본 연구는 여성건강에 관한 지역사회 기반의 최초 대규모 연구인 여성건강연구(Women's Wellness Study) 데이터를 이용하여, 여성의 생리주기가 우울감정과 관련된 현상을 조사하였다. 생리를 경험하고 있는 13세에서 55세까지의 1,246명의 여성을 미국 중서부지역으로부터 표집하여 구축된, 60일간 매일의 감정증상 데이터와 소변검사를 통한 호르몬 데이터가 분석되었다. 생리주기 동안의 우울감정의 변화를 검증하기 위해, 성별, 결혼상태, 소득, 교육수준, 직업수준, 피임약복용 여부를 통제하고 난후, 선형복합모델(Linear Mixed Model)을 사용하여 분석하였다. 생리주기 동안 통계적으로 유의미한 수준에서 여성의 우울감정 변화가 발견되었으며, 생리후 단계에 비해 생리전 단계(후기 황체기) 동안의 우울증상 정도가 통계적으로 유의미하게 높게 나타났다. 이러한 결과는 생리주기동안 우울증상의 유의미한 변화가 있음을 보여주며, 이러한 감정변화의 임상적 유의성에 대한 추가적인 연구가 필요하다. 본 연구의 결과는 여성정신건강 증진을 위한 연구 및 임상목적의 정신건강 변수 측정시 생리주기의 정보가 고려되어야 함을 함의한다. 생리주기의 정보를 고려하지 않은 여성정신건강 사정은 부적절한 진단적 판단을 야기할 가능성이 있다.

주요어 : 여성정신건강, 우울감정, 생리주기

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