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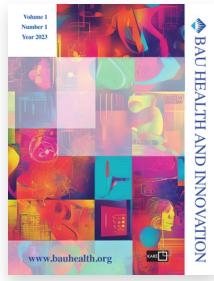

Original Article

Effects of Premenstrual Syndrome and Giving Birth on Women's Cognitive Abilities

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Abstract

Objectives: Premenstrual syndrome (PMS) is a cyclic disorder that affects many young and middle-aged women that arises during the luteal phase of the menstrual cycle and meliorates during the follicular phase. Neuropsychological symptoms of PMS have been researched as well as other symptoms. However, previous information about the effects of PMS on cognition is not univocal. Therefore, this study is conducted to contribute to the literature. The previous research does not include the long-term effects of giving birth on cognition. Therefore, the present study is conducted to examine the long-term effects of motherhood on cognitive functions.

Methods: In this study, women in the luteal phase and follicular phase were compared to examine the effects of PMS on cognition. Beck Depression Inventory and Beck Anxiety Inventory were applied to discriminate the symptoms of depression, anxiety, and PMS. PMS screening tool was applied to determine whether PMS exists or not. Tests that measure visual memory, verbal memory, attention and concentration, visuospatial organization, and executive functions were conducted.

Results: In this study, we found that PMS significantly affects attention and concentration (Digit Span Forward Test p = 0.023). We could not find any significant effect of PMS on visual memory, visuospatial organization, executive functions, and verbal memory. The same group was compared as nulliparous and parous to examine the long-term effects of giving birth on cognitive abilities. The results showed no significant effect of giving birth on attention and concentration, visual memory, verbal memory, visuospatial organization, and executive functions.

Conclusion: We conducted this study because the information about the effects of PMS was not solid. Furthermore, previous studies did not investigate the long-term effects of giving birth on cognition. In this study, the effects of PMS on cognitive functions were investigated and we found that PMS affects attention and concentration. In addition, we studied the effects of giving birth on women's cognitive functions. We could not find any significant long-term effect of giving birth on women's cognitive functions. The study's sample size was limited because to the COVID-19 pandemic. Studies with greater sample sizes are thought to produce superior findings.

Keywords: Cognitive functions, giving birth, premenstrual syndrome.

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Premenstrual Syndrome (PMS)

PMS is a cyclic disorder that affects many young and middle-aged women that arises during the luteal phase of the menstrual cycle and meliorates during the follicular phase.[1] Symptoms of PMS are defined as cognitive, behavioral, physical, emotional, and psychological.[2,3]

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So far, studies about the effects of PMS on cognitive functions showed different results. Komnenich et al. and Keenan et al. found that women with PMS are significantly worse than women without PMS on executive function tasks. [4,5] On the other hand, Broverman et al., Morgan et al. and Slyepchenko et al. found that PMS has no significant effect on executive functions.[6-8] Posthuma et al. suggested that women with PMS show significantly worse performance on visual constructional tasks compared to non-PMS women. [9] However, Broverman et al. and Morgan et al. found that PMS does not significantly affect visual constructional abilities.[6,7] Slyepchenko et al. and Hatta and Nagaya stated that PMS significantly affects women's attention and concentration,[8,10] while Rapkin et al. and Keenan et al. suggested the opposite.[11,12] Keenan et al. suggested that PMS has significant effects on working memory and cognitive flexibility,[13] while Slyepchenko et al. demonstrated that PMS does not significantly affect working memory[8] and Morgan et al. suggested that PMS has no significant effect on cognitive flexibility.[7] Keenan et al. found that there was no significant effect of the menstrual phase on cognitive abilities such as; verbal memory, attention, and nonverbal memory.[5] On the other hand, Diener et al. found that women with PMS showed worse performance in the luteal phase on attention and memory tasks. Furthermore, women with PMS showed significantly worse performance on visual memory tasks in the follicular phase.[14] Solís-Ortiz and Cabrera found that the menstrual phase significantly affects working memory, visuospatial abilities, and attention.[15] Hartley et al. showed that the menstrual phase significantly affects verbal memory.[16] Hatta and Nagaya demonstrated found that the menstrual phase does not significantly affect memory, but affects attentional abilities. [10] Thus, the present research was conducted to contribute to the literature, comparing women in the follicular phase or luteal phase because previous research is not univocal.

