Effects of Caffeine Consumption on Premenstrual Syndrome: A Prospective Study

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Citation

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Abstract

OBJECTIVE: To test hypotheses concerning patterns of caffeine consumption as a function of menstrual cycle phase in women with premenstrual syndrome (PMS), as compared with controls. METHODS: Daily symptom ratings were obtained online for two consecutive menstrual cycles. Women displaying a 30% increase in PMS symptoms during the luteal phase in both cycles were assigned to the PMS group. Participants were screened using the Patient Health Questionnaire for the following exclusion criteria: pregnancy, caffeine sensitivity, and any diagnosis of psychiatric disorder within the past 6 months.RESULTS: Caffeine intake was higher during the follicular phase than during the luteal phase for both the PMS and non-PMS groups, [F (1, 67) = 7.86, P < 0.01]. There was no significant difference between the two groups in caffeine intake, [F (1, 67) = 0.93, P = 0.338] after adjusting for age, marital status, use of oral contraceptives, regular use of medication, and cigarette smoking. Moreover, caffeine consumption was lower during the luteal compared to the follicular phase of the menstrual cycle.CONCLUSION: Overall, results suggest that PMS-sufferers were as likely to consume caffeine as normal volunteers, and that women consumed more caffeine during the follicular compared to the luteal phase.

BACKGROUND

Premenstrual syndrome (PMS) and the more severe premenstrual dysphoric disorder (PMDD) are debilitating illnesses of women in their reproductive years (1, 2) and have even been associated with suicidal behavior (3). Within the United States, studies show that 15% to 40% (1, 4, 5, 6) of women experience premenstrual syndrome. Considerable research shows that the severity of PMS symptoms is significantly impacted by dietary factors (7, 8, 9, 10, 11, 12, 13).

A potentially important dietary factor in PMS is caffeine. This powerful stimulant is the most widely consumed drug in the world (14), and its arousal properties are well-documented (15, 16), as is its toxicity (17). Moreover, caffeine has been reported to exacerbate PMS (7, 18, 19, 20, 21, 22). The authors of a more recent retrospective study also concluded that caffeine may exacerbate PMS symptoms, although they note that caffeine accounted for only a small proportion of the variance (23). Based primarily on the Rossignol studies, caffeine restriction is frequently recommended (24).

These studies, which employed self-administered questionnaires, showed that the risk of PMS was significantly elevated in college women who consumed more than four caffeinated drinks per day and increased further in those ingesting 8-10 drinks (19, 21, 22).

While the Rossignol studies suggested that caffeine intake is associated with PMS, Caan and colleagues failed to support this association (26). They diagnosed PMS retrospectively and then collected caffeine intake data for three consecutive days during both premenstrual and postmenstrual weeks via telephone interviews. The authors suggested that women with PMS were less likely to consume caffeinated coffee or tea, but were more likely to drink decaffeinated beverages (26).

As Halbreich and colleagues have recently pointed out, studies of PMS often suffer from methodological limitations (27), and those mentioned above are no exception to this observation. First, none of these studies diagnosed PMS according to the NIMH Workshop diagnostic guidelines (28). Specifically, data must be gathered for two complete cycles, in each of which must occur a 30% increase in symptoms during the luteal, as compared with the follicular, phase (29). Second, Rossiginol's studies were cross-

sectional and retrospective. While Caan and colleagues addressed the latter concern, their study was also cross-sectional. Third, previous studies did not report any screening of their participants for preexisting psychiatric conditions. And finally, the basis for determining the caffeine content of foods and beverages was not specified.

In order to address the methodological limitations seen in earlier work, the present study first implemented the NIMH diagnostic guidelines. Our diagnostic procedures were also consistent with those proposed by the recent consensus conference for inclusion in the next edition of the International Classification of Diseases (ICD-11) of the World Health Organization (30). Participants were then diagnosed with PMS only if they reported at least a 30% increase on at least one of either physical or emotional symptom scores 5 days before the onset of menses and symptom remission within 4 days of onset of menses. The Patient Health Questionnaire (PHQ, 31) was used to screen for current and previous psychiatric conditions, and participants who reported any psychiatric diagnoses within the past six months were excluded. Finally, caffeine values were adopted from Juliano & Griffiths (2005) and were consistent with those reported elsewhere (32).

