

Pregnancy and vestibular challenges: A narrative review

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Abstract

Pregnancy includes several physical, hormonal, and psychological changes from conception to labor. The vestibular system is also affected during this life cycle and several challenges in patients who present vertigo or vestibular disorders during this time still being unregistered and there is a lack of information about how the vestibular system is affected during pregnancy, clinical and physiological correlation, and the expected results of vestibular testing in this population. Herein, we performed a review of expected physiological, clinical and vestibular testing results in pregnant patients to get the deepest understanding of the vestibular phenomenon during this time.

Keywords: Vestibulocochlear nerve diseases; Vestibular disorders; Pregnancy; Dizziness; Vertigo diagnosis

1. Introduction

Pregnancy is considered the state of having implanted products of conception located in the uterus or elsewhere in the body, which ends with spontaneous or elective abortion or delivery [1]. During pregnancy, several corporal changes involving all organs systems are seen, leading to physical, mental, and emotional challenges [1]. Renal, pulmonary, and cardiovascular affections are commonly described, however, otolaryngological manifestations are also described [2]. This lifetime period can exacerbate several audio-vestibular systems disorders, such as hearing loss, tinnitus, unsteadiness, feeling of floating, rotation, falls and vertigo [2]. Vertigo during pregnancy may be explained by changes involving estrogen and progesterone in specific structures such as stria vascularis, cochlea and spiral ligament [2,3]. Chemical, osmolar and vascular changes in the endolymphatic fluid and within the arteries layers are some related to altered gait, perception and receptors functioning [2,3]. Estrogen alterations may present peripheral or central changes [4]. Besides the impairment in balance and proprioception, vertigo and other vestibular symptoms may lead to an altered quality of life, loss of self-confidence, concentration and performance, concentration at work, depression, and frustration [5,6].

For every 1000.000 instances reported in the United States per year, 32 pregnant patients see primary care physicians for vertigo, and at least 50% of pregnant women would experience vertigo and or dizziness frequently during the first two gestational trimesters [7,8]. However, there are some facing challenges for practitioners regarding diagnosis, clinical manifestations, and vestibular testing in pregnant patients. Herein, we performed a narrative review focused on these critical points, to get a better understanding of vertigo and its implications during pregnancy.

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2. Material and methods

This literature search was conducted in PubMed, Scopus, Bvsalud, and Scielo to search for articles published between January 2000 and November 2022 in English and Spanish languages using the following medical subject heading (MeSH) terms: “dizziness,” “vertigo,” “pregnancy,” “vestibular disease,” and “vestibulocochlear nerve diseases” and boolean operators AND/OR. This search was conducted between November 2022 to February 2023. The inclusion criteria were articles reporting vertigo during pregnancy including the following types of studies: case reports, retrospective chart reviews, cross-sectional studies, case-control cohorts, and systematic reviews. Additionally, articles reporting Meniere’s disease, vestibular neuritis, benign paroxysmal positional vertigo (BPPV), and other presentations of peripheral vertigo during pregnancy were included. Editorials, narrative reviews, scope reviews, letters to the editors, comments, and abstracts were excluded. Articles not focused on vertigo during pregnancy and those focused on vertigo before pregnancy or during adolescence were also excluded. Reports of vertigo in pregnant females associated with inner ear malformations, arteriovenous malformations, and central nervous diseases were also excluded. In total, 77 articles were found, of which 12 articles were included in this review. All articles selected were cross-checked by the authors. This research was conducted according to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines. We included observational studies, prospective and retrospective studies, case-cohorts and cohorts. Studies focused on vestibular testing and relevant data on the otoneurologic evaluation of pregnant patients. (Figure 1).