Giving Birth

Keenan et al. and Casey et al. found no significant effect of giving birth on implicit memory,[12,17] while Brindle et al. and Sharp et al. revealed a significant effect of giving birth on implicit memory.[18,19] According to Brindle et al., motherhood significantly affects verbal memory;[18] however, according to Keenan et al. and Sharp et al., it does not significantly affect verbal memory.[12,19] This study was conducted to contribute to the literature, comparing women who have never been pregnant and women who have been with children for more than 12 months because previous studies about the effects of motherhood on cognitive abilities are not capable of highlight differences in the brain after giving birth because they are not univocal and all cases do not include nulliparous women.

Materials and Methods

Study Design

Participants

According to the literature, the sample size for PMS-related neuropsychological research ranged from 30 to 78 people. Based on this, the study's sample size was found to be 60. However, due to the COVID-19 pandemic, the sample size has been limited to 34.[10,13] Therefore, 34 healthy women aged between 18 and 41 participated in the study. Extreme situations, such as menopause before the age of 40, were excluded from the study. Menopause in women aged 40–45 is referred to as typical early menopause, with a cut-off age of 41. Menopause usually occurs around 45 years or older. As a result, it was excluded from the study.[20] Their educational level was bachelor's degree and master's degree. None of them were taking oral contraceptives or other hormonal treatments. All participants were regularly menstruating (25–28 days). The exclusion criteria were (1) a high level of Beck Depression Test, (2) a high level of Beck Anxiety Test, (3) none PMS results from PSST, (4) current breastfeeding, (5) current usage of oral contraceptives. One participant's data were excluded due to a high level of depression, two participants' data were excluded due to a high level of anxiety and also one participant's data were excluded due to the "none PMS" result. In total, 30 participants were included in the data and four participants were excluded from the study. Participants were divided as 15 in the follicular phase and 15 in the luteal phase, while 11 participants were in the parous group (gave birth) and 19 participants were in the nulliparous group (not given birth). All participants were literated in Turkish and they approved the volunteer participation form.

Procedure

This study was approved by the Ethics Committee of the Bahçeşehir University in 2020 and it was executed in compliance with the Helsinki Declaration. Participants were separated according to the cycle phase. All participants were tested in the follicular phase – days 3 or 4, or in the luteal phase – days 20 or 21 only once to prevent learning. Furthermore, participants were divided into two groups as parous (women who gave birth at least once) and nulliparous (women who have never given birth). First, each participant was informed about the study and its contributions and then signed a volunteer consent form. Later, they took Beck Depression Inventory and Beck Anxiety Inventory to

separate the symptoms of depression and anxiety from the symptoms of PMS because depression and anxiety are very common indications of PMS.[21]

After those inventories, participants' PMS level was evaluated by Premenstrual Symptom Screening Tool (PSST). Afterward, the digit span test (attention and concentration), visual reproduction test (short-term visual memory and long-term visual memory), Oktem Verbal Memory Processes Test (verbal learning, short-term verbal memory, and long-term verbal memory), Benton's Judgement of Line Orientation Test (visuospatial organization), Stroop Test (cognitive flexibility) and Trail Making Test (visuospatial processing, motor abilities, working memory, complex attention, planning, and task switching) were conducted respectively. The total testing time was 1 h.

Materials

Beck Depression Inventory

Beck depression inventory was constituted according to the depressed symptoms of psychiatry patients. The test includes 21 depression symptoms which are: (1) mood, (2) pessimism, (3), sense of failure, (4) lack of satisfaction, (5) guilt, (6) sense of punishment, (7) self-dislike, (8) self-accusation, (9) suicidal thoughts, (10) crying, (11) feeling irritated, (12) social withdrawal, (13) indecisiveness, (14) distorted body image, (15) work inhibition, (16) sleep disturbance, (17) fatigability, (18) loss of appetite, (19) somatic preoccupation, (20) loss of libido, and (21) weight loss. These items are rated between 0 (not at all) and 3 (severely) for intensity. Participants rated the items according to their moods, feelings, and attitudes regarding the previous week of the interview.[21,22] The reliability study of this test was conducted by Buket Tegin in 1980,[23] and the validity study was conducted by Nesrin Hisli in 1988.[24]