The present study is the first to address the diagnostic limitations of prior studies examining the relationship between PMS and caffeine intake. Based on prior literature indicating a positive association between caffeine consumption and experience of PMS symptoms, we hypothesized that women with PMS would consume more caffeine than would controls across the entire menstrual cycle.

SUBJECTS AND METHODS

The current project was reviewed and approved by the Institutional Review Board at the University of Maryland College Park (IRB #: 04-0583) for recruitment of undergraduates at the institution. Participants were primarily recruited through advertisements in psychology courses, and 110 female undergraduate students initially met with the researcher individually or in small groups to sign informed consent prior to completing online screening questionnaires. Participants who indicated caffeine sensitivity, pregnancy, a diagnosed psychiatric condition within the past six months, or a history of drug abuse were dropped form the study (33, 34). Psychiatric history was assessed using the PHQ. A total of seven participants endorsed suicidal ideation (n = 3), previous or current diagnosis of depression (n = 3), or caffeine sensitivity (n = 1), leaving the sample of 103. Attrition rate was approximately 18% (n = 20). The final sample (N = 83) ranged in age from 18 to 26 (M = 19, SD = 1.98).

SCREENING INSTRUMENTS

The Participant Screening Form is a demographic questionnaire created by the researcher that elicits the following information: age, marital status, racial/ethnic identity, current medication regime, habitual smoking, and level of habitual caffeine intake. It was used to assess the representativeness and composition of the sample.

The Patient Health Questionnaire (PHQ; 31) is a tool provided to help primary care practitioners quickly diagnose mental disorders. The full PHQ is a four-page questionnaire derived from the Primary Care Evaluation of Mental Disorders (PRIME-MD; 31). The measure screens for common mental disorders (somatoform, mood, anxiety, eating, and alcohol) and functional impairment. It also includes questions about recent stressors and, for women, questions regarding menstruation, pregnancy, and childbirth. Clinicians often use only the first three pages, or some components, such as the 9-item depression module (PHQ-9; 31). The measure has good internal and test-retest reliability, with Cronbach's alpha value of above 0.84 (35). Additionally, internal validity was 0.86 and validity of 0.70 and around that range for psychiatric diagnoses (e.g. depression and anxiety; 36).

DAILY DAIRIES

The Caffeine Intake Form was used in the study to record daily caffeine consumption. Participants were asked to record their intake of foods and beverages daily. The response options for specified serving sizes were provided in the instruction. The relevant beverages included on the questionnaire and calculations of total caffeine intake were as recommended in Juliano and Griffiths (2005). It assesses the amount of consumption for various products containing caffeine (37). This form was included in the daily diaries.

The Self-Rating Scale for Premenstrual Tension Syndrome (PMTS-SR; 38) was used as part of the daily diary in order to record PMS symptoms. The correlation coefficients of the PMTS-SR and the Premenstrual Tension Scale for Others (PMTS-O) are 0.83 premenstrual and 0.84 postmenstrual as reported by Bergant and colleagues (2004). Reliability is 0.71 and 0.77 for the PMTS-O and PMTS-SR, respectively (39). In order to meet criteria for PMS, participants had to

endorse at least a 30% increase in symptom severity during the luteal phase, as compared to the follicular phase, for 2 consecutive months. The PMTS-SR assessed for symptoms such as mood swings (sudden sadness or tearfulness), depression, anxiety (tension and nervousness), and irritability, avoidance of social activities, sensitivity, and loss of enjoyment or hopelessness. Percent increase was calculated using the difference between premenstrual and postmenstrual time periods.

