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Evaluation of auditory perception in women during menstrual cycle: a systematic review

Avaliação da percepção auditiva em mulheres durante ciclo menstrual: revisão sistemática

Percepción de evaluación de audiencia sobre la mujer durante el ciclo menstrual: revisión sistemática

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Abstract

Introduction: Hormonal fluctuations that normally occur during the menstrual cycle can interfere with the audio system. The change most found in this period is the reduction of auditory acuity, which seems to be more related to fluctuating estrogen levels, when it is reduced in the luteal phase of the menstrual period end. **Objective:** Investigate through a systematic review hearing in women during the menstrual cycle phases. **Method:** A search was made in the electronic databases, national and international, LILACS,

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CSC, DSS and RTSC data collection, tabulation, interpretation, and article construction.
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MEDLINE, PubMed and SciELO, by consulting the following descriptors: “auditory perception” and “menstrual cycle”, “speech perception” and “menstrual cycle”, “speech perception” and “hormones” and their corresponding in Portuguese. **Results:** Twenty-two articles were found, but only 7 articles were chosen after the criteria for inclusion and exclusion. The amount of the sample of selected articles ranged between 15 and 39 women, aged between 17 and 46 years old. In most articles, any type of medical procedure to estimate the phases of the menstrual cycle was used. The performance of auditory perception tests in the seven selected articles was observed, highlighted with the dichotic tests. **Conclusion:** There is a need of further research on the subject, demanding a greater methodological rigor in the preparation of these studies, through clinical safe and standardized to measure hormone levels procedures.

Keywords: Adrenal cortex hormones; Menstrual cycle; Speech perception; Auditory perception

Resumo

Introdução: As flutuações hormonais que ocorrem normalmente durante o ciclo menstrual podem interferir no sistema auditivo. A alteração mais encontrada neste período é a diminuição da acuidade auditiva, que parece estar mais associada à flutuação dos níveis de estrogênio, quando este se encontra reduzido na fase lútea final do período menstrual. **Objetivo:** Investigar por meio de uma revisão sistemática a percepção auditiva de mulheres durante as fases do ciclo menstrual. **Método:** Foi realizada uma busca nas bases de dados eletrônicas, nacionais e internacionais, LILACS, MEDLINE, PubMed e SciELO, através da consulta pelos seguintes descritores: “percepção auditiva” AND “ciclo menstrual”, “percepção de fala” AND “ciclo menstrual”, “percepção de fala” AND “hormônios” e seus correspondentes na língua inglesa. **Resultados:** Dos 293 artigos encontrados, foram selecionados apenas 7 artigos, após os critérios de inclusão e exclusão. A caracterização da amostra dos artigos selecionados variou entre 15 a 39 mulheres, com idade variando entre 17 e 46 anos. Na maioria dos artigos, nenhum tipo de procedimento clínico para estimar as fases do ciclo menstrual foi utilizado. Foi observada a realização de testes de percepção auditiva nos sete artigos selecionados, tendo destaque os testes dicóticos. **Conclusão:** Há necessidade da realização de mais pesquisas sobre o assunto, exigindo-se também maior rigor metodológico na elaboração desses estudos, através de procedimentos clínicos seguros e padronizados para mensuração dos níveis hormonais.

Palavras-chave: Hormônios; Ciclo menstrual; Percepção de fala; Percepção auditiva.