Beck Anxiety Inventory

Beck Anxiety Inventory focuses on physiological indications of anxiety. Beck Anxiety Inventory focuses on physiological indications of anxiety. It includes 21 self-report items and measures anxiety levels in psychiatric patients. Each item ranges from 0 (not at all) to 3 (severely). The inventory focuses on anxious mood terms (four items), specific fears (three items), and autonomic hyperactivity, generalized anxiety disorder, panic (14 items). Participants rated these items in regard to their moods, feelings, and attitudes in the previous week of the interview.[25]

PMS Screening Tool (PSST)

PSST was developed according to the premenstrual dysmorphic disorder (PMDD) diagnosis criteria of DSM IV, to diagnose PMDD and PMS. The first four items of the tool comprise core PMDD symptoms. These are: (1) Markedly depressed mood, feelings of hopelessness, or self-deprecating thoughts, (2) marked anxiety, tension, feelings of being "keyed up" or "on edge," (3) marked affective lability (e.g., feeling suddenly sad or tearful or increased sensitivity to rejection), and (4) persistent and marked anger or irritability or increased interpersonal conflicts. The symptoms must markedly interfere with work or school or with usual social activities and relationships with others (e.g., avoidance of social activities, decreased productivity, and efficiency at work or school). The presence of the cyclical pattern of symptoms must be confirmed by prospective daily symptom ratings for a minimum of two consecutive symptomatic cycles and must be present for most months during the previous year.

The last five items evaluate psychosocial status such as; the effects of PMDD or PMS on school and work activities, social activities, and responsibilities. Participants marked all items as "none," "mild," "moderate," and "severe."

Participants marked all items as "none," "mild," "moderate," and "severe." Participants who marked at least one of the first four items and at least one of the psychosocial items as "moderate to severe" are defined as "moderate-to-severe PMS."[8]

Digit Span Test (WMS-R)

During the digit span test, participants recall and repeat digit spans which increase, backward, and forward until some numbers of the length are missed. The Digit span test measures attention and concentration.[26] The normative data of this test are found in the Bilnot Battery Manual prepared by Sirel Karakaş in 2006.[27]

Visual Reproduction Test (WMS-R)

Visual Reproduction Test (VPR) evaluates visual memory and it is divided into two sections; Visual Reproduction Test I and Visual Reproduction Test II. During VPR I, participants are shown three geometric figures separately for 10 s and are expected to recall and draw these figures immediately, to assess short-term visual memory. VPR II measures long-term memory. Participants are asked to recall and redraw as much as they remember the geometric figures half an hour after VPR I.[28]

Oktem Verbal Memory Processes Test (Öktem Sözel Bellek Süreçleri Testi)

Oktem Verbal Memory Test is improved to assess verbal learning, long term, and short-term verbal memory. To assess short-term verbal memory, participants are read 15 Turkish words in order and expected to memorize

and repeat them. The examiner reads the words until participants remember and repeat 15 words (not necessarily in the same order) at a time. If the participant is not able to remember all words, the examiner reads them until 10 trials are completed. Long-term verbal memory is assessed 30–40 min after the short-term memory test. Participants are expected to remember those 15 words the examiner read. The validity and reliability studies of this test were conducted by Oget Oktem in 2011.[29]

Benton's Judgement of Line Orientation Test

This test was developed by Benton to determine abnormalities associated with the visual-spatial organization. The lines are introduced on a booklet and separated as response choice and "stimuli." Response-choice lines are sorted by angle, numbered from 1 to 11, and 3.8 cm long. Two stimuli lines are introduced, half of a response-choice line (1.9 cm), and they are on either the proximal, middle, or distal side of response-choice lines. Participants determine the same lines on response-choice and stimuli pages according to place and angle. Five pages are split as practice items and the examiner informs participants if their responses were correct or incorrect, only this part. Responses are accepted as correct if the participant determines both lines correctly.[30] The normative data of this test are found in the Bilnot Battery Manual prepared by Sirel Karakaş in 2006.[27]

Stroop Test

The Stroop Test measures cognitive flexibility, which is an executive function. It is the ability to inhibit a habitual response, shifting perceptual according to changing requisitions. The test is divided into three cards; Card A, Card B, and Card C. Card A also the color card includes three to five colors. The participants are required to verbalize these colors, scanning from left to right and as fast as possible. Card B is the word card and includes black and white printed names of the colors. The participants read the names of the colors as quickly as possible. On Card C, the color-word card, the names of the colors are printed in conflicting colors. For example, yellow is printed in blue, red, or green but not in yellow. Therefore, participants need to ignore the conflicting color names and name the colors of the inks.[31] The validity and reliability studies of this test were conducted by Emek Savaş et al. in 2020.[32]