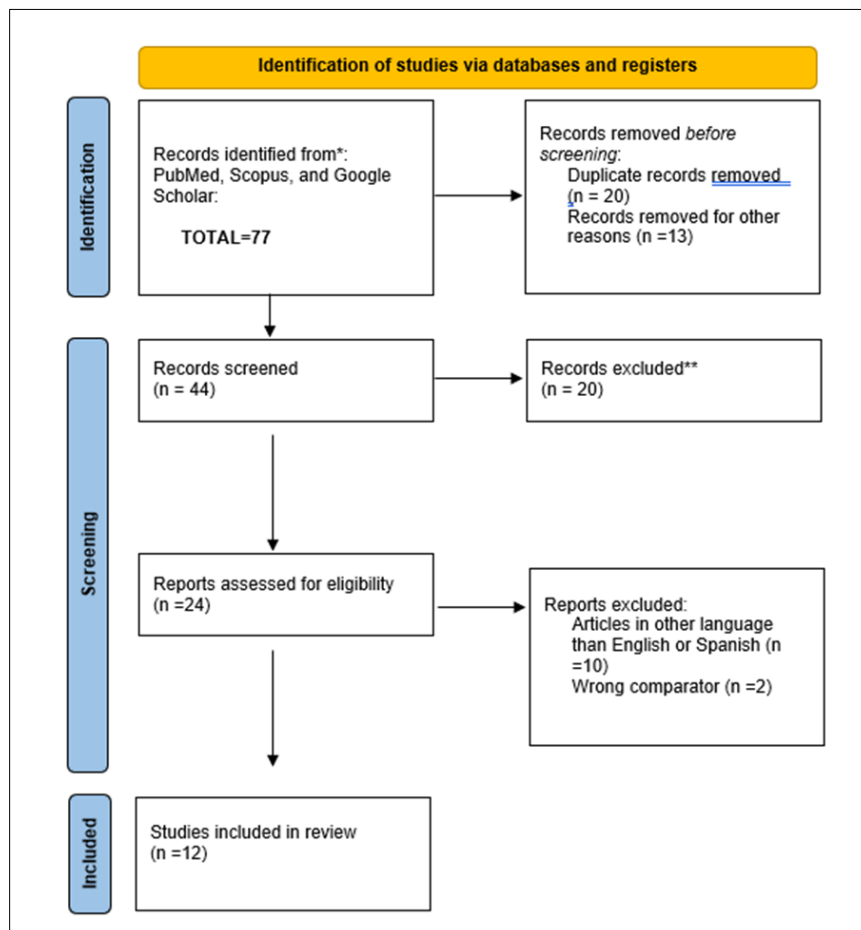


Figure 1 Search flow diagram

2.1. Vestibular challenges

Pregnant females face several challenges during this lifetime including anatomical, functional, and sensorial changes within diverse systems such as cardiovascular, neurological and vestibular [1,3]. Otolaryngologic organs such as larynx, middle and inner ear seem to be also involved [1,3]. Anterior and posterior labyrinth located at the inner ear, are responsible for two crucial functions: hearing and balance. These regions are composed by the otic capsule and the membranous labyrinth [8]. This one is composed by endolymphatic fluid which is known to be affected by hormonal

changes given during pregnancy, menopause, and menarche [8]. Within this fluid, an increase in sodium and water retention result in electrolytic balance and in an increase of extracellular fluid in areas such as stria vascularis, spiral ligament, saccule, and utricle, leading to clinical manifestation such as vertigo, tinnitus and transitory hearing loss [2,8]. However, these changes are not the ones described during pregnancy. Vasculitic changes such as increased coagulation factors (VII, VIII, IX, X and XII) and increased erythrocyte aggregation within the labyrinthine artery and its branches are known to be involved in hearing and balance disorders during pregnancy [9]. These are also given by the action of estrogens within the intimal layer of these arteries mainly in the second and third trimester [9]. Other estrogen actions associated with hearing and balance impairment during pregnancy are at brain, specifically at the motor cortex, leading to difficulties in spatial orientation during various gestational weeks [10]. In each trimester, diverse estrogen-related changes are described leading to different clinical manifestations. Registered clinical manifestations and their correlated physiological changes are listed in Table 1.

Table 1 Clinical manifestations and correlated physiological changes

Pregnancy trimester	physiological changes	Clinical manifestations
First trimester	Labyrinthine habituation due to hormonal alteration vascular occlusion at the labyrinthine artery Increase of coagulation factors (VII, VIII, IX, X, XII) and fibrinogen	Vertigo spells starting since 1 week of gestation and progressively increasing until 20 week of gestation
	Increased hormones levels	Aural fullness and hearing loss at low frequencies, with a decrease in hearing levels at frequencies of 125, 250, and 500 Hz
Second trimester	Labyrinthine habituation Ligament and joint changes Reduction in postural stability	Instability Gait imbalance Risk of falls
Third trimester	Increase on body weight and postural change Instability or falling tendency is explained by increase of body weight and changing of posture of the pregnant women that increase with progression of gestation. Greater antero-posterior oscillation during the third trimester in comparison to the first trimester of pregnancy Ligament and joints changes Circulating progesterone levels are 20 times higher than basal levels and estradiol levels are 30 to 40 times higher than basal levels in non-pregnant females	Instability Tendency to fall Greater antero-posterior oscillation

