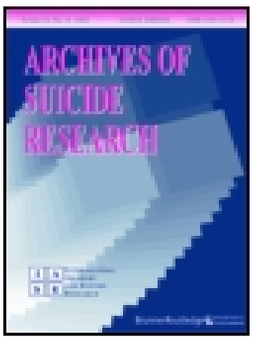

Archives of Suicide Research

ISSN: 1381-1118 (Print) 1543-6136 (Online) Journal homepage: http://www.tandfonline.com/loi/usui20

Menstrual Cycle Effects on Mental Health Outcomes: A Meta-Analysis

Daisung Jang & Hillary Anger Elfenbein

To cite this article: Daisung Jang & Hillary Anger Elfenbein (2018): Menstrual Cycle Effects on Mental Health Outcomes: A Meta-Analysis, Archives of Suicide Research, DOI: 10.1080/13811118.2018.1430638

To link to this article: https://doi.org/10.1080/13811118.2018.1430638

Accepted author version posted online: 20 Feb 2018.
Published online: 14 May 2018.

Archives of Suicide Research, 0:1–21, 2018

ISSN: 1381-1118 print/1543-6136 online
DOI: 10.1080/13811118.2018.1430638

Routledge
Taylor & Francis Group

Menstrual Cycle Effects on Mental Health Outcomes: A Meta-Analysis

Daisung Jang and Hillary Anger Elfenbein

The premenstrual phase of cycle has long been associated with a constellation of health symptoms for women. However, there has been no recent quantitative review of severe mental health outcomes as a function of the menstrual cycle. We examine cycle influences on completed suicides, suicide attempts, suicidal ideation, and psychiatric admissions, and contrast these with non-suicide deaths. We conducted a meta-analysis of 32 papers, with an N of 3,791. We find 26% greater risk of suicide deaths, 17% greater risk of suicide attempts, and 20% greater risk of psychiatric admissions at menstruation. We also observe 13% greater risk of psychiatric admissions during the premenstrual phase. Suicidal ideation was unrelated to the stage of menstrual cycle. Available evidence finds serious and consequential mental health outcomes in the menstrual and premenstrual phases.

Keywords menstrual cycle, mental health, meta-analysis, suicide

Much has been written and speculated about women's health throughout the menstrual cycle. Systematic efforts to study the cycle and its influences on health has become increasingly important, as the number of cycles experienced by women across history as women increased greatly. Women experienced just 5 lifetime cycles for much of human history, but with advances in contraception and nutrition, that number has grown to an estimated 450–500 cycles per lifetime for the youngest generation of American women (Gwartney, 2016). In this meta-analysis, we examine the accumulated evidence on menstrual cycle influences on severe psychological health outcomes, namely completed suicides, suicide attempts, suicidal ideation, and psychiatric admissions, and we contrast this with non-suicide deaths. We examine all phases of the menstrual cycle and highlight two phases likely to be associated with negative mental health outcomes for women: the menstrual and premenstrual phases.

Physiological and psychological symptoms around menstruation may contribute to mental health outcomes. Physical pain and discomfort (dysmenorrhea) is a common experience (45% to 95% of women studied, Proctor & Farquhar, 2006). Dysmenorrhea is associated not only with physical pain, but significantly lower health-related quality of life perceptions (Unsal, Ayranci, Tozun, Arslan, &

Calik, 2010). In addition, menstruation is associated with a range of psychological symptoms, including perceptions of lower self-esteem, and greater levels of anxiety, dysphoria, and feelings of persecution (Brock, Rowse, & Slade, 2016). Behavioral symptoms, such as reduced social engagement during menstruation, may contribute to feelings of isolation and even depression (van Iersel, Kiesner, Pastore, & Scholte, 2016). Indeed, previous large-scale reviews have suggested that women may be at risk of a greater incidence of completed suicides and suicide attempts in the menstrual phase (Saunders & Hawton, 2006). Rather than being independent of natural hormonal shifts, these past reviews suggest psychological symptoms, and accordingly, mental health outcomes, could coincide with menstruation. In line with these earlier reviews, we posit that symptoms experienced during menstruation may contribute to serious outcomes related to mental health.

Mental health outcomes at menstruation might also be influenced by stress related to societal stereotypes. Across cultural and religious groups, women were often sequestered from others, and faced institutionalized sanctions around the time of menstruation, particularly in the absence of modern health education (Dennerstein & Burrows, 1979; Hall, 1904; Phipps, 1980). Although such sanctions may not be a part of many women's lives today, negative stereotypes persist, for example in advertisements of sanitary products, with menses associated with themes of shame, denial, and impediment (Block Courts & Berg, 1993). Stereotypes that associate menstruation and dysfunction held by the self, one's peers, and codified in one's culture can create a hostile environment for psychological functioning around menstruation. Taken together, H_1 is that the menstrual phase will be associated with a greater rate of negative mental health outcomes compared to the other phases.

The premenstrual phase has been associated with the experience of distress. Commonly described as the premenstrual syndrome (PMS), women tend to experience an increase of negative affect before menstruation (Dennerstein & Burrows, 1979). Although there is variability in both the quality of studies and results obtained in this line of research, symptoms such as depression, affective lability, tension, anger, and irritability are commonly reported to occur before menstruation (Gallant & Hamilton, 1988). PMS is also associated with physical symptoms such as breast tenderness and water retention, as well as behavioral symptoms such as social withdrawal, and sleep disturbances (Freeman, 2003). Severe forms of premenstrual distress can comprise a depressive disorder, for which a formal clinical diagnosis exists (American Psychiatric Association, 2013). Consistent with this view, an early narrative review concluded that the premenstrual phase was associated with greater likelihood of suicide behavior (Dalton, 1964). However, the small body of existing research meant that the only three studies that examined suicidal ideation and completed suicides were reviewed. Taken together, H_2 is that the premenstrual phase will be associated with a greater rate of negative mental health outcomes compared to the other phases. H_3 is that premenstruation will be associated with a higher rate of mental health outcomes compared to menstruation. H_3 is based on the premise that mental health professionals have created a formal diagnostic criterion for disorders specific for the premenstrual phase, whereas no such guidelines exist for the menstrual phase.

Studies that indicate increased symptoms around menstruation and premenstruation indicate correlation between ovarian hormone fluctuations and psychological symptoms. Indeed, prior

studies have shown they correlate with other kinds of mental health outcomes, such as eating disorder symptoms (Edler, Lipson, & Keel, 2007; Klump et al., 2006, 2013). The notion of hormonal influence on mental health outcomes is also consistent with experimental findings that show deliberate ovarian suppression with leuprolide significantly reduced symptoms among women with premenstrual syndrome (Schmidt, Nieman, Danaceau, Adams, & Rubinow, 1998). Thus, we sought to test the moderating effects of the oral contraceptive pill (OC). OC use has been said to ameliorate the symptoms of dysmenorrhea for 66% of women with existing dysmenorrhea (Brill, Norpoth, Schnitker, & Albring, 1991). Similarly, reviews of combined progesterone and estrogen OC trials show them to be effective in reducing the symptoms of premenstrual dysphoric disorder (Lopez, Kaptein, & Helmerhorst, 2012). Where the data were available, we compared the pattern of outcomes in women taking oral contraceptives vis-à-vis naturally cycling women. H_4 is that menstrual cycle effects are attenuated by OC.

To test the hypotheses, we conducted a meta-analysis of observational studies of women who experienced a mental health outcome. We report results using the guidelines recommended by the Meta-analysis of Observational Studies in Epidemiology Group (MOOSE; Stroup et al., 2000).