Resumen

Introducción: Las fluctuaciones hormonales que ocurren normalmente durante el ciclo menstrual puede interferir con el sistema de audio. El hallazgo más frecuente en este periodo es la reducción de la agudeza auditiva, lo que parece estar más relacionado con la fluctuación de los niveles de estrógenos, cuando se reduce en la fase lútea del final del periodo menstrual. **Objetivos:** Investigar a través de una revisión sistemática de la percepción auditiva de la mujer durante las fases del ciclo menstrual. **Métodos:** Se realizó una búsqueda en bases de datos electrónicas, nacionales e internacionales, LILACS, MEDLINE, PubMed y SciELO, mediante la consulta de los siguientes descriptores: “la percepción auditiva” Y “ciclo menstrual”, “la percepción del habla” Y “ciclo menstrual”, “la percepción del habla” y “hormonas” y sus homólogos en el idioma Inglés. **Resultados:** De los 293 artículos encontrados, se seleccionaron sólo 7 artículos, después de que los criterios de inclusión y exclusión. La caracterización de la muestra de los artículos seleccionados osciló entre 15 y 39 mujeres, con edades comprendidas entre los 17 y 46 años. En la mayoría de los artículos, cualquier tipo de procedimiento médico para estimación se utilizan las fases del ciclo menstrual. el rendimiento de la prueba de percepción auditiva se observó en los siete elementos seleccionados, resalte que tiene dicóticos. **Conclusión:** Existe la necesidad de más investigación sobre el tema, lo que requiere también mayor rigor metodológico en la elaboración de estos estudios, através de procedimientos clínicos segura y estandarizada para medir los niveles hormonales.

Palabras clave: Corticoesteroides; Ciclo menstrual; Percepción de habla; Percepción auditiva.

Introduction

Women regularly go through reproductive cycles that prepare them for pregnancy. These cycles begin at puberty and extend normally throughout the reproductive life[1]. The Menstrual cycle can be divided into three main phases: follicular phase, ovulatory phase, and luteal phase, which varies from the first day of menstruation to the first day of the next menstruation[2,3].

During these phases, there are variations in the production of ovarian hormones (estrogen and progesterone), which happens in a short period of time, controlled by the hypothalamic-pituitary-ovary system. Estrogen is higher in the follicular phase, while progesterone is higher in the luteal phase[2].

The change in the concentration of these hormones in the female organism, which is normal during the menstrual cycle, can have repercussions on many physiological processes, such as well-being, sleep, and immune activity. It is also related to mood changes, anxiety, migraine, stress, and auditory changes[4,5].

The hormonal fluctuation and its relationship with auditory problems have been studied, but not clarified yet. According to some authors[6,7], estrogen and progesterone may influence the auditory system at different levels of the Central Nervous System by modulating some neurotransmitters, as well as by acting on specific receptors found in various organs and systems, including inner ear. There is presence of receptors for the steroid hormones in the cochlea, identified from preclinical and clinical studies[8,9]. Therefore, changes in the hormonal levels may affect inner ear homeostasis and the auditory system in general. Moreover, according to some authors, they cause a characteristic symptom of dizziness, tinnitus, sudden deafness, atrial fullness, hyperacusis, decreased auditory acuity, sensitivity to sound and/or difficulty of understanding[10,11].

It is imperative to invest in studies that go deeper into the subject, given the scarcity of research found in the literature and the need for a careful look at the existence of physiological and sensorial repercussions, especially auditory, during the menstrual cycle, by providing a more specific knowledge about the auditory function, aiming at the prevention/improvement of possible auditory changes in women, to improve their quality of life.

Given the possible influence of hormones on hearing function, the objective of the study was to investigate, through a systematic review, the auditory perception of women during the phases of the menstrual cycle.

Methods

To reach the objective of the research, we opted for the systematic literature review method, since it is an important resource of evidence-based medicine that allows the collection and synthesis of a specific subject for focusing on the best selection of health procedures.

The research was performed in the national and international electronic databases LILACS, MEDLINE, PubMed, and SciELO, from the following Health Sciences descriptors (HSDs): “auditory perception” AND “menstrual cycle”; “speech perception” AND “menstrual cycle”; “speech perception” AND “hormones”, and their correspondents in the Portuguese language, during the month of September 2014.

The articles identified by the search strategy were evaluated independently and blinded by two researchers, strictly adhering to the inclusion criteria: a) text in its entirety; b) target population of women during the menstrual cycle; c) publications in Portuguese and English; d) publications without a defined period. Such strategies were taken with the intention of maximizing the results of the research, once there was a lack of literature on the subject. The following were excluded: a) repeated articles; b) articles not consistent with the object of the study; c) paid articles.