As is was reported in Table 1, vertigo onset is usually seen at the first trimester, then at the second trimester instability and gait imbalance are mostly presented and in the third trimesters, instability and tendency to fall are even more frequent [11]. These events are mostly associated with vestibular impairment derived from the hormonal influx to the brain, joints, ligaments, and inner ear during the first two trimesters and labyrinthine habituation seen at the third trimester [11]. These events are described in all pregnant patients with or without previous clinical history of vestibular disorders.

In patients who have previous clinical history of vestibular disorders such as Ménière's disease, benign paroxysmal positional vertigo, and vestibular migraine, may present increased rate of acute exacerbations, worsening of symptoms and severity of vertigo [2,12].

Ménière's disease is usually attributed to a dysregulation in the endolymphatic fluid in the inner ear, leading to obstruction, increased endolymphatic flow and volumetric changes followed by to hearing loss, fullness and vertigo [12]. During pregnancy, there is a reduction of osmolality of systemic and local fluid to the ear, leading to an increased and turbulent osmotic gradient called endolymphatic hydrops mainly located at the endolymphatic sac, saccule, utricle, semicircular canals and cochlea [10,12]. These changes are mostly released during the early pregnancy and several

flare-ups are observed during the third trimester [10,12]. After labor, these events are usually reversed [12,13] (Table 2).

Other types of vertigo, such as benign paroxysmal positional vertigo during pregnancy is usually exacerbated due to the prolonged bed rest, compression of vena cava, calcium and vitamin D metabolisms and higher metabolic demands of the fetus mainly at the second trimester [14]. These episodes are commonly reversed at labor; however, some episodes may be present at the postpartum period given by the deficiency of vitamin D and electrolytic dysregulation [14] (Table 2).

Vestibular migraine is one the most common types of vertigo in females, characterized by episodic vertigo, phonophobia, photophobia and headache. To date, hormonal changes are known to exacerbate vestibular migraine episodes. During pregnancy, exacerbations of this disorder is usually seen throughout all the trimesters and vertigo lasts from minutes to hours with frequent complain of osmophobia and tinnitus in both ears compared to non-pregnant females [2,15]. The most representative changes are listed in Table 2.

Table 2 Vestibular disorders, physiological changes and vestibular testing results

Vestibular disorder	Physiological changes	Clinical manifestations and vestibular testing results
Ménière's Disease	Significantly reduced serum osmolality Changes in the osmolarity of endolymphatic fluid Disturbances in the regulation of endolymphatic fluid in the inner ear, leading to obstruction at the endolymphatic duct, increased and turbulent endolymphatic flow, and volumetric changes within the endolymphatic sac, saccule, semicircular canals and cochlea	Increased vertigo spells up to ten times per month during early pregnancy Flare-ups in the third trimester <i>Vestibular testing:</i> Increased vestibular unilateral deficits in videonistagmography
Vestibular migraine	Hormonal instabilities	Flare-ups in the third trimester <i>Vestibular testing:</i> Persistent positional nystagmus or saccadic pursuits in videonistagmography Reduced unilateral caloric responses Increased contralateral preponderance
Benign paroxysmal positional vertigo	Hormonal instabilities Increased calcium resorption in several systems such as bone and kidneys Vitamin D deficiency Higher metabolic demand of fetus Prolonged bed rest Sleeping on the left side (as it is recommended to reduce compression of the vena cava during pregnancy)	Increased episodes of spinning vertigo Increased severity of vertigo at higher gestation weeks <i>Vestibular testing:</i> Persistent positional nystagmus in videonistagmography

Even though, clinical testing may be altered in patients with previous clinical history of vestibular disorders, pregnant patients may present some specific results during vestibular testing. In the literature, there is a lack of information regarding the expected results of these test during pregnancy, however, in this review, we found some information related to Cervical Vestibular Myogenic Potentials (C-VEMP), Ocular Vestibular Myogenic Potentials (O-VEMP), videonistagmography and video head impulse test (vHIT). During the first trimester, reductions in amplitude in C-VEMO and O-VEMP are usually described indicating that a peripheral labyrinthine dysfunction and altered otolithic function are underway [16]. Semicircular canal dysfunction is seen in patients in the second trimester correlated with low gain values of left anterior canal and higher asymmetry in the left anterior-right posterior (LARP) [17]. In the first

and second trimesters saccadic pursuits and persistent positional nystagmus, contralateral predominance and increased vestibular unilateral deficits are seen indicating a unilateral dysfunction and altered vestibule-ocular reflex [18] (Table 3).