METHOD

Search Strategy

We conducted a systematic review of electronic databases that could contain research about human behavior with respect to the menstrual cycle: PsycInfo, Pubmed, Social Science Research Network, Econlit, and the National Bureau of Economic Research. These databases contain behavioral research that is published as journal articles, books, dissertations, and unpublished working papers. In each database, we used the following terms to retrieve documents: "menstrual," "menses," "estrus," "oestrus," "progesterone," "estrogen," "oestrogen," "luteal," "follicular," and "ovulation." Because we wanted to focus on menstrual cycles among menstruating females, we included limits to the search results for databases that allowed limits on results. For Pubmed, we included articles relevant to human, female, published in English (due to resource constraints), and with participant populations aged from 6 to 64, and excluded studies that contained the terms: "embryo," "cancer," "treatment," "pregnancy," "epidemiology," "infection," "contract," "case study," "anorexia," "bulimia," "trial," "syndrome," "inflammation," "congenital," "disorder," "pathogenesis," "cell," "virus," "pathways," "secretion," "morphology," "substrate," "immunology," "implant," "arthritis," and "urinary." For PsycInfo, we included articles that were published in English, had female participants, and with participant populations aged from 6 to 64. We placed no lower bound limitations on published date of the study, and the search was current as of March 2015. No specialized software was used to conduct the search.

The first round of inclusion criteria involved examining the titles and abstracts of the papers for mentions of mental health related behavior (suicides, suicidal ideation, suicide attempt, psychiatric admissions) across the menstrual cycle. We added to that list by conducting forward and backward citation searches of those articles using Google Scholar. We also requested published and unpublished papers and datasets on the American Psychological Association division listservs for suicideology, trauma psychology, clinical psychology,

psychopharmacology and substance abuse, and addiction.

The full text of the papers remaining in the candidate pool were subject to a second set of criteria. Papers were included if they provided the number of women experiencing a mental health outcome within menstrual phases defined in terms of specific days of the cycle. Papers that did not define the menstrual cycle in terms of specific date ranges and case studies were excluded since they contained insufficient information to compute effect sizes. The list of papers that did not meet the second criteria are available from the researchers upon request. The first author, who holds an MA, and PhD in Organizational Behavior, conducted the literature search.

Data Coding and Interrater Reliability

The first author coded all variables, and a research assistant blind to the hypotheses served as a second coder, independently examining 20% of studies (i.e., 7) selected at random. The second coder recorded the publication year, menstrual status of the participants, country of origin of the participants, phase definitions as reported in the results section, determination of menstrual cycle, dependent variables measured, and the counts of outcomes in each menstrual phase as defined in the results section. There was perfect agreement between the two raters on all records.

Mental Health Outcomes

Studies were selected for analysis if they measured one of the following dependent variables: completed suicides, suicidal ideation, suicide attempts, and mental health related hospital intakes on a between-subjects basis.

Completed suicides were studied in five papers. In all cases, only the people judged to have committed suicide by the article authors were included in the analyses. Examination of cadavers were conducted in suicides reported to medical institutes or mortuaries. For comparison, deaths due to non-suicide causes were studied in the same five papers. This included deaths due to accidents, disease, and other causes. Although we did not originally aim to analyze non-suicide deaths, the data were present in all papers reporting completed suicides, so we took the opportunity to examine the data.

Suicidal ideation was studied in three papers. These included telephone calls to suicide prevention phone lines and assessment of suicidal ideation at time of psychiatric admission.

Suicide attempts were studied in 17 papers. These included studies of women admitted or referred to hospitals for suicide attempts, admitted to psychiatric facilities for suicide attempts, referred to poisoning treatment centers, or who visited military stations. As such, all suicide attempts studied were based on women's subsequent use of healthcare following the attempt.

Psychiatric admissions were studied in 14 papers. These included studies of women admitted for non-suicide related mental health reasons, such as depression and schizophrenia. We conducted separate analyses for the subset of admissions for drug abuse (alcohol and cocaine).

Oral Contraceptive Use

We conducted subset analyses where at least two studies reported data on the same dependent variable for women using oral contraception and naturally cycling women. It was possible to conduct such analyses only for suicide attempts. Although we recognize that women on OC do not truly experience a menstrual cycle, they still serve as a useful comparison group against which the potential effects of hormonal shifts can be observed.

Definition of Menstrual Cycle

Apart from a near universal agreement across the studies sampled that a menstrual cycle is typically 28 days long, there was no consistent agreement on the number and length of phases across studies. Thus, we relied on a precedent set by Riley, Robinson, Wise, and Price (1999) in their meta-analysis of pain perception across the menstrual cycle. They divided a nominal 28-day cycle into five phases: Phase 1—menstrual (days 1–5), Phase 2—follicular (days 6–11), Phase 3—periovulatory, days 12–16, Phase 4—luteal (days 17–23), Phase 5—premenstrual (days 24–28).

This division of the cycle makes the tradeoff between being able to examine theoretically interesting aspects of the cycle (i.e., menstrual, ovulation, and premenstrual), and methodological elegance. Some studies define the cycle in terms of four equally spaced phases, but this precludes the ability to examine periovulatory effects. Below we explain how we handled data that were reported with differing definitions of the cycle.

Computation of Effect Sizes

All dependent measures involved counts of women who exhibited a health outcome. Because we were interested in the relative risk of an outcome across the cycle, we selected a ratio measure, the Standardized Mortality Ratio (SMR) (Kahn, 1989) as the dependent variable. The SMR is defined as the ratio of the observed count of an incident, divided by the expected number of incidents. Thus, for all outcomes, a ratio greater than 1 indicates a greater rate of that outcome than would be expected. A ratio less than 1 indicates a lower rate of that outcome than would be expected. The variance of SMR was defined as estimated SMR divided by the expected count (Kahn, 1989).

Because of the varying definition of menstrual cycles across studies, we standardized the data across the studies. We first recorded the phase definition and the number of outcomes reported in each study. We assumed that the number of outcomes (e.g., suicide attempts) within each phase was evenly distributed within the phase. We then calculated the proportion of counts in the original study that would map to this definition of the menstrual cycle. That is, most studies that did not use the Riley et al. (1999) system reported a smaller number of phases. So the count of women in each of these larger phases was split proportionately into the Riley et al. system of smaller phases. In studies that used a larger number of phases, the counts were aggregated into the phases defined by Riley et al.

To provide an example, SMRs for the Vanezis's (1990) study on completed suicides in the following way. Vanezis provided data in terms of four phases: menstrual (days 1–5; 10 deaths), proliferative (days 6–15; 18 deaths), early secretory (days 16–19; 9 deaths), mid/late secretory (days 20–28; 13 deaths). Vanezis' definition of menstrual phase coincided with our definition of the menstrual phase, requiring no further action. To estimate the number of attempts for Phase 2 in our cycle definition, we divided the 18 deaths by 8 days (i.e., calculate a per-day estimate of number of attempts), then multiplied this figure by 6 to reflect the number of days in Phase 2 to arrive at 13.5 attempts for this cycle (Phase 2: $18/8 \times 6 = 13.5$ attempts). A similar procedure was used to calculate estimates for expected counts for the remainder of phases.

Reliability of menstrual phase measurement remains an open issue. No study we examined provided reliability statistics for measuring the cycle. Given the nature of the outcomes under study, namely suicide and other serious mental health outcomes, more reliable methods to detect phases

may be impossible to apply, such as prospectively tracking cycles. Rather, taking advantage of more vs. less visible points in the cycle may remain the best approach to dealing with reliability concerns. Because of its visible manifestation on the body, menstruation is likely to be more reliably detected than other phases of the cycle. This also implies lower accuracy in identifying other phases of the cycle, and lower confidence of the estimates for other phases. H_1, which compares the menstrual phase to the remainder of phases, presents the best opportunity to examine cycle effects where reliability concerns exist.