PROCEDURES

The present study included two phases, Electronic Screening and Daily Diaries. Participants were required to attend an information session to receive instructions on how to proceed and also to sign informed consents. The screening session was online and available at a website provided on the Information Sheet for Participants. The screening session included a caffeine consumption survey, a demographic questionnaire, and the entire Patient Health Questionnaire (PHQ). Participants who qualified to continue the second phase of the study (i.e. did not meet any exclusion criteria), completed the daily diaries described above. In order to control for possible time-of-day-effects, daily entries were undertaken at the same time every night for two consecutive menstrual cycles, and the experimenter was able to determine for each entry the exact date and time. Data obtained from participants who missed more than five entries in either month were excluded from the final analysis. Participants who missed one day of entry were allowed to complete the entry the following day by submitting two entries at the same time. Data submitted more than 24 hours late were excluded from analysis.

RESULTS

STATISTICAL PROCEDURES

For purposes of the data analysis, mean caffeine intake was computed for each participant for each phase of the cycle (caffeine values adopted from Juliano & Griffiths, 2005). Average caffeine intake was the average across both months of daily dairies. A goodness-of-fit (Chi Square) analysis was completed to control for possible demographic differences among groups. A mixed Analysis of Variance (ANOVA) compared caffeine consumption and symptoms of PMS. The between-subjects variable was Diagnosis [PMS (N = 34) and Control (N = 49)], and the within-subjects factor was menstrual cycle Phase (follicular vs. luteal).

DEMOGRAPHIC VARIABLES

Goodness-of-fit, Chi-Square test, analyses did not reveal group differences in age, [χ^2 (7, N = 83) = 5.63; P = 0.58], marital status, [χ^2 (1, N = 83) = 2.99; P = 0.084], oral contraceptives [χ^2 (1, N = 83) = 0.75; P = 0.39], regular use of medication (s) [χ^2 (1, N = 83) = 0.48; P = 0.49], or cigarette smoking [χ^2 (2, N =83) = 1.52; P = 0.47].

CAFFEINE CONSUMPTION AND PMS

Analysis of Variance (ANOVA) did not reveal any main effect of Diagnosis [F (1, 81) = 1.59, P = 0.21]. Furthermore, there were no significant Diagnosis X Phase interaction, [F (1, 81) = 1.82; P = 0.18]. This data suggest that PMS experiences are likely unrelated to levels of caffeine consumption. On the contrary, there was a significant effect of menstrual cycle Phase on caffeine consumption [F (1, 81) = 5.42; $P < 0.05$], demonstrating that participants across both groups were more likely to consumed higher levels of caffeine during the follicular (mean intake 131.mg/day) compared to the luteal phase (mean intake 113.54 mg/day).

DISCUSSION

Physicians frequently recommend that PMS patients restrict their intake of caffeine, which has been thought to potentially exacerbate symptoms (24, 25). The principal evidence supporting this assumption comes from a series of investigations conducted by Rossignol and colleagues (19-22). However, as detailed above, significant methodological questions have been raised concerning these studies. In particular, these cross-sectional studies (a) used retrospective self-reports rather than prospective dairies for diagnostic purposes (e.g. 1983 NIMH Workshop guidelines on DSM criteria for PMDD (40); American Psychological Association, 2000 (41), (b) failed to screen for psychiatric conditions, and (c) did not report the basis for determining the caffeine content of foods and beverages (42).

Two previous studies provide results contrary to those of the Rossignol group. In the first of these, PMS was diagnosed on a retrospective basis, and caffeine consumption was based on three days of daily caffeine intake data. Results showed no evidence that caffeine contributes to PMS symptoms (26). In the second, Gold and colleagues (43) employed retrospective, questionnaire data for both PMS and caffeine consumption. They also reported that caffeine had no significant effect on PMS symptomatology. Unfortunately, both studies also suffered from some of the same methodological concerns associated with the Rossignol studies.

The present study employed a design and methodology that

addressed the issues raised concerning the prior work. In particular, this study used a prospective approach both for PMS diagnosis and for the assessment of caffeine intake. Specifically, data on both PMS symptoms and caffeine consumption were based on daily monitoring over the course of two complete menstrual cycles. In addition, psychiatric history was screened, and caffeine content was based on guidelines derived from prior research (38). This methodology provided for both a more accurate diagnosis of PMS and a more accurate assessment of caffeine consumption.