Table 3 Vestibular testing results and clinical correlation

Vestibular Testing	Results	Clinical correlation
C-VEMP	Reduction in amplitude in first trimester	Peripheral labyrinthine dysfunction
O-VEMP	Reduction in amplitude in first trimester	Peripheral labyrinthine dysfunction Altered otolithic function
Videohead Impulse Test	Low gain values of left anterior canal Higher asymmetry in the left anterior-right posterior (LARP) in the second trimester	Semicircular canal dysfunction
Videonystagmography	Saccadic pursuits and persistent positional nystagmus Contralateral predominance Increased vestibular unilateral deficits during the first and second	Unilateral dysfunction Altered vestibule-ocular reflex

Vestibular testing results may represent a challenge for clinicians and non-clinicians. The hormonal influx and electrolytic dysregulation to critical structures such as cochlea, semicircular canals, utricle and saccule, are represented by the results obtained in videonystagmography, vHIT and VEMPS [16-18]. However, most of them are usually done once in the lifetime, without follow-up throughout all the trimesters, leading to a limited comparison between trimesters and how utricle, saccule and semicircular canals functions may be altered during this time [16-18]. Other challenges during the vestibular assessment is the position of patients during videonystagmography inducing vascular compression and discomfort in the positional testing [19]. In the vHIT patients may experiment dizziness and limitation at head movements due to neck pain and cervical changes within vertebral canal [20,21]. For O-VEMP and C-VEMP, further clinical experiences are needed to comprehend diverse challenges during their performance in pregnant patients. For better clinical correlations and objective evaluations in pregnant patients, the use of questionnaires such as Dizziness Handicap Inventory and Dizziness Severity Index are needed to have a deeper understanding of clinical manifestations and the limitation given by vertigo during pregnancy. An adequate correlation between questionnaires and vestibular testing would be useful to get a better understating of vestibular changes throughout pregnancy.

3. Conclusion

Several vestibular changes are mostly seen during pregnancy, most of them related to hormonal influx and electrolytic changes within the membranous labyrinth, macules, and semicircular canals. These changes can exacerbate vestibular disorders such as Meniere's Disease, Benign Paroxysmal Positional Vertigo and Vestibular Migraine and may be clinically assessed on the vestibular testing including vHIT, Videonystagmography and VEMPS. Even though, evidence shows diverse results in vestibular testing, further studies are needed to get a better understanding about the anatomic and functional changes in the vestibular system of pregnant patients.

Compliance with ethical standards

Disclosure of conflict of interest

There are no conflicts of interest to declare by any of the authors of this study.

Author's contributions

MCB: Substantial contributions to conception and design, data acquisition, or data analysis and interpretation, Drafting the article or critically revising it for important intellectual content, Final approval of the version to be published,

Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of the work are appropriately investigated and resolved

AMT: Substantial contributions to conception and design, data acquisition, or data analysis and interpretation, Drafting the article or critically revising it for important intellectual content, Final approval of the version to be published, Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of the work are appropriately investigated and resolved

MMT: Substantial contributions to conception and design, data acquisition, or data analysis and interpretation, Drafting the article or critically revising it for important intellectual content, Final approval of the version to be published, Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of the work are appropriately investigated and resolved

JM: Substantial contributions to conception and design, data acquisition, or data analysis and interpretation, Drafting the article or critically revising it for important intellectual content, Final approval of the version to be published, Agreement to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of the work are appropriately investigated and resolved