Analysis Strategy

Because five SMRs were nested in each study, we conducted a multi-level analysis, using the *metafor* package (version 1.9-9) with the R statistical software language. We conducted a no-intercept analysis in order to compare each log(SMR) against the theoretically meaningful comparison level of zero, and assumed compound symmetry of the covariance structure. Thus, the level 1 regression equation was:

$$Y_{ij} = \beta_{1j} X_{ij} + e_{ij}$$

Where Y_{ij} represents the log(SMR) of ith phase in the jth sample, X_{ij} represents the ith phase in the jth sample, and e_{ij} represents error for ith phase in the jth sample. The level 2 regression equation was:

$$\beta_{1j} = \gamma_{10} + U_{1j}$$

Where γ_{10} represented the mean log (SMR), and U_{1j} represents the deviation for study j. SMRs were log-transformed before analyses, because directly comparing ratios greater than one and less than one are not appropriate (Lipsey & Wilson, 2001). The variance of log(SMR) were defined as: var(SMR) × $1/SMR^2$, derived by applying the delta method (Hosmer, Lemeshow, & May, 2008). All of the results displayed in Table 1 display the exponentiated coefficients.

Assessment of Heterogeneity and Study Quality

Heterogeneity was assessed across all analyses using the Q test for residual heterogeneity.

A previous review indicated the method of menstrual cycle determination as a differentiator of study quality, with hormonal assays representing the highest quality (Saunders & Hawton, 2006). Thus, we tested for the robustness of the main conclusions by comparing the pattern of results against the subset of studies that used hormonal assays.

RESULTS

Out of a candidate pool of 8,057 potential papers, 32 met criteria for inclusion in the analyses, describing an overall N of 3,791 women (Figure 1). The samples had an average of 88.16 participants (median = 75). Table 1 describes each sample, including birth control used (naturally cycling, hormonal contraception, or mixed), participant age, occupation, national origin of the participants, occupation, method of menstrual phase determination, and effect sizes for each study. Table 2 houses the results for all analyses, and Figures 2 and 3 display the results graphically. None of the Q heterogeneity tests were significant, and so moderators were not tested and will not be discussed further.

Completed Suicides

The menstrual phase is associated with a greater rate of suicide. Examining the Standardized Mortality Ratio (SMR) for

TABLE 1. **Characteristics of Samples Included in the Meta-Analysis**

Dependent Variable	Study	OC use	N	Age M	Recruitment Context	Country	Cycle determination	SMR P1	SMR P2	SMR P3	SMR P4	SMR P5
Suicide	MacKinnon and MacKinnon (1956)	–	23	–	Autopsies conducted at mortuary	UK	Examination of endometrial tissue	.02	.12	.56	2.43	1.46
Suicide	MacKinnon, MacKinnon, and Thomson (1959)	–	38	–	Autopsies conducted at mortuary	UK	Examination of endometrial tissue	.19	.22	.72	2.74	.59
Suicide	Vanezis (1990)	NC	50	32.90	Autopsies conducted by coroner	UK	Examination of endometrial tissue	1.12	1.26	.76	1.00	.81
Suicide	Dogra et al. (2007)	–	202	–	Autopsies conducted at medical institute	India	Examination of uterine cavity	3.05	.55	.55	.55	.55
Suicide	Leenaars, Dogra, Girdhar, Dattagupta, and Leenaars (2009)	–	43	26.16	Autopsies conducted at medical institute	India	Examination of endometrial tissue	1.82	.46	.59	1.10	1.10
Non-suicide deaths	MacKinnon and MacKinnon (1956)	–	15	–	Autopsies conducted at mortuary	UK	Examination of endometrial tissue	.04	.19	1.23	2.13	1.12
Non-suicide deaths	MacKinnon et al. (1959)	–	64	–	Autopsies conducted at mortuary	UK	Examination of endometrial tissue	.16	.35	.91	2.13	1.14
Non-suicide deaths	Vanezis (1990)	NC	121	30.07	Autopsies conducted by coroner	UK	Examination of endometrial tissue	.74	1.42	.80	1.02	.93

(Continued)

TABLE 1. **Continued**

Dependent Variable	Study	OC use	N	Age M	Recruitment Context	Country	Cycle determination	SMR P1	SMR P2	SMR P3	SMR P4	SMR P5
Non-suicide deaths	Dogra et al. (2007)	–	210	–	Autopsies conducted at medical institute	India	Examination of uterine cavity	.43	1.12	1.12	1.12	1.12
Non-suicide deaths	Leenaars et al. (2009)	–	29	29.48	Autopsies conducted at medical institute	India	Examination of endometrial tissue	.39	1.64	1.46	.74	.74
Suicidal ideation	Mandell and Mandell (1967)	–	87	–	Calls to suicide prevention center	US	Self-report	1.79	.48	1.05	.59	1.37
Suicidal ideation	Wetzel, Reich, and McClure (1971)	–	49	–	Calls to suicide prevention center	US	Self-report	1.71	.93	.94	.65	.91
Suicidal ideation	Targum, Caputo, and Ball (1991)	NC	20	30.80	Psychiatric admissions	US	Self-report	1.47	1.40	.77	.15	1.47
Suicide attempt	Dalton (1959)	NC	36	–	Psychiatric admissions	UK	Self-report	2.33	.39	1.24	.44	.93
Suicide attempt	Thin (1968)	NC	100	28.80	Poisoning treatment centers & military stations	–	Self-report	1.18	.98	.67	.56	1.79
Suicide attempt	Tonks, Rack, and Rose (1968)	OC and NC combined	95	26.30	Hospital admissions	–	Self-report	.93	.84	.80	.99	1.47
Suicide attempt	Glass, Heninger, Lansky, and Talan (1971)	NC	13	25.00	Psychiatric admissions	US	Self-report	.62	.31	.15	.99	3.08
Suicide attempt	Birtchnell and Floyd (1974)	NC	76	–	Hospital admissions	UK	Self-report	1.26	1.26	1.05	.74	.74
		NC	114	–	Hospital admissions	UK	Self-report	1.12	.92	.82	.94	1.23

Suicide attempt	Pallis and Holding (1976)											
Suicide attempt	Luggin, Bernsted, Petersson, and Jacobsen (1984)	OC and NC samples	32	32.67	Psychiatric admissions	Denmark	Self-report	1.50	.75	.43	.82	1.63
Suicide attempt	Ekeberg, Jacobsen, Sørum, and Aass (1986)	NC	41	31.00	Suicidal self-poisoning	Norway	–	1.27	1.27	1.00	.67	.88
Suicide attempt	Fourestié et al. (1986)	OC and NC samples	108	27.40	Hospital admissions	France	Self-report	1.44	1.12	.86	.76	.89
Suicide attempt	Targum et al. (1991)	NC	14	30.80	Psychiatric admissions	US	–	.50	.75	.60	.29	3.20
Suicide attempt	Baca-García, González, Diaz-Corralero, García, and de Leon (1998)	NC	113	–	Hospital admissions	Spain	Self-report	1.45	.98	.70	.79	1.17
Suicide attempt	Baca-García, Díaz-Sastre, de Leon, and Saiz-Ruiz (2000)	NC	90	–	Hospital admissions	Spain	Hormonal assay	1.30	1.30	.50	.93	.93
Suicide attempt	Lande and Karamchandani (2002)	NC	11	–	Psychiatric admissions	–	Self and other report	1.18	.76	.98	.85	1.33
Suicide attempt	Baca-García et al. (2003)	NC	104	30.58	Hospital admissions	Spain	Hormonal assay	1.52	.89	.89	.89	.89
Suicide attempt	Çayköylü et al. (2004)	NC	52	26.51	Hospital admissions	Turkey	Hormonal assay	1.69	.97	.65	.78	1.00

(Continued)