The variables analyzed were title, year of publication, objective, sample, age group, clinical procedures, auditory perception evaluation tests, dichotic tests, and menstrual cycle phases. The data obtained were analyzed for hormonal variation during the menstrual cycle and the characteristics of the auditory perception of women, in addition to the contributions in the area.

All types of study design were considered, in view of the scarcity of studies with control and randomized groups. Regarding the type of participants, the work with women during the menstrual cycle at any age was considered.

The results were analyzed through the program Excel for Windows, version 2007, and presented through representations and tables.

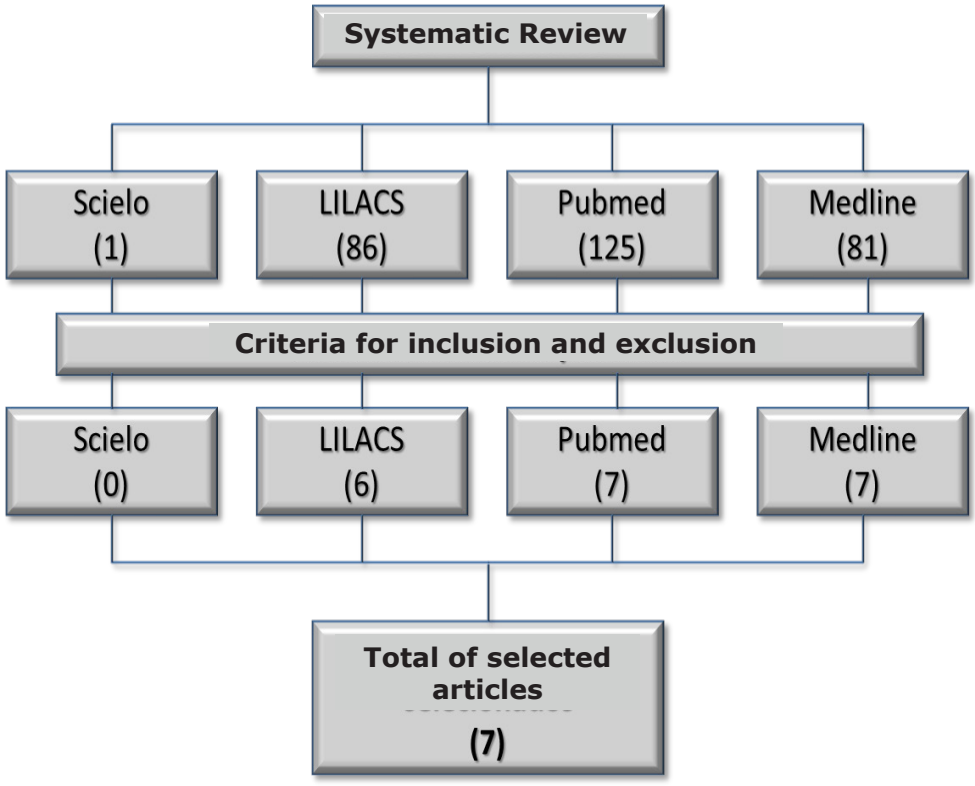

Figure 1. Flowchart of the criteria for inclusion and exclusion of articles used in the systematic review

Results

A total of 293 articles were found, of which 07 were selected, being therefore excluded repeated articles, review articles, those unavailable or those with words or issues that do not fit the theme.

Table 1 shows the characteristics of each study through the following variables: author and year of publication, objectives, sample, and age group.

The selected studies were conducted in different countries, three in the United States, three in England, and one study in Norway. Regarding the year of publication, this review highlights research between the years of 1989 and 2012.

The sample size regarding those who participated in the selected articles ranged from 15 to 39 women, and only three studies compared this population to a control group (men). Regarding the age group, a variation between 17 years and 46 years was observed, presenting a mean of 31.5 years of age, considering that each research presents a different variation for age of the sample.