Trail Making Test

Trail Making Test measures visuospatial processing, motor abilities, and executive functions such as; working memory, complex attention, planning, and task switching. The test is comprised of two parts as A and B. All stimuli items are set scattered on both A and B forms. On A form, stimuli items are numbers in circles from 1 to 25 and participants match those items correctly and in order. On B form, stimuli items are numbers from 1 to 13 and letters from A to L in circles. Participants match those circles in order and in sequence as 1-A, 2-B, 3-C, and 4-D… While part A mostly measures processing speed dependent on visual scanning, part B measures task switching and ability to follow the sequence. The normative study of this test was conducted by Türkeş et al. in 2015.[33]

Data Analysis

The study consists of nine tests in total. The data collected by the tests were transferred to the SPSS 25.0 (Statistical Package for the Social Sciences, version 25) program, and then statistical analyzes of the data were made using this program. Descriptive statistics were used to form a distribution table and examined participants' sociodemographic qualities. Independent sample t-test was used to compare neuropsychological performances in follicular phase and luteal phase, and parous group and nulliparous group. In cases where there is no normal distribution, Mann–Whitney U Test is used to determine the difference between two groups on one ordinal variable.[34] Therefore, Mann–Whitney U test was used when the t-test results showed a significant difference between the follicular phase and the luteal phase. In this study, the Statistical Package for the Social Sciences (SPSS) Program,[25] manufactured by IBM and compatible with Microsoft was used. The headquarter of IBM is located in New York, USA.

Results

The sample size of the study is formed by 30 random participants. Furthermore, the target group was contacted through the convenience sampling method.

Table 1 provides demographic information about average age, average menstrual period, average menstrual cycle length, and presence of dysmenorrhea.

In this study, the effects of PMS on attention, concentration, short- and long-term visual memory, verbal learning, short- and long-term verbal memory, visual-spatial organization, and cognitive flexibility were investigated. Our results showed that PMS affects only attention and concentration ($p<0.05$) (Table 2). To confirm this result, Mann–Whitney U Test was conducted. The result of this test also showed that the menstrual phase significantly affected digit span forward test scores $z=64.500$, $p<0.05$. Women in the follicular phase group ($\mu=6.27$) performed significantly higher than women in the luteal phase group ($\mu=7$). It is possible to say that women in the follicular phase showed significantly

Table 1. Demographics

	Luteal (n=15)	Follicular (n=15)	p	Nulliparous (n=19)	Parous (n=11)	p
Age (years) (mean [SD])	31.13 (3.7)	27.8 (3.6)	0.146	27.7 (4.4)	32.8 (5.1)	0.004
Duration of Mensturation (days) (mean [SD])	5.2 (1.2)	5.6 (1.6)	0.422	5.4 (1.3)	5.5 (1.5)	0.820
Duration of the menstrual cycle (days) (mean [SD])	28.5 (1.6)	26 (1.6)	0.481	30.2 (2.8)	30.7 (2.9)	0.642
Presence of dysmenorrhea (n [%])	8 (47)	6 (40)	0.285	11 (55)	6 (60)	0.032

t-test, p≤0.05 statistically significant.