TABLE 1. **Continued**

Dependent Variable	Study	OC use	N	Age M	Recruitment Context	Country	Cycle determination	SMR P1	SMR P2	SMR P3	SMR P4	SMR P5
Suicide attempt	Ainsah, Norharlina, and Osman (2008)	NC	86	25.00	Psychiatric admissions	Malaysia	–	1.58	.93	.57	.74	1.30
Suicide attempt	Baca-García et al. (2010)	NC	281	30.80	Hospital admissions	Spain	Hormonal assay	1.58	1.03	.91	.78	.78
Hospital admission	Dalton (1959)	NC	240	–	Psychiatric admissions	UK	Self-report	1.64	.79	.87	.71	1.15
Hospital admission	Kramp (1968)	NC	435	–	Psychiatric admissions	Denmark	–	1.08	.81	.81	.91	1.47
Hospital admission	Janowsky, Gorney, Castelnuovo-Tedesco, and Stone (1969)	NC	44	–	Psychiatric admissions	US	Self-report	2.04	.32	.51	.82	1.53
Hospital admission	Glass et al. (1971)	NC	84	25.00	Psychiatric admissions	US	Self-report	.90	.63	.50	.96	2.10
Hospital admission	Zola, Meyerson, Reznikoff, Thornton, and Concool (1979)	NC	51	34.00	Psychiatric admissions	US	Self-report	1.11	.92	.92	.95	1.15
Hospital admission	Abramowitz, Baker, and Fleischer (1982)	NC	115	33.07	Psychiatric admissions	US	Self-report	1.49	.73	.73	.73	1.49
Hospital admission	Luggin et al. (1984)	OC and NC samples	89	32.67	Psychiatric admissions	Denmark	Self-report	1.39	1.15	.93	.78	.81
Hospital admission	Shen (1984)	NC	33	–	Alcoholism admissions	US	Self-report	2.55	.74	.47	.91	.42

Hospital admission	Targum, Caputo, and Ball (1991)	NC	17	30.80	Psychiatric admissions	US	–	.82	1.24	.33	.71	1.98
Hospital admission	O'Dwyer, Friedman, and Clifford (1997)	OC and NC combined	93	33.00	Psychiatric admissions	–	Self-report	1.25	.87	.72	.92	1.29
Hospital admission	Lande and Karamchandani (2002)	NC	21	–	Psychiatric admissions	–	Self and other report	1.59	.27	.52	.74	2.13
Hospital admission	Ambrose-Lanci, Sterling, Weinstein, and Van Bockstaele (2009)	NC	75	–	Cocaine abuse admissions	US	Self-report	2.13	1.14	.60	.58	.69
Hospital admission	Weston, Speroni, Ellis, and Daniel (2012)	NC	177	34.10	Psychiatric admissions	US	Self-report	2.06	.77	.77	.77	.77

Note. NC = Naturally cycling, OC = women using oral contraceptives, OC and NC samples = outcomes for OC and NC samples reported separately, OC and NC combined = study did not report separately outcomes for OC and NC samples.

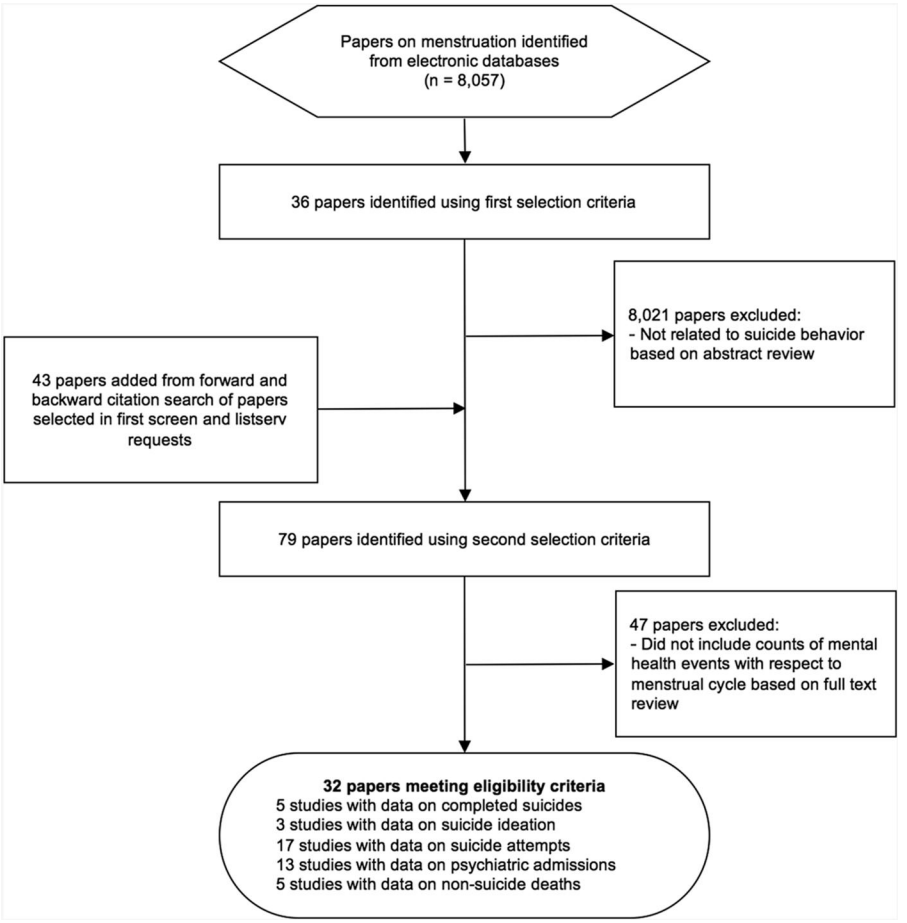

FIGURE 1. *Study selection flowchart.*

the premenstrual phase showed women were 26% more likely to die from suicide in the menstrual phase than would be expected by chance ($p = .048$). None of the other phases were associated with an increased or decreased probability of completed suicides. H_1, which proposed a greater rate of suicide in the menstrual phase vs. the average of other phases, was supported ($p = .02$). However, H_2, which proposed a greater rate of suicide in the premenstrual phase vs. the average of other phases was not supported ($p = .06$). H_3, which compared the premenstrual and menstrual phases, was not supported ($p = .09$).

Deaths Due to Non-Suicide Causes

There was a lower SMR during menstruation compared to other phases ($p = .04$), and the premenstrual phase was not distinguishable from the average of other phases ($p = .73$). There was no significant difference between the premenstrual and menstrual phases ($p = .11$)

TABLE 2. **Standardized Mortality Ratios of Suicide Behavior, Suicidal Ideation, and Mental Health Hospital Admissions Across the Menstrual Cycle ($k = 32$, $N = 3{,}791$)**