Table 1. Description of the research articles selected in the systematic review

Author and year of publication	Location	Database	Journal	Objective	Sample (N)	Age Range (years)
Altemus et al, 1989[12]	United States	Pubmed	Neuropsychology	Not informed	39F	18-45
Sanders[13]; Wenmoth, 1998	England	Pubmed	Neuropsychology	Not informed	32F	13
Alexander[14] et al 2001	United States	Pubmed	Neuropsychology	Not informed	30F 12M	F-17-46 M-18-50
Wadnarker[15] 2007	England	Pubmed	Brain and Cognition	Systematically analyzing the impact of the cycle and the difference between sexes in the performance of dichotic listening.	25F 20M	20-25
Tilman[16] 2010	United States	Pubmed	Psychoneuroendocrinology	Not informed	23F	18-35
Cowell et al[17] 2011	England	Pubmed	Brain and Cognition	Examining the variation in the asymmetry of speech perception in women during the menstrual cycle.	21F	20-30
Hjelmervik et al[18] 2012	Norway	Pubmed	Psychoneuroendocrinology	Investigating whether hormonal fluctuations during the menstrual cycle affect the lateralization of language.	15F 15M	20-28

Legend: F: female; M: male (Control Group).

Regarding the clinical procedures to determine the phase of the woman's menstrual cycle, among the 7 articles selected, 2 (28.6%) studies performed saliva collection, 1 (14.3%) performed blood collection, and 4 (57.1% %) studies have not performed clinical procedures. However, it is worth mentioning that they conducted the research by a simple and subjective analysis, mentioned as counting the days of the menstrual cycle, having as reference the onset of menstruation.

Table 2. Description of clinical procedures for determining the phase of the menstrual cycle in young women, from the 7 selected research articles

Clinical Procedures	Articles (N)	%
Saliva Collection	2	28.6
Blood Collection (Hemogram)	1	14.3
None	4	57.1
TOTAL	07	100.0

Auditory perception tests were performed in the seven selected articles, with emphasis on dichotic tests (Table 3). The majority of the articles consisted of the consonant-vowel test, 6 (60%); followed by the word test, 2 (20%); the consonant-vowel-consonant test, 1 (10%); and the music test, 1 (10%). No other dichotic test was reported in the selected articles.

Table 3. Description of the auditory perception tests used in the selected articles

Auditory Perception Test	Articles (N)	%
Dichotic Tests		
Consonant-vowel	6	60.0
Word	2	20.0
Consonant-vowel-consonant	1	10.0
Music	1	10.0
Digit dichotic test	-	-
SSW-Alternating dissyllables	-	-
Other AP tests	-	-
TOTAL(1)	10	100.0

(1): Considering the hypothesis that the same article cites more than one test for evaluation of auditory perception in women, the basis for calculating the percentages is considered and not the total of the articles.

It is important to note that each dichotic test was performed in different phases of the menstrual cycle, in order to relate the hormonal factor and the auditory perception (Table 4). It can be observed that the dichotic consonant-vowel test was the most cited, with 4 (57.1%) occurrences in the initial and final follicular phase.

Table 4. Performance of dichotic tests during the phases of the menstrual cycle found in the selected articles

Auditory Perception Test	Phases of the Menstrual Cycle							
	Initial follicular		Final folicular		Initial luteal		Final luteal	
	N	%	n	%	N	%	N	%
Dichotic Tests								
Consonant-vowel	4	57.1	4	57.1	3	75.0	2	50.0
Consonant-vowel-consonant	1	14.2	1	14.2	-	-	-	-
Word	1	14.2	2	28.5	-	-	2	50.0
Music	1	14.2	-	-	1	25.0	-	-
TOTAL	7	100.0	7	100.0	4	100.0	4	100.0

Discussion

Auditory perception tests were observed in the seven selected articles, with emphasis on dichotic tests (Table 3). The majority of the articles consisted of the vowel-consonant test 6 (60%), followed by the word test 2 (20%), the consonant-consonant test 1 (10%), and the music test, 1 (10%). No other dichotic test was reported in the selected articles. From the analysis of the results, it was observed that a predominant number of studies did not demonstrate the concern to perform any type of clinical procedure to define the phases of the menstrual cycle, which can be determinant for a precise detection of each phase of the cycle, in which different levels of estrogen would be found[12,13,14,15]. Thus, when defining the phases by criteria other than the hormone levels, there may be misinterpretations in the correlation between phase and auditory perception. Recent studies also do not mention any type of

clinical procedure in their research[10,16,20]. In general, they are methodologically limited in this regard.