Table 2. Cognitive effects of PMS and giving birth

	Luteal phase (n=15)	Follicular phase (n=15)	p	Parous (n=19)	Nulliparous (n=11)	p
Beck depression ınventory	11.8 (4.05)	13.8 (6.8)	0.340	1.64 (0.6)	1.74 (0.6)	0.695
Beck anxiety ınventory	13.8 (6.8)	15.1 (7.9)	0.620	1.45 (0.8)	1.11 (0.7)	0.651
PSST Score	4.1 (3.3)	2.7 (0.8)	0.070	4.45 (3.9)	2.63 (0.5)	0.057
Oktem Immediate Verbal Recall	8.93 (2.7)	8 (2.4)	0.328	8.64 (2.4)	8.37 (2.7)	0.789
Oktem Verbal Learning	139.4 (10.8)	138.2 (5.8)	0.709	140.73 (4.2)	137.68 (10.2)	0.265
Oktem Delayed Verbal Recall	14.67 (0.6)	14.27 (1)	0.208	14.73 (0.6)	14.32 (0.9)	0.212
Immediate Visual Recall (WMS-R)	12.6 (1.5)	12 (1.6)	0.313	12.91 (0.8)	11.95 (1.8)	0.061
Delayed Visual Recall (WMS-R)	12 (1.8)	11.80 (1.3)	0.925	12.45 (0.8)	11.58 (1.8)	0.147
Benton's Line Orientation Test Score	13.8 (6.8)	15.1 (7.9)	0.627	26 (4)	24.11 (3.5)	0.188
Digit Span Forward	7 (0.65)	6.27 (1.1)	0.035*	7 (1)	6.42 (0.9)	0.114
Digit Span Backward	5.67 (0.9)	5.13 (1.06)	0.149	5.73 (1)	5.21 (0.9)	0.178
Trail-Making Test A	26.8 (5.3)	27.1 (6.8)	0.906	25.91 (5.4)	27.63 (6.3)	0.459
Trail Making Test B	58.4 (16.4)	53.3 (14.2)	0.375	51.36 (10)	58.47 (17.4)	0.227
Stroop Test	31.8 (10.7)	33.7 (12.2)	0.650	60 (11)	60.05 (13.8	0.147

t-test, *p≤0.05 statistically significant. PMS: Premenstrual syndrome, PSST: Premenstrual syndrome screening tool, WMS-R: Weschler memory scale revised.

better attention and concentration performance compared to women in the luteal phase (Table 2). In addition, we investigated the effects of giving birth on the same cognitive abilities. We could not find any significant effect of giving birth on women's cognitive functions.

Discussion

PMS is a cyclic disorder with psychological, cognitive, emotional, physical, and behavioral symptoms.[1-3] It starts during the luteal phase of the menstrual cycle and comes to an end during the follicular phase.[1] In our study, we investigated the effects of PMS on cognitive functions to contribute to the literature because previous research about this topic was not univocal. The previous study demonstrated that progesterone level in the luteal phase has a positive relationship with better performance on attention, concentration, visual memory, and working tasks.[6,35,36] However, this study showed that women in the luteal phase performed worse than women in the follicular phase in the digit span forward test. In other words, it is possible to say that PMS affects attention and concentration consistent with Hatta and Nagaya (2009) and Slyepchenko's results.[8,10] The results on visual recall are consistent with Morgan et al.'s[7] results. There is no significant effect of PMS on visual recall. In addition, we could not find a significant effect of PMS on executive functions as Broverman et al., Komnenich et al., and Morgan et al.[4,7]

Our results on verbal recall are the same as Rapkin et al., and Keenan et al.'s[11,13] results, we did not find any significant effect of PMS on verbal recall. Unlike Keenan et al.,[5] we could not find a significant effect of PMS on delayed verbal recall and verbal learning. This study shows that women do not have difficulties in verbal learning due to PMS. Our results showed no significant effect of PMS on visuospatial organization ability as Broverman et al., Posthuma et al., and Morgan et al.'s results.[5,7,9] The reason why the test results in this study showed no significant difference may be that gonadal hormone levels were not measured. It is possible that the lack of measurement of gonadal hormone levels contributed to the test results in this study showing no

significant difference. It has been noted that sex hormones released during the menstrual cycle and cognitive functioning are related, as indicated by Phillips and Sherwin. This is further supported by additional studies, which shows that learning, memory, and executive functions are significantly influenced by GABAergic, dopaminergic, glutamatergic, and serotonergic pathways. These pathways interact with estrogen and progesterone as components of neurotransmitter systems relevant to cognition.[37]

Furthermore, we investigated the long-term effects of giving birth on cognitive functions to contribute to the literature because previous research focused on short-term cognitive changes during pregnancy and 2 years postpartum. We could not find any significant effects of giving birth on attention and concentration, immediate and delayed visual recall, verbal learning, visuospatial organization skills, and executive functions. Although Brindle et al.[18] and Sharp et al.[19] revealed a significant effect of giving birth on verbal memory, we could not find any significant effect of giving birth on immediate and delayed verbal memory consistent with Casey et al.,[17] Keenan et al.[13] and Sharp et al.[19]'s results.