				P1: Menstrual (Days 1–5)		P2: Follicular (Days 6–11)		P3: Periovulatory (Days 12–16)		P4: Luteal (Days 17–23)		P5: Premenstrual (Days 24–28)		H1	H2	H3
Health Outcome	***k***	***N***	***Q***	***M***	**95% CI**	***M***	**95% CI**	***M***	**95% CI**	***M***	**95% CI**	***M***	**95% CI**	***Z***	***Z***	***Z***
Mental health outcomes																
Completed suicides	5	356	15.39	1.26*	[1.00 ~ 1.58]	.78	[.55 ~ 1.09]	.77	[.54 ~ 1.09]	1.11	[.86 ~ 1.42]	.86	[.62 ~ 1.21]	2.28*	–.52	–1.71†
Suicidal ideation	3	156	1.39	1.27	[.92 ~ 1.75]	.91	[.58 ~ 1.43]	.99	[.65 ~ 1.52]	.79	[.49 ~ 1.28]	1.11	[.76 ~ 1.62]	1.70†	.64	–.61
Suicide attempts (full sample)	17	1,366	14.40	1.17*	[1.05 ~ 1.30]	1.00	[.89 ~ 1.13]	.92	[.79 ~ 1.06]	.91	[.81 ~ 1.03]	1.08	[.95 ~ 1.21]	2.87**	1.17	–.99
No oral contraception	16	1,229	12.98	1.18*	[1.06 ~ 1.32]	1.01	[.89 ~ 1.14]	.91	[.78 ~ 1.06]	.90	[.79 ~ 1.03]	1.07	[.94 ~ 1.21]	3.05*	.98	–1.20
Oral contraceptive users	2	42	.68	.98	[.37 ~ 2.57]	1.12	[.52 ~ 2.39]	1.08	[.45 ~ 2.62]	.88	[.35 ~ 2.21]	1.05	[.40 ~ 2.74]	–.11	.08	.12
Psychiatric admissions (full sample)	13	1,474	15.66	1.20**	[1.08 ~ 1.33]	.92	[.81 ~ 1.05]	.89	[.78 ~ 1.03]	.92	[.82 ~ 1.03]	1.13*	[1.01 ~ 1.26]	3.69**	2.33*	–.79
Drug abuse admissions	2	108	.48	1.43†	[.97 ~ 2.11]	1.01	[.60 ~ 1.72]	.78	[.36 ~ 1.70]	.85	[.47 ~ 1.56]	.82	[.39 ~ 1.72]	2.52*	–.62	–1.71†
Other admissions	11	1,366	11.83	1.17*	[1.05 ~ 1.31]	.91	[.80 ~ 1.04]	.90	[.78 ~ 1.04]	.92	[.82 ~ 1.04]	1.14*	[1.02 ~ 1.28]	3.09**	2.54*	–.32
Overall mental health events	32	3,352	62.84	1.23**	[1.15 ~ 1.32]	.95	[.88 ~ 1.03]	.90*	[.82 ~ .99]	0.94†	[.87 ~ 1.01]	1.09*	[1.01 ~ 1.18]	6.21**	2.05*	–2.43*
Non-suicide deaths	5	439	6.80	.75†	[.53 ~ 1.05]	1.08	[.88 ~ 1.32]	1.02	[.82 ~ 1.28]	1.13	[.94 ~ 1.36]	1.02	[.82 ~ 1.28]	–2.04*	.35	1.61

Note. **p < .01, *p < .05, †p < .01. Effect sizes reported as odds ratios. Q is the coefficient of heterogeneity among effect sizes. H1 = Hypothesis 1, comparison between P1 menstrual phase and the average of other phases. H2 = Hypothesis 2, comparison between P5 premenstrual phase and the average of other phases. H3 = Comparison between P5 premenstrual phase and P1 menstrual phase.

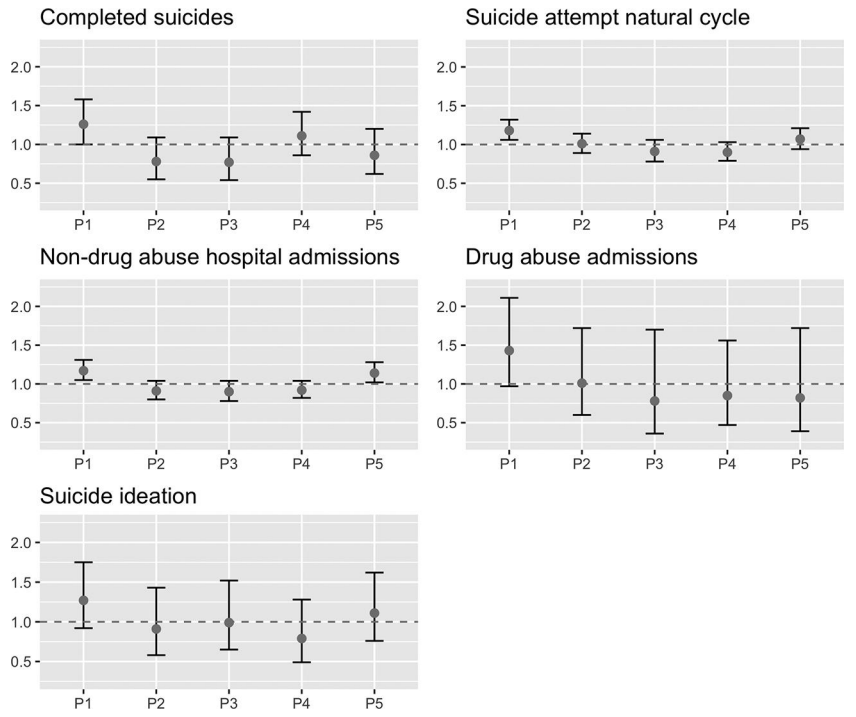

FIGURE 2. *95% Confidence intervals of standardized mortality ratios for mental health outcomes. Each panel displays standardized mortality ratios of mental health outcomes across the menstrual cycle. Error bars indicate 95% confidence intervals. P1 = Menstrual phase, days 1-5. P2 = Follicular phase, days 6-11. P3 = Periovulatory phase, days 12-16. P4 = Luteal phase, days 17-23. P5 = Premenstrual phase, days 24-28.*

Suicide Attempts

Women were 17% more likely to attempt suicide at the menstrual phase than would be expected by chance ($p = .006$), and women were more likely to attempt suicide at the menstrual phase compared to the remainder of phases (H_1: $p = .004$). The premenstrual phase was not associated with a higher rate of suicide attempts

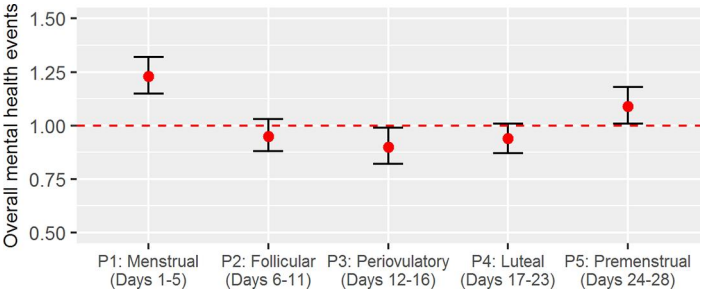

FIGURE 3. *95% Confidence intervals of standardized mortality ratios for overall mental health events.*

compared to the average of the other phases (H_2: $p = .24$). The premenstrual and menstrual phases did not differ from each other on risk of suicide attempts (H_3: $p = .33$).

Sufficient numbers of studies were available to compare results separately for women who were on oral contraceptives vs. those who were naturally cycling. The pattern of results was dissimilar: women taking OC did not have an elevated rate of suicide attempts at any phase of the cycle, nor were the contrasts between menstrual/premenstrual phases and other phases significant. In contrast, naturally cycling women had an 18% greater likelihood of suicide attempt at the menstrual phase ($p = .004$). For them, the menstrual phase was associated with a greater rate of suicide attempts compared to the remainder of phases (H_1: $p = .002$), but the premenstrual phase was not associated with a greater rate of suicide compared to the remainder of phases (H_2: $p = .33$). This pattern of results provides support for H_4, which proposed menstrual cycle effects are attenuated by OC.

Psychiatric Admissions

Greater rates of psychiatric admissions were observed during the premenstrual and menstrual phases. There were 20% more admissions than would be expected by chance in the menstrual phase ($p < .001$), and 13% more admissions than would be expected during the premenstrual phase ($p = .03$). Comparison between the menstrual phase and the remainder of phases was significant (H_1: $p < .001$), as was the comparison between the premenstrual phase and the average of the remainder of phases (H_2: $p = .02$). There was no significant difference between premenstrual and menstrual phases (H_3: $p = .43$). Examining drug abuse hospitalizations separately, the menstrual phase was associated with higher risk of drug abuse admissions compared to the remainder of phases (H_1: $p = .01$). The premenstrual phase was not associated with greater rate of admissions ($p = .51$), and there was no significant difference between the premenstrual phase with the remaining phases (H_2: $p = .53$).

Comparing the two phases, there was no significant difference in the rate of drug abuse admissions between the two phases (H_3: $p = .09$).

Suicidal Ideation

There was no consistent evidence to suggest the menstrual cycle is associated with suicidal ideation. None of the SMRs approached significance for the individual phases by themselves. The menstrual phase was associated with a marginally higher rate of suicidal ideation compared to the remainder of phases (H_1: $p = .09$), and the premenstrual phase was not associated with a higher rate of suicidal ideation (H_2: $p = .52$). There was no significant difference between premenstrual and menstrual phases (H_3: $p = .54$).