Such procedures have been reported only in a limited number of researches, where saliva and blood collection procedures have been highlighted[18, 19,20].

In the collection of saliva, the concentration of free steroids that are present in the blood is verified; however, the total levels of hormones in the circulation is not presented. Therefore, the collection of saliva cannot be considered a method totally equivalent to blood collection, which measures the total levels of bound and free steroids[21].

Among the tests used to evaluate auditory perception, the analyzed studies show the preference to use the dichotic listening tests, considering that these allow to delimit the hemispheric specialization for verbal sounds, in which the difference between the responses of the two ears has been used as a basis for inferring the direction or degree of lateralization, the nature of the mechanisms of auditory perception, and temporal lobe alterations[22].

The most cited tests in the research were the consonant-vowel test, which consists of the simultaneous presentation of pairs of different syllables, one in each ear; the word test, which consists of the simultaneous presentation of pairs of dissyllable words in each ear; and the musical test, which is performed through the simultaneous presentation of two musical chords in each ear. These tests can help to clarify the questions raised by the researchers about the auditory perception, since they are tests of high reliability.

As to the phases selected for performing the dichotic tests, there is no agreement between the authors regarding the nomenclature used to designate the phases of the menstrual cycle, nor the number of phases selected. Notwithstanding, it was found that most articles[12,13,14,15,16] prioritized to perform the tests in only two phases of the cycle, as also evidenced in some current research[19,20]. At the same time, other studies[17,18] have chosen to perform the tests in three or even four phases, as reported in several studies[10,23,24,25,26,27,28]. Notably, the highest number of phases tends to be more accurate as to the effect of each hormone or hormones on the tests studied at a given phase.

It is known that each stage of the menstrual cycle is characterized by distinct oscillations in the production of ovarian steroid hormones, especially estrogen and progesterone. The former shows higher levels in the late follicular phase, while the latter is higher in the late luteal phase. Such hormones can influence the auditory system through the action of estrogen and progesterone receptors in various structures that make up the system. Therefore, the occurrence of this hormonal fluctuation, which is normal during the menstrual cycle, may affect the auditory function, with consequences such as decreased auditory acuity, sensitivity to sound, difficulty in understanding, among others.

As for the results of the dichotic listening tests, it is possible to observe in the researches a probable influence of the ovarian steroid hormones on the auditory perception[12,13,14,15,16,17,18].

One study used the consonant-vowel (CV) dichotic listening test in women during the menstrual cycle, demonstrating better performance in the right ear in the middle luteal phase compared to the menstrual phase. The author states that the high level of estrogen in the middle luteal phase reinforces left hemisphere function, resulting in advantage of the right ear [12].

Furthermore, the music dichotic listening and vowel consonant (CV) tests[13] were performed in another research. There was a better performance of the left ear in the menstrual phase compared to the middle luteal phase, which suggests that the increase in estrogen levels in the middle luteal phase is related to a decrease in right hemisphere function. In turn, in the consonant-vowel dichotic listening test, the performance of the right ear in the middle luteal phase was better when compared to the menstrual phase. This demonstrates that the increase in estrogen levels in the middle luteal phase is associated with an improvement in left hemisphere function. In fact, it is perceived that estrogen has opposite effects on the right and left hemispheres.