There were two principal findings in the present study. First, that caffeine intake is not associated with PMS symptoms (e.g. women with PMS were not more likely to consume caffeine than non-PMS sufferers). As noted above, this finding is consistent with those of two retrospective studies (26, 43). Present findings suggest that it is unlikely that caffeine consumption exacerbates PMS symptoms. The second major finding in the present study was that women, across groups, consumed more caffeine during the follicular than during the luteal phase. Thus the menstrual cycle phase difference in level of consumption appeared independent of diagnosis. In interpreting the findings of the present study, it is important to note that the college student sample, although they met inclusion criteria, may not consume as much caffeine as do older populations (44) and it was also unclear whether any participant(s) restricted caffeine use during the course of this study. A final consideration is that the PMS diagnostic criterion used here was a 30% increase in symptomatology, as recommended by NIMH guidelines, and thus level of impairment could not be determined (45). Nonetheless, self-ratings of impairment have been shown to be highly correlated with symptom self-ratings in women with PMS (32).

CONCLUSION

Media and internet sites often suggest that caffeine exacerbates PMS symptoms (25, 46-48). The current data does not provide evidence to support these recommendations. Data suggests that caffeine intake decreased during the luteal phase across women with and without PMS. The present study has demonstrated the value of longitudinal methods of data collection, in order to facilitate our understanding of how the menstrual cycle interacts with caffeine consumption, and it recommended that similar methods be applied to future research. In addition, future research might address the effects of caffeine withdrawal symptoms in relation to PMS, since there are some overlapping symptoms (49). Finally, further research should be more clearly guided by knowledge of underlying mechanisms and by theoretical models of caffeine-adenosine effects that integrate those mechanisms.

References

1. Dean, B.B., Borenstein, J.E., Knight, K., & Yonkers, K. Evaluating the criteria used for identification of PMS. Journal of Women's Health 2006; 15(5), 546-555. [PubMed: 16796482]
2. Wang, Y., Teng, C., Filho, A., Gorenstein, C., & Andrade, L.H. Premenstrual syndrome: confirmatory factor analysis of premenstrual dysphoric symptoms among college students. Brazilian Journal of Medical and Biological Research 2007; 40(5), 639-647.
3. Saunders, A., Kate, E., & Hawton, K. Suicidal behaviour and the menstrual cycle. Psychological Medicine 2006; 36(7), 901-912.
4. American College of Obstetricians and Gynecologists. Premenstrual syndrome. ACOG Practice Bulletin #15. April 2000.
5. Halbreich, U. The diagnosis of premenstrual syndromes and premenstrual dysphoric disorder – clinical procedures and research perspective. Gynecological Endocrinology 2004; 19(6), 320-334.
6. The National Women's Health Information Center [NWHIC], Prevalence Statistics about Premenstrual Syndrome.2004. Available online at: http://www.4woman.gov.
7. Abraham CE & Rumley RE. Role of nutrition in managing the premenstrual tension syndromes. J Reprod Med, 1987; 32;405-417.
8. Bendich A. The Potential for Dietary Supplements to Reduce Premenstrual Syndrome. Journal of the American College of Nutrition, 2000;19;3-12.
9. Bryant, M., Truesdale, K., & Dye, L. (2006). Modest changes in dietary intake across the menstrual cycle: implications for food intake research. British Journal of Nutrition, 2006; 96(5), 888-894.
10. Miller L. Premenstrual Dysphoric Disorder. Psychiatric Times, June 1,2002 pg. 54. Available online at: www.web4.infotrac.galegroup.com.
11. Thys-Jacobs S, Starkey J, Bernstein D, & Tian, J, Calcium carbonate and the premenstrual syndrome: Effects on premenstrual and menstrual symptoms. Premenstrual Syndrome Study Group. Am J Obstet Gynecol, 1998;179(2):444-452.
12. Tobin MB, Schmidt PJ, & Rubinow DR., Reported alcohol use in women with premenstrual syndrome. Am J Psychiatric, 194;151(10):1503-1504.
13. Wyatt KM. Dimmock PW., Jones PM, & O'Brien PM, Efficacy of vitamin B-6 in the treatment of premenstrual syndrome: Systematic review. BMJ, 1999;318;1375-81
14. Smith, B.D., White, T., & Shapiro, N. The Arousal Drug of Choice: Sources and Consumption of Caffeine. In B.D Smith (Ed.), Caffeine and Activation Theory: Effects on Health and Behavior. Boca Raton, FL: CRC Press. 2007.
15. Barry, R., Rushby, J., Wallace, M., Clarke, A., Jonhstone, S., & Zlojutro, I. Caffeine effects on resting-state arousal. Clin Neurophysiol., 2005. 116: 2693- 2700.
16. Smith, B.D. & Aldridge, K. Acute Cardiovascular Effects of Caffeine: Hemodynamics and Heart Function. In B.D Smith (Ed.), Caffeine and Activation Theory: Effects on Health and Behavior. Boca Raton, FL: CRC Press. 2007.