Conclusion

In this study, the effects of PMS on cognitive functions were investigated to contribute to the literature because previous research about this topic was not decisive. Initially, the individuals' levels of anxiety and depression were assessed using the Beck Depression and Anxiety Inventory. The PMS symptoms were then measured using the PSST. Cognitive functions were then assessed. Measures were taken of the participants' cognitive abilities, including planning, task switching, working memory, complex attention, visual memory, verbal memory, visual-spatial organization, cognitive flexibility, and visuospatial processing.

The Digit Span Test was first used in cognitive testing to assess concentration and attention (WMS-R). Next, visual memory was assessed using the Visual Reproduction Test (WMS-R). The Oktem Verbal Memory Test was then employed to assess verbal memory functions. Following the completion of this assessment, visual-spatial organization was measured using Benton's Judgment of Line Orientation Test. Afterward, the Stroop Test was used to evaluate cognitive flexibility. Lastly, the Trail Making Test was used to assess working memory, complex attention, motor skills, visuospatial processing, task switching, and planning abilities.

This study showed that women in the luteal phase performed worse than women in the follicular phase in the digit span forward test. In other words, it is possible to say that PMS affects attention and concentration. In addition, we studied the effects of giving birth on women's cognitive functions. We could not find any significant long-term effect of giving birth on women's cognitive functions. These not significant results might be due to limited participants.

The COVID-19 pandemic process prevented 60 volunteers from participating in this study, which was originally scheduled to be conducted on 30. Further research conducted with more participants could show better explanations about the effects of PMS on cognitive abilities.

Disclosures

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Ethics Committee Approval: The study was approved by the Bahçeşehir University Scientific Research and Publication Ethics Committee (date: 16/12/2020).

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References

1. Slap GB. Menstrual disorders in adolescence. Best Pract Res Clin Obstetr Gynaecol 2003;17(1):75–92.
2. Freeman EW. Premenstrual syndrome and premenstrual dysphoric disorder: Definitions and diagnosis. Psychoneuroendocrinology 2003;28:25–37.
3. Clare AW. Psychiatric and social aspects of premenstrual complaint. Psychol Med Monogr Suppl 1983;4:1–58.
4. Komnenich P, Lane DM, Dickey RP, Stone SC. Gonadal hormones and cognitive performance. Physiol Psychol 1978;6(1):115–20.
5. Keenan PA, Lindamer LA, Jong SK. Menstrual phase-independent retrieval deficit in women with PMS. Biol Psychiatry 1995;38(6):369–77.
6. Broverman DM, Vogel W, Klaiber EL, Majcher D, Shea D, Paul V. Changes in cognitive task performance across the menstrual cycle. J Comp Physiol Psychol 1981;95(4):646–54.
7. Morgan M, Rapkin AJ, D'Elia L, Reading A, Goldman L. Cognitive functioning in premenstrual syndrome. Obstetr Gynecol 1996;88(6):961–6.