Overall Risk of Poor Mental Health Outcomes

Given that the balance of results suggested greater risk of a mental health outcome in the menstrual phase, we considered whether the menstrual phase was associated with a greater risk of a mental health outcome of any kind. We aggregated all types of mental health outcomes across studies into a single analysis. Table 2 indicates that—in comparisons with the other phases—there is elevated risk in the menstrual phase (H_1: $p < .001$) and in the premenstrual phase (H_2: $p = .04$). Comparing the coefficients revealed that the menstrual phase is associated with a greater likelihood of a poor mental health outcome vis-à-vis the premenstrual phase (H_3: $p = .02$).

Sensitivity Testing and Publication Bias

Results obtained when analyzing only high-quality studies suggest the menstrual phase is associated with a greater rate of suicide attempts. Hormonal assays are superior to other methods in assessing phases of the menstrual cycle (Saunders & Hawton, 2006). Four studies examined suicide attempts and used hormonal assays to determine menstrual cycle phase (Baca-García et al., 2010; Baca-García, Díaz-Sastre, de Leon, & Saiz-Ruiz, 2000; Baca-García, Vaquero, et al., 2003; Çayköylü, Çapoglu, & Öztürk, 2004). Analyses using only this subset indicated a significant increase in the rate of suicide attempts in the menstrual phase (SMR = 1.21, $p = .04$), while none of the other phases were associated with a greater rate of suicide attempts (follicular SMR = 1.02, $p = .82$; periovulatory SMR = .92, $p = .49$, luteal SMR = .92, $p = .41$; premenstrual SMR = .93, $p = .55$). This pattern of results is consistent with those obtained with the full sample of suicide attempts. Examining only the studies that did not use hormonal assays, we observe an elevated, but non-significant trend for higher rate of attempts in the menstrual (SMR = 1.14, $p = .08$) and premenstrual phases (SMR = 1.14, $p = .07$), but not in the other phases (follicular SMR = .99, $p = .92$; periovulatory SMR = .91, $p = .32$, luteal SMR = .90, $p = .19$). Higher quality studies produce a pattern of results consistent with the overall pattern observed in the study, namely that the menstrual phase is associated with greater rate of mental health events.

To examine the presence of influential observations, we examined standardized residuals. For each model, we looked for the presence of an excess number of large standardized residuals (i.e., number of residuals with significant Z values greater than the total number of effect sizes divided by 10) (Viechtbauer & Cheung, 2010). For all models we estimated, we did not observe an excess of effect sizes with large standardized residuals, suggesting the models generally fit the data well. We did not examine other indicators of influence that rely on examining the influence of single observations, such as Cook's distances and leave-one-out analyses. This is because we hypothesized that effect sizes would be larger in the menstrual and premenstrual phases. Thus, individual effect sizes may have outsized influence not because they are aberrant observations, but because they reflect genuine differences across phases.

We assessed for the potential for publication bias by examining funnel plots that placed each effect size against the standard error, sampling variance, inverse standard error, and inverse sampling variance for all of the types of outcomes. We did not observe significant asymmetries in effect sizes that indicated publication bias.

DISCUSSION

Contrary to expectations that premenstrual distress would translate to greater rates of negative health outcomes, our results show the menstrual phase of women's cycles to be associated with the greatest risk of serious mental health outcomes. Completed suicides, suicide attempts, psychiatric admissions, and drug abuse occur at a greater rate in the menstrual phase than would be expected by chance. We also find support for an association between the premenstrual phase and psychiatric admissions. Comparing the two phases to each other, the menstrual phase was more strongly associated with serious mental health outcomes than the premenstrual phase.

Although only correlational in nature, these findings provide room to speculate that fluctuations in hormone levels may influence mental health outcomes. Indeed, they are consistent with findings that show fluctuations in ovarian hormones are

correlated with other kinds of mental health outcomes, such as eating disorder symptoms (Edler et al., 2007; Klump et al., 2006, 2013). It is also consistent with our finding that use of oral contraceptives, which mollifies hormone fluctuations, is also associated with a risk profile that does not change across phases.

Although we speculate that fluctuations in hormone levels may help to drive the current findings, a potential alternative explanation is that the apparent cycle effects observed could actually be the result of an interaction between physiological and psychological influences (Gallant & Hamilton, 1988). Physical discomfort, such as dysmenorrhea could compound societal stereotypes about menstruation, which could influence behaviors directed at women during menstruation and exacerbate or contribute to the development of mental health outcomes.

This pattern of results suggests a need for greater attention to be applied to women's health—particularly mental health—in the menstrual phase. Refocusing efforts to discover the antecedents of mental health outcomes in the menstrual phase might be fruitful for a better understanding of women's health. The consequences of premenstrual symptoms, despite their prevalence, appear to be smaller in magnitude than the severe mental health outcomes examined in this study. The pattern we observe is consistent with observations that show women to visit walk-in clinics at a higher rate in the premenstrual phase compared to the menstrual phase, and also show higher rates of admissions to emergency rooms during the menstrual phase compared to the premenstrual phase (Jacobs & Charles, 1970). Alternatively, mental health outcomes observed at menstruation may be result of problems that originate in the premenstrual phase, but take time to manifest. Both possibilities represent avenues for further investigation.

An important caveat to these findings is that the severe mental outcomes we reviewed were probably more likely to occur among groups with existing clinical diagnoses or at risk of meeting the threshold for such diagnoses. Indeed, psychosis symptoms worsen for a sizable portion (32.4%) of schizophrenic women when menstruating (Gleeson et al., 2016). For women who are not similarly at risk, the effects of the menstrual cycle may be different. In support of this idea, our data show non-suicide deaths were actually less likely to occur during menstruation. Prior research has also speculated on the existence of individual differences on the effect of hormone fluctuations on behavior (Klump et al., 2013), and it is possible that hormonal influences are greater among people already at risk for psychological distress.

Limitations in the current study suggest potential for future research. Only four studies used high quality methods, but the pattern of results obtained with that subsample are consistent with those obtained with the full sample. In addition, all studies sampled report on women exhibiting some health outcome, but exclude those who do not report such outcomes—that is, we lack information about the base rates of these outcomes. To obtain firm estimates about the magnitude of menstrual cycle influences on health outcomes, longitudinal studies of a large representative sample of women would enable researchers to calculate incidence ratios. By studying the menstrual cycle only among women who have had a particular health outcome could increase the apparent influence of the menstrual cycle.

Inconsistent definitions of the menstrual cycle across studies represented a barrier to aggregating results. Where scientific data are not amenable to cumulative study, the ability to understand the phenomenon is impaired. As such, for consistency, we recommend that future

research make use of the definition put forward by Riley et al. (1999). A related issue is the reliability of the measurement of the menstrual cycle. Future studies should utilize high quality methods to measure menstrual cycles and provide estimates of uncertainty in measurement where possible. Where reliability concerns exist, the best opportunity to detect cycle influences would be to compare the most visible aspect of the cycle (i.e., menstruation) to the remainder of the cycle, which H_1 aimed to assess. Using this design, we observed persistent increase in risk of suicide behavior and psychiatric admissions associated with the menstrual phase. A final limitation is that non-English articles were excluded due to resource constraints.

In conclusion, the primary contribution of this research is to aggregate and analyze severe mental health outcomes in relation to the menstrual cycle. There has been considerable research on women's health with respect to the cycle, in which much of the research has focused on diffuse or self-reported symptoms such as irritability and mood changes, and an assorted set of behavioral and physiological symptoms (American Psychiatric Association, 2013; Freeman, 2003). By focusing on objective behavioral outcomes rather than subjective symptoms, we provide a potentially different picture of the consequence of the cycle on women's health.