17. Kerrigan. S., & Lindsey, T. Fatal caffeine overdose: two case reports. 2005. Forensic Sci Int. 153(1), 67-69.
18. Piesse JW. Nutrition and the premenstrual syndrome: A review, Int Clin Nutr Rev, 1984;4;56-64.
19. Rossignol AM. Caffeine-containing beverages and premenstrual syndrome in young women. American Journal of Public Health, 1985;75;1335-1337.
20. Rossignol AM. & Bonnlander H. Caffeine-containing beverages, total fluid consumption, and premenstrual syndrome. American Journal of Public Health,1990; 80;1106-9.
21. Rossignol AM, Bonnlander H, Song L, & Phillis JW. Do women with premenstrual symptoms self-medicate with caffeine? Epidemiology, 1991;2;403-8.
22. Rossignol AM, Zhang J, Chen Y, & Xiang Z. Tea and premenstrual syndrome in the People's Republic of China. American Journal of Public Health, 1989;79; 67-69.
23. Rasheed, P., Al-Sowielem, L.S. Prevalence and predictors of premenstrual syndrome among college-aged women in Saudi Arabia. Ann Saudi Med 2003; 23(6); 381-7. [Pubmed: 16868373].
24. Dickerson, L.M., Mazyck, P.J., Hunter, M.H. Premenstrual Syndrome. Am Fam Physician 2003; 67(8); 1743-52.
25. Hamilton, Patsy. Caffeine And PMS Are A Bad Combination, Here's Why. EzineArticles 2006; Retrieved May 16, 2007, from http://ezinearticles.com/?Caffeine-And-PMS-Are-A-Bad-Combination,-Heres-Why&id=338064
26. Caan B, Duncan D, Hiatt R, Lewis J, Chapman J, & Armstrong MA. Association between alcoholic and caffeinated beverages and premenstrual syndrome. Journal of Reproductive Medicine,1993;38;630-6.
27. Halbreich, J., Halbreich, U., & Smail, N. Screening of patients for clinical trials of premenstrual syndrome/ premenstrual dysphoric disorder: Methodological issues. Psychiatry Res 2006; 141(3), 349-352.
28. NIMH premenstrual syndrome workshop guidelines, National Institute of Mental Health, (not published), Rockville, MD (1983) in Rubinow DR, & Roy-Byrne P. Premenstrual syndromes: Overview from a methodological perspective. Am. J. Psychiatry, 1884;141:2 ;163-172.
29. Futterman, LA & Rapkin, AJ. Diagnosis of premenstrual disorders. J Reprod Med, 2006; 51(4 Suppl); 349-58.
30. Halbreich U, Backstrom T, Eriksson E, O'Brien S, Calil H, Ceskova E, et al. Clinical diagnostic criteria for premenstrual syndrome and guidelines for their quantification for research studies. Gyn Endo, 2007;23(3), 123-130.
31. Spitzer, R.L., Kroenke, K., & Williams, J.B. Validation and utility of a self-report version of PRIME-MD: the PHQ primary care study. Primary Care Evaluation of Mental Disorders. Patient Health Questionnaire. JAMA 1999 282(18), 1737-44.
32. Smith MJ, Schmidt PJ, & Rubinow DR. Operationalizing DSM-IV criteria for PMDD: selecting symptomatic and asymptomatic cycles for research. J Psychiatr Res, 2003, 37(1), 75-83. [PubMed: 12882473].
33. Odber J, Cawood EH, & Bancroft J. Salivary cortisol in women with and without perimenstrual mood changes. Jr of Psychosomatic Research, 1998;45(6); 557-568.