8. Slyepchenko A, Lokuge S, Nicholls B, Steiner M, Hall GB, Soares CN, et al. Subtle persistent working memory and selective attention deficits in women with premenstrual syndrome. Psychiatry Res 2017;249:354–62.
9. Posthuma BW, Bass MJ, Bull SB, Nisker JA. Detecting changes in functional ability in women with premenstrual syndrome. Am J Obstet Gynecol 1987;156(2):275–8.
10. Hatta T, Nagaya K. Menstrual cycle phase effects on memory and stroop task performance. Arch Sex Behav 2009;38(5):821–7.
11. Rapkin AJ, Chang LC, Reading AE. Mood and cognitive style in premenstrual syndrome. Obstet Gynecol 1989;74(4):644–9.
12. Keenan PA, Yaldoo DT, Stress ME, Fuerst DR, Ginsburg KA. Explicit memory in pregnant women. Am J Obstet Gynecol 1998;179(3):731–7.
13. Keenan PA, Stern RA, Janowsky DS, Pedersen CA. Psychological aspects of premenstrual syndrome I: Cognition and memory. Psychoneuroendocrinology 1992;17(2–3):179–87.
14. Diener D, Greenstein FL, Turnbough PD. Cyclical variation in digit-span and visual-search performance in women differing in the severity of their premenstrual symptoms. Percept Motor Skills 1992;74(1):67–76.
15. Solís-Ortiz S, Corsi-Cabrera M. Sustained attention is favored by progesterone during early luteal phase and visuo-spatial memory by estrogens during ovulatory phase in young women. Psychoneuroendocrinology 2008;33(7):989–98.
16. Hartley LR, Lyons D, Dunne M. Memory and menstrual cycle. Ergonomics 1987;30(1):111–20.
17. Casey P, Huntsdale C, Angus G, Janes C. Memory in pregnancy. II: Implicit, incidental, explicit, semantic, short-term, working and prospective memory in primigravid, multigravid and postpartum women. J Psychosom Obstet Gynecol 1999;20(3):158–64.
18. Brindle PM, Brown MW, Brown J, Griffith HB, Turner GM. Objective and subjective memory impairment in pregnancy. Psychol Med 1991;21(3):647–53.
19. Sharp K, Brindle PM, Brown MW, Turner GM. Memory loss during pregnancy. Br Obstet Gynaecol 1993;100(3):209–15.
20. Hao W, Fu C, Dong C, Zhou C, Sun H, Xie Z, et al. Age at menopause and all-cause and cause-specific dementia: A prospective analysis of the UK Biobank cohort. Hum Reprod 2023;38(9):1746–54.
21. Rapkin AJ, Winer SA. Premenstrual syndrome and premenstrual dysphoric disorder: Quality of life and burden of illness. Expert Rev Pharmacoecon Outcomes Res 2009;9(2):157–70.
22. Beck AT, Steer RA, Carbin MG. Psychometric properties of the beck depression inventory: Twenty-five years of evaluation. Clin Psychol Rev 1988;8(1):77–100.
23. Tegin B. Depresyonda Bilişsel Süreçler: Beck Modeline Göre. Yayinlanmamiş Doktora Tezi. Ankara: Hacettepe Üniversitesi, Psikoloji Bölümü; 1980.
24. Hisli N. Beck depresyon envanterinin geçerliliği üzerine bir çalışma. Psikol Derg 1988;6:118–26.
25. Ulusoy M, Sahin N, Erkmen H. Turkish version of the beck anxiety inventory: Psychometric properties. J Cogn Psychother 1998;12(2):163–72.
26. Kent P. The evolution of the Wechsler memory scale: A selective review. Appl Neuropsychol Adult 2013;20(4):277–91.
27. Karakaş S. Bilnot Bataryasi el Kitabi: Nöropsikolojik Testler Için Araştırma ve Geliştirme Çalişmalari. 2nd ed. Türkiye: Eryilmaz Ofset Matbaacilik; 2006.
28. Gfeller JD, Meldrum DL, Jacobi KA. The impact of constructional impairment on the WMS-R visual reproduction subtests. J Clin Psychol 1995;51(1):59–63.
29. Öktem Ö. Öktem Sözel Bellek Süreçleri Testi-Öktem SBST El Kitabi. Ankara: Türk Psikologlar Derneği Yayinlari; 2016.
30. Riccio CA, Hynd GW. Validity of Benton's judgement of line orientation test. J Psychoeduc Assess 1992;10(3):210–8.
31. Jensen AR. Scoring the Stroop test. Acta Psychol (Amst) 1965;24:398–408.
32. Emek Savaş DD, Yerlikaya D, Yener GG, Öktem Tanör Ö. Stroop testi çapa formu'nun geçerlik-güvenirlik ve norm çalişmasi. Türk Psikiyatri Derg 2020;31(1):9–21.
33. Türkeş P, Handan Can P, Murat P, Banu P, Dikeç E. İz sürme testi'nin 20–49 yaş araliğinda türkiye için norm belirleme çalişmasi. Türk Psikiyatri Derg 2015;26(3):189–96.
34. McKnight PE, Najab J. Man-Whitney U test. In: The Corsini Encyclopedia of Psychology. Hoboken: John Wiley and Sons, Inc.; 2010.
35. Phillips S, Sherwin BB. Variations in memory function and sex steroid hormones across the menstrual cycle. Psychoneuroendocrinology 1992;17(5):497–506.
36. Solis-Ortiz S, Guevara MA, Corsi-Cabrera M. Performance in a test demanding prefrontal functions is favored by early luteal phase progesterone: An electroencephalographic study. Psychoneuroendocrinology 2004a;29:1047–57.
37. Le J, Thomas N, Gurvich C. Cognition, the menstrual cycle, and premenstrual disorders: A review. Brain Sci 2020;10(4):198–212.