AUTHOR NOTE

Daisung Jang, College of Business, University of Illinois, Urbana-Champaign, Urbana-Champagne, Illinois, USA.

Hillary Anger Elfenbein, John M. Olin School of Business, Washington University in St. Louis, St. Louis, Missouri, USA.

We thank Zhenling Jiang and Michael J. Strube for their review of the statistical analyses and the library staff of Washington University for their tireless assistance. We also thank Jack Zhang for his assistance as an independent coder of the articles. The authors did not obtain funding for this research.

Correspondence concerning this article should be addressed to Daisung Jang, Postdoctoral Research Associate, College of Business, University of Illinois, Urbana-Champaign, Champaign, IL 61820. E-mail: daisung@illinois.edu

ORCID

Daisung Jang http://orcid.org/0000-0001-7624-5678
Hillary Anger Elfenbein http://orcid.org/0000-0002-3973-1447

REFERENCES

*Abramowitz, E., Baker, A., & Fleischer, S. (1982). Onset of depressive psychiatric crises and the menstrual-cycle. *American Journal of Psychiatry*, *139*(4), 475–478.

*Ainsah, O., Norharlina, B., & Osman, C. B. (2008). The association between deliberate self-harm and menstrual cycle among patients admitted to Hospital Kuala Lumpur. *Hong Kong Journal of Psychiatry*, *18*(4), 158–165.

*Ambrose-Lanci, L. M., Sterling, R. C., Weinstein, S. P., & Van Bockstaele, E. J. (2009). The influence of intake urinalysis, psychopathology measures, and menstrual cycle phase on treatment compliance. *The American Journal on Addictions*, *18*(2), 167–172. doi:10.1080/10550490902772710

American Psychiatric Association. (2013). *Diagnostic and statistical manual of mental disorders: DSM-5* (5th ed.). Washington, D.C.: American Psychiatric Association.

*Baca-García, E., Díaz-Sastre, C., Ceverino, A., Perez-Rodriguez, M. M., Navarro-Jimenez, R., Lopez-Castroman, J.,…Oquendo, M. A. (2010). Suicide attempts among women during low estradiol/low progesterone states. *Journal of Psychiatric Research*, *44*(4), 209–214. doi:10.1016/j.jpsychires.2009.08.004

*Baca-García, E., Díaz-Sastre, C., Ceverino, A., Saiz-Ruiz, J., Diaz, F. J., & de Leon, J. (2003). Association between the menses and suicide attempts: A replication study. *Psychosomatic Medicine*, *65*(2), 237–244.

*Baca-García, E., Díaz-Sastre, C., de Leon, J., & Saiz-Ruiz, J. (2000). The relationship between menstrual cycle phases and suicide attempts. *Psychosomatic Medicine*, *62*(1), 50–60.

*Baca-García, E., González, A. S., Diaz-Corralero, P. G., García, I. G., & de Leon, J. (1998). Menstrual cycle and profiles of suicidal behaviour. *Acta Psychiatrica Scandinavica*, *97*(1), 32–35. doi:10.1111/j.1600-0447.1998.tb09959.x

Baca-García, E., Vaquero, C., Díaz-Sastre, C., Ceverino, A., Saiz-Ruiz, J., Fernández-Piquera, J., & de Leon, J. (2003). A pilot study on a gene-hormone interaction in female suicide attempts. *European Archives of Psychiatry and Clinical Neuroscience*, *253*(6), 281–285. doi:10.1007/s00406-003-0441-6

*Birtchnell, J., & Floyd, S. (1974). Attempted suicide and the menstrual cycle—A negative conclusion. *Journal of Psychosomatic Research*, *18*(5), 361–369. doi:10.1016/0022-3999(74)90057-9

Block Courts, L., & Berg, D. H. (1993). The portrayal of the menstruating woman in menstrual product advertisements. *Health Care for Women International*, *14*(2), 179–191. doi:10.1080/07399339309516039

Brill, K., Norpoth, T., Schnitker, J., & Albring, M. (1991). Clinical experience with a modern low-dose oral contraceptive in almost 100,000 users. *Contraception*, *43*(2), 101–110. doi:10.1016/0010-7824(91)90037-G

Brock, R., Rowse, G., & Slade, P. (2016). Relationships between paranoid thinking, self-esteem and the menstrual cycle. *Archives of Women's Mental Health*, *19*(2), 271–279. doi:10.1007/s00737-015-0558-4

*Çayköylü, A., Çapoglu, I., & Öztürk, I. (2004). The possible factors affecting suicide attempts in the different phases of the menstrual cycle. *Psychiatry and Clinical Neurosciences*, *58*(5), 460–464. doi:10.1111/j.1440-1819.2004.01286.x

*Dalton, K. (1959). Menstruation and acute psychiatric illnesses. *British Medical Journal*, *1*(5115), 148.

Dalton, K. (1964). *The premenstrual syndrome*. Springfield, IL: C.C. Thomas.

Dennerstein, L., & Burrows, G. D. (1979). Affect and the menstrual cycle. *Journal of Affective Disorders*, *1*(2), 77–92. doi:10.1016/0165-0327(79)90027-2

*Dogra, T. D., Leenaars, A. A., Raintji, R., Lalwani, S., Girdhar, S., Wenckstern, S., & Lester, D. (2007). Menstruation and suicide: An exploratory study. *Psychological Reports*, *101*(2), 430–434. doi:10.2466/PR0.101.6.430-434

Edler, C., Lipson, S. F., & Keel, P. K. (2007). Ovarian hormones and binge eating in bulimia nervosa. *Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences*, *37*(1), 131–141. doi:10.1017/S0033291706008956

*Ekeberg, Ø., Jacobsen, D., Sørum, Y., & Aass, G. (1986). Self-poisoning and the menstrual cycle. *Acta Psychiatrica Scandinavica*, *73*(3), 239–241. doi:10.1111/j.1600-0447.1986.tb02680.x

*Fourestié, V., Lignières, B., Roudot-Thoraval, F., Fulli-Lemaire, I., Nahoul, K., Cremniter, D.,… Lejonc, J.-L. (1986). Suicide attempts in hypo-oestrogenic phases of the menstrual cycle. *The Lancet*, *328*(8520), 1357–1360. doi:10.1016/S0140-6736(86)92005-2

Freeman, E. W. (2003). Premenstrual syndrome and premenstrual dysphoric disorder: definitions and diagnosis. *Psychoneuroendocrinology*, *28*, *Supplement 3*, 25–37. doi:10.1016/S0306-4530(03)00099-4

Gallant, S. J., & Hamilton, J. A. (1988). On a premenstrual psychiatric diagnosis: What's in a name? *Professional Psychology: Research and Practice*, *19*(3), 271–278. doi:10.1037/0735-7028.19.3.271

*Glass, G. S., Heninger, G. R., Lansky, M., & Talan, K. (1971). Psychiatric Emergency Related to the Menstrual Cycle. *American Journal of Psychiatry*, *128*(6), 705–711.

Gleeson, P. C., Worsley, R., Gavrilidis, E., Nathoo, S., Ng, E., Lee, S., & Kulkarni, J. (2016). Menstrual cycle characteristics in women with persistent schizophrenia. *Australian and New Zealand Journal of Psychiatry*, *50*(5), 481–487. doi:10.1177/0004867415590459

Gwartney, P. A. (2016). People, place, and power: Changing life courses and inequality. *Sociological Perspectives*, *59*(1), 7–16. doi:10.1177/0731121416632071

Hall, G. S. (1904). *Adolescence: Its psychology and its relations to physiology, anthropology, sociology, sex, crime, religion and education* (Vol. 1). New York, NY: D Appleton & Company.

Hosmer, D. W., Lemeshow, S., & May, S. (2008). Appendix 1: The delta method. In *Applied survival analysis: Regression modeling of time-to-event data* (pp. 355–358). Hoboken, N.J.: Wiley-Interscience.