34. Roca CA, Schmidt PJ, Altemus,M, Deuster P, Danaceau MA, Putman K, & Rubinow DR. Differential menstrual cycle regulation of hypothalamic-pituitary-adrenal axis in women with premenstrual syndrome and controls. The Journal of Clinical Endocrinology & Metabolism, 2003;88(7);3057-3063.
35. Kroenke K, Spitzer RL, & Williams JBW. The PHQ-9: Validity of a brief depression severity measures. Journal of General Internal Medicine, 2007; 16(9); 606-613.
36. Spitzer RL, Williams JBW, Kroenke K, Hornyak R, McMurray J. Validity and utility of the PRIME-MD Patient Health Questionnaire in assessment of 3000 obstetic-gynecologic patients: The PRIME-MD Patient Health Questionnaire Obstetric-Gynecology Study. Am J Obstet Gynecol, 2000; 759-769.
37. Juliano LM, & Griffiths RR. Caffeine. In Lowinson JH, Ruiz P, Millman RB, & Langrod JG (Eds.). Substance Abuse: A ComprehensiveTextbook, Fourth Edition. (pp 403-421). Baltimore: Lippincott, Williams, & Wilkins. 2005.
38. Steiner M, Haskett RF, & Carroll BJ. Premenstrual tension syndrome: The development of research diagnostic criteria and new rating scales. Acta Psychiat Scand,1980; 62;177-190.
39. Bergant A, Schneider A, Tran T, Hacket E, Lanczik M, & Steiner M. Diagnosis of prementstrual disorders. Deutsche Medicine Wochenschritt, 2004; 129(5); 188-192.
40. NIMH Workshop on Premenstrual Syndrome, Rockville, Md., April 14-15, 1983
41. APA Diagnostic and Statistical Manual of Mental Disorders (DSM-IV) American Psychiatric Association, 2000
42. Leviton, A. Study on PMS and caffeine consumption flawed. Am J Public Health 1991; 81(12):1673-1675. [Pubmed: 1405286]
43. Gold EB, Bair Y, Block G, Greendale GA, Harlow SD, Johnson S, et al. Diet and lifestyle factors associated with premenstrual symptoms in a racially diverse community sample: Study of Women's Health Across the nation (SWAN). J Women's Health 2007; 16(50): 641-56. [Pubmed: 17627400].
44. Harrison M. Self-help for premenstrual syndrome. New York: Random House; 1982
45. Frary CD, Johnson RK, Wang MQ. Food sources and intakes of caffeine in the diets of persons in the United States. Am Dietetic Association, 2005; 108(4), 110-113.
46. Health Square. 2006. Premenstrual Syndrome (PMS): Guide to Women's Health (From the PDR Family Guide to Women's Health). Online at http://www.healthsquare.com/fgwh/wh1ch03b.htm
47. Internet Health Library. 2006. Premenstrual Syndrome (PMS): Research Diet and Lifestyle. Online at http://www.internethealthlibrary.com/Health-problems/Premenstrual%20Syndrome%20(PMS)%20-%20researchDiet&Lifestyle.htm
48. Lark SM. Premenstrual syndrome self-help book: A women's guide to feeling good all month, PMS Self-Help Center, Los Altos, California.1984
49. Allen SS, Hatsukami D., Christianson D, & Nelson, D. (1996). Symptomatology and energy intake during the menstrual cycle in smoking women. Journal of Substance Abuse, 8(3), 303-319.

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