Likewise, other studies performed the dichotic listening test using syllables and words. A better performance of the right ear in the post-menstrual phase was evidenced when compared to the pre-menstrual phase[12,14]. The authors emphasize that during the post-menstrual phase there is a change in regional brain function, since there is an improvement in the left hemisphere, related to the processing of sensory information. This highlights a possible influence of ovarian steroid hormones on verbal functions of the left hemisphere.

Moreover, in another study[17], it was observed in the dichotic test (CV) that the performance of

each ear remained stable throughout the phases, not presenting significant results. However, when the ears were compared to each other, a better performance of the right ear was observed in all phases studied, showing a smaller asymmetry between the ears in the menstrual phase and an increase in the preovulatory and middle luteal phases, suggesting an influence of ovarian steroid hormones.

In the same sense, another study analyzed changes in hemispheric asymmetry during the menstrual cycle, through the analysis of data related to Event Related Potentials (ERP) during the performance of women in a dichotic listening task. It was possible to perceive that each hemisphere was distinctly affected in each phase by the hormone levels, indicating reduced latency in the processing of stimuli of the left ear (right hemisphere) in the menstrual phase, and less latency in the right ear in the preovulatory phase. The author notes that the tasks performed to involve the left hemisphere are best performed when estrogen levels are high, while the tasks performed to involve the right hemisphere are best performed when estrogen levels are low. This suggests that the differences in hemispheric asymmetry are associated with estrogen levels[16].

The analysis of the results showed that changes in dichotic listening may depend on the action of ovarian steroid hormones during the menstrual cycle, as evidenced in the studies above. However, there is a considerable heterogeneity of the methodologies used, since the studies differ in the selection of the phases of the cycle, as well as in the methods used to measure the hormone levels aiming to identify each phase, which impairs the interpretation of the influence of ovarian hormones on auditory perception.

Finally, the need for further research on this subject is emphasized, as well as the need for greater methodological rigor in the performance of these studies, including safe and standardized clinical procedures for measuring hormone levels.

Conclusion

From this systematic review, we observe a small number of studies investigating the relationship between ovarian hormones and auditory perception. These are all carried out outside Brazil. Notwithstanding, the possible influence of ovarian hormones on dichotic listening has been verified in the studies, although the exact mechanism of hormonal action is still not well understood, which may be justified by the methodological divergence and reduced sample of the studies.

References

1. Mitre EI, Figueira AS, Rocha AB, Alves SMC. Avaliações audiométrica e vestibular em mulheres que utilizam o método contraceptivo hormonal oral. Braz J Otorhinolaryngol. 2006; 72: 350-4.

2. Ishii C, Nishino LK, Campos CAH. Caracterização vestibular no ciclo menstrual. Braz J Otorhinolaryngol. 2009; 75: 375-80.

3. Guyton AC. Fisiologia Humana e Mecanismos das Doenças. 6 ed. Rio de Janeiro: Guanabara Koogan, 2008.

4. Souaid J, Rappaport JM. Fluctuating sensorineural hearing loss associated with the menstrual cycle. Braz J Otorhinolaryngol. 2000; 30: 246–50.

5. Mendes NCW, Pinto SJL. O Impacto do ciclo menstrual na biologia feminina. Feminina. 2006; 34: 743-7.

6. Hederstierna C, Hultcrantz M, Collins A, Rosenhall U. Hearing in women at menopause: Prevalence of hearing loss, audiometric configuration and relation to hormone replacement therapy. Acta Oto-Laryngologica. 2007; 127:149-55.

7. Oliveira TSC. Estudo do efeito da terapia de reposição hormonal no potencial evocado auditivo de mulheres na pós-menopausa [dissertação]. Brasília: Faculdade de Ciências da Saúde, 2012.

8. Stenberg AE, Wang H, Fish J, Schrott-fischer A, Sahlin L, Hultcrantz M. Estrogen receptors in the normal adult and developing human inner ear and in Turner's syndrome. Hearing Research. 2001; 157: 87-92.

9. Charitidi K, Meltser I, Tahera Y, Canlon B. Functional responses of estrogen receptors in the male and female auditory system. Hearing Research. 2009; 252: 71-8.