Jacobs, T. J., & Charles, E. (1970). Correlation of psychiatric symptomatology and the menstrual cycle in an outpatient population. *American Journal of Psychiatry*, *126*(10), 1504–1508.

*Janowsky, D. S., Gorney, R., Castelnuovo-Tedesco, P., & Stone, C. B. (1969). Premenstrual-menstrual increases in psychiatric hospital admission rates. *American Journal of Obstetrics and Gynecology*, *103*(2), 189–191.

Kahn, H. A. (1989). *Statistical methods in epidemiology*. New York, NY: Oxford University Press.

Klump, K. L., Gobrogge, K. L., Perkins, P. S., Thorne, D., Sisk, C. L., & Breedlove, S. M. (2006). Preliminary evidence that gonadal hormones organize and activate disordered eating. *Psychological Medicine: A Journal of Research in Psychiatry and the Allied Sciences*, *36*(4), 539–546. doi:10.1017/S0033291705006653

Klump, K. L., Keel, P. K., Racine, S. E., Burt, S. A., Neale, M., Sisk, C. L.,…Hu, J. Y. (2013). The interactive effects of estrogen and progesterone on changes in emotional eating across the menstrual cycle. *Journal of Abnormal Psychology*, *122*(1), 131–137. doi:10.1037/a0029524

*Kramp, J. L. (1968). Studies on the premenstrual syndrome in relation to psychiatry. *Acta Psychiatrica Scandinavica*, *43*(S203), 261–267. doi:10.1111/j.1600-0447.1968.tb02002.x

*Lande, R. G., & Karamchandani, V. (2002). Chronic mental illness and the menstrual cycle. *The Journal of the American Osteopathic Association*, *102*(12), 655–659.

*Leenaars, A. A., Dogra, T. D., Girdhar, S., Dattagupta, S., & Leenaars, L. (2009). Menstruation and suicide: A histopathological study. *Crisis: The Journal of Crisis Intervention and Suicide Prevention*, *30*(4), 202–207. doi:10.1027/0227-5910.30.4.202

Lipsey, M. W., & Wilson, D. B. (2001). *Practical meta-analysis*. Thousand Oaks, CA: Sage Publications.

Lopez, L. M., Kaptein, A. A., & Helmerhorst, F. M. (2012). Oral contraceptives containing drospirenone for premenstrual syndrome. *Cochrane Database of Systematic Reviews*, 2. doi:10.1002/14651858.CD006586.pub4

*Luggin, R., Bernsted, L., Petersson, B., & Jacobsen, A. T. (1984). Acute psychiatric admission related to the menstrual cycle. *Acta Psychiatrica Scandinavica*, *69*(6), 461–465. doi:10.1111/j.1600-0447.1984.tb02520.x

*MacKinnon, I. L., MacKinnon, P. C. B., & Thomson, A. D. (1959). Lethal hazards of the luteal phase of the menstrual cycle. *The British Medical Journal*, *1*(5128), 1015–1017.

*MacKinnon, P. C. B., & MacKinnon, I. L. (1956). Hazards of the menstrual cycle. *British Medical Journal*, *1*(4966), 555–555.

*Mandell, A. J., & Mandell, M. P. (1967). Suicide and the menstrual cycle. *JAMA: The Journal of the American Medical Association*, *200*(9), 792–793. doi:10.1001/jama.1967.03120220094022

*O'Dwyer, J., Friedman, T., & Clifford, E. (1997). The relationship between menstruation and psychiatric admissions. *Irish Journal of Psychological Medicine*, *14*(2), 46–48.

*Pallis, D. J., & Holding, T. A. (1976). The menstrual cycle and suicidal intent. *Journal of Biosocial Science*, *8*(1), 27–33. doi:10.1017/S0021932000010427

Phipps, W. E. (1980). The menstrual taboo in the Judeo-Christian tradition. *Journal of Religion & Health*, *19*(4), 298–303. doi:10.1007/BF00996252

Proctor, M., & Farquhar, C. (2006). Diagnosis and management of dysmenorrhoea. *BMJ: British Medical Journal*, *332*(7550), 1134–1138.

Riley, J. L., Robinson, M. E., Wise, E. A., & Price, D. D. (1999). A meta-analytic review of pain perception across the menstrual cycle. *Pain*, *81*(3), 225–235. doi:10.1016/S0304-3959(98)00258-9

Saunders, K. E. A., & Hawton, K. (2006). Suicidal behaviour and the menstrual cycle. *Psychological Medicine*, *36*(7), 901–912. doi:10.1017/S0033291706007392

Schmidt, P. J., Nieman, L. K., Danaceau, M. A., Adams, L. F., & Rubinow, D. R. (1998). Differential behavioral effects of gonadal steroids in women with and in those without premenstrual syndrome. *The New England Journal of Medicine*, *338*(4), 209–216. doi:10.1056/NEJM199801223380401

*Shen, W. (1984). A note on menstruation and hospital admission date of intoxicated women. *Biological Psychiatry*, *19*(7), 1133–1136.

Stroup, D. F., Berlin, J. A., Morton, S. C., Olkin, I., Williamson, G. D., Rennie, D.,…(MOOSE) Group, for the M. O. O. S. E. (2000). Meta-analysis of observational studies in epidemiology: A proposal for reporting. *JAMA*, *283*(15), 2008–2012. doi:10.1001/jama.283.15.2008

*Targum, S. D., Caputo, K. P., & Ball, S. K. (1991). Menstrual cycle phase and psychiatric admissions. *Journal of Affective Disorders*, *22*(1–2), 49–53. doi:10.1016/0165-0327(91)90083-5

*Thin, R. N. T. (1968). Premenstrual symptoms in women who attempt suicide. *Journal of the Army Medical Corps*, *114*, 136–9.

*Tonks, C. M., Rack, P. H., & Rose, M. J. (1968). Attempted suicide and the menstrual cycle. *Journal of Psychosomatic Research*, *11*(4), 319–323. doi:10.1016/0022-3999(68)90028-7

Unsal, A., Ayranci, U., Tozun, M., Arslan, G., & Calik, E. (2010). Prevalence of dysmenorrhea and its effect on quality of life among a group of female university students. *Upsala Journal of Medical Sciences*, *115*(2), 138–145. doi:10.3109/03009730903457218

*Vanezis, P. (1990). Deaths in women of reproductive age and relationship with menstrual cycle phase. An autopsy study of cases reported to the coroner. *Forensic Science International*, *47*(1), 39–57. doi:10.1016/0379-0738(90)90284-6

van Iersel, K. C., Kiesner, J., Pastore, M., & Scholte, R. H. J. (2016). The impact of menstrual cycle-related physical symptoms on daily activities and psychological wellness among adolescent girls. *Journal of Adolescence*, *49*, 81–90. doi:http://dx.doi.org.proxy2.library.illinois.edu/10.1016/j.adolescence.2016.03.007

Viechtbauer, W., & Cheung, M. W.-L. (2010). Outlier and influence diagnostics for meta-analysis. *Research Synthesis Methods*, *1*(2), 112–125. doi:10.1002/jrsm.11

*Weston, J., Speroni, K. G., Ellis, T., & Daniel, M. G. (2012). The effect of menstruation on psychiatric hospitalization. *Journal of Psychosocial Nursing and Mental Health Services*, *50*(7), 39–43. doi:10.3928/02793695-20120605-01

*Wetzel, R. D., Reich, T., & McClure, J. N. (1971). Phase of the menstrual cycle and self-referrals to a suicide prevention service. *The British Journal of Psychiatry*, *119*(552), 523–524. doi:10.1192/bjp.119.552.523

*Zola, P., Meyerson, A. T., Reznikoff, M., Thornton, J. C., & Concool, B. M. (1979). Menstrual symptomatology and psychiatric admission. *Journal of Psychosomatic Research*, *23*(4), 241–245. doi:10.1016/0022-3999(79)90025-4

*Denotes studies included in the meta-analysis.