10. Arruda PO, Silva IMC. Estudo das emissões otoacústicas durante o ciclo hormonal feminino. Braz J Otorhinolaryngol. 2008; l74: 106-11.

11. Price K, Zhu X, Guimaraes PF, Vasilyeva ON, Frisina RD. Hormone replacement therapy diminishes hearing in peri-menopausal mice. Hearing Research. 2009; 252: 29-36.

12. Altemus M, Wexler BE, Boulis N. Changes in perceptual asymmetry with the menstrual cycle. Neuropsychologia. 1989; 27: 233–40.

13. Sanders G, Wenmoth D. Cerebral asymmetry and cognitive performance show complementary fluctuations across the menstrual cycle. In: Ellis L, Ebertz L. Males Females and Behavior Toward Biological Understanding. Westport: Praeger. 1998.

14. Alexander GM, Altemus M, Peterson B S, Wexler B. Replication of a premenstrual decrease in right-ear advantage on language-related dichotic listening tests of cerebral laterality. Neuropsychologia. 2002; 40:1293–9.

15. Wadnerkar MB, Whiteside SP, Cowell PE. Dichotic listening asymmetry: Sex differences and menstrual cycle effects. Laterality. 2008; 13: 297–309.

16. Tilman G. Estradiol levels during the menstrual cycle differentially affect latencies to right and left hemispheres during dichotic listening: An ERP study. Psychoneuroendocrinology. 2010; 35: 249–61.

17. Cowell P.E., Ledger WL, Wadnerkar M.B, Skilling F.M., Whiteside S.P. Hormones and dichotic listening: Evidence from the study of menstrual cycle effects. Brain and Cognition. 2011; 76: 256–62.

18. Hjelmervik H., Westerhausen R., Osnes B., Endresen C.B., Hugdahl K., Hausmann M., Specht K. Language lateralization and cognitive control across the menstrual cycle assessed with a dichotic-listening paradigm. Psychoneuroendocrinology. 2012; 37: 1866-75.

19. Gurbuzler L, Yelken K, Aladag I, Eyibilen A, Koc S. Comparison of transient and distortion-product otoacoustic emissions during the luteal and follicular phases of the menstrual cycle. Ear, Nose & Throat Journal. 2012; 91: 322-34.

20. McFadden DA. Speculation about the parallel ear asymmetries and sex differences in hearing sensitivity and otoacoustic emissions. Hearing Research. 1993; 68:143-51.

21. Lipson SF, Ellison PT. Comparison of salivary steroid profiles in naturally occurring conception and non-conception cycles. Human Reproduction. 1996; 11: 2090-6.

22. Pereira LD, Schochat E. Processamento Auditivo Central: Manual de Avaliação. São Paulo: Lovise, 1997.

23. Al-mana D, Ceranic B, Djahanbakhch O, Luxon LM. Hormones and the auditory system: a review of physiology and pathophysiology. Neuroscience. 2008; 153:881-90.

24. Walpurger V, Pietrowsky R, Kirschbaum C, Wolf OT. Effects of the menstrual cycle on auditory event-related potentials. Hormones and Behavior. 2004; 46: 600-6.

25. Serra A, Maiolino L, Agnello C, Messina A, Caruso S. Auditory brain stem response throughout the menstrual cycle. Annals of Otology Rhinology e Laryngology. 2003; 112: 549–53.

26. Caruso S, Maiolino L, Rugolo S, Intelisano G, Farina M, Cocuzza S. Auditory brainstem response in premenopausal women taking oral contraceptives. Human Reproduction. 2003; 18: 85– 9.

27. Yadav A, Tandon OP, Vaney N. Auditory evoked responses during different phases of menstrual cycle. Indian J Physiol Pharmacol. 2002; 46: 449–56.

28. 28-Resende LA, Silva MD, Impemba F, Achoa NB, Schelp AO. Multimodal evoked potentials and the ovarian cycle in young ovulating women. Arq Neuro-psiquiatr. 2000; 58:418–23.