References

- [1] Pascual ZN, Langaker MD. Physiology, Pregnancy. [Updated 2022 May 19]. In: StatPearls [Internet]. Treasure Island (FL): StatPearls Publishing, 2022 Jan-. Available from: <https://www.ncbi.nlm.nih.gov/books/NBK559304/>
- [2] Castillo-Bustamante M, Del Cid Chua C, Vázquez M, Bello Dotel L, Baez Recalde M. Estrogen and neurotological disorders in women. Sexual hormones and neurotological disorders in women]. *Rev Fac Cien Med Univ Nac Cordoba*. 2020 Dec 19, 77(4):351-355. Spanish. doi: 10.31053/1853.0605.v77.n4.29349. PMID: 33351371.
- [3] Bittar RSM, Bottino MA, Bittar RE, Formigoni LG, Miniti A, Zugaib M. A study of inner ear in normal gestation. *Bras Ginecol*. 1991, 101(9):381–383
- [4] Silva MLG. Common disorders in Otoneurology. Atheneu, São Paulo: 2000. p. 260. [Google Scholar]
- [5] Pedalini MEB, Bittar RSM, Formigoni LG, Cruz OLM, Bento RF, Miniti A. Vestibular rehabilitation as a vertigo treatment: experience of 116 cases. *Arq Fund Otorrinolaringol*. 1999, 3(2):74–78. [Google Scholar]
- [6] Hansen L, Sobol SM, Abelson TI. Otolaryngologic manifestations of pregnancy. *J Fam Pract*. 1986 Aug, 23(2):151-5. PMID: 3525737.
- [7] Serna-Hoyos LC, Herrón Arango AF, Ortiz-Mesa S, Vieira-Rios SM, Arbelaez-Lelion D, Vanegas-Munera JM, Castillo-Bustamante M. Vertigo in Pregnancy: A Narrative Review. *Cureus*. 2022 May 27, 14(5):e25386. doi: 10.7759/cureus.25386. PMID: 35765386, PMCID: PMC9233861.
- [8] Baki H. Estrogen and Growth Hormone and their Roles in Reproductive Function *Int J Anim and Vet Adv*. 5(1): 21-28, 2013 DOI:10.19026/ijava.5.5574 ISSN: 2041-2894, e-ISSN: 2041-2908
- [9] Sennaroglu G, Belgin E. Audiological findings in pregnancy. *J Laryngol Otol*. 2001 Aug, 115(8):617-21. doi: 10.1258/0022215011908603. PMID: 11535140.
- [10] Uchide K, Suzuki N, Takiguchi T, Terada S, Inoue M. The possible effect of pregnancy on Ménière's disease. *ORL J Otorhinolaryngol Relat Spec*. 1997 Sep-Oct, 59(5):292-5. doi: 10.1159/000276956. PMID: 9279870.
- [11] Swain SK, Pati BK, Mohanty JN. Otological manifestations in pregnant women - A study at a tertiary care hospital of eastern India. *J Otol*. 2020 Sep, 15(3):103-106. doi: 10.1016/j.joto.2019.11.003. Epub 2019 Nov 22. Erratum in: *J Otol*. 2020 Dec, 15(4):179. PMID: 32884561, PMCID: PMC7452357.
- [12] Wu PH, Cheng PW, Young YH. Inner ear disorders in 68 pregnant women: a 20-year experience. *Clin Otolaryngol*. 2017 Aug, 42(4):844-846. doi: 10.1111/coa.12693. Epub 2016 Jun 28. PMID: 27299361.
- [13] Naftalin L, Mallett KJ. Case report of ?hormonal vertigo. *J Laryngol Otol*. 1980 Mar, 94(3):311-6. doi: 10.1017/s0022215100088824. PMID: 6445391.
- [14] Giacomini PG, Napolitano B, Alessandrini M, Di Girolamo S, Magrini A. Recurrent paroxysmal positional vertigo related to oral contraceptive treatment. *Gynecol Endocrinol*. 2006 Jan, 22(1):5-8. doi: 10.1080/09513590500441614. PMID: 16522527.

- [15] Lempert T, Neuhauser H. Epidemiology of vertigo, migraine and vestibular migraine. *J Neurol.* 2009 Mar, 256(3):333-8. doi: 10.1007/s00415-009-0149-2. Epub 2009 Feb 17. PMID: 19225823.
- [16] Bhavana G, Kumar K, Anupriya E. Assessment of otolith function using vestibular evoked myogenic potential in women during pregnancy. *Braz J Otorhinolaryngol.* 2022 Jul-Aug, 88(4):584-588. doi: 10.1016/j.bjorl.2020.08.003. Epub 2020 Sep 28. PMID: 33067134, PMCID: PMC9422406.
- [17] Tulmaç ÖB, Kılıç R, Yaman S, Aktulum F, Şimşek G, Erdiñç S. Evaluation of the vestibular system with video head impulse test in pregnant women with hyperemesis gravidarum. *J Obstet Gynaecol Res.* 2021 Jan, 47(1):96-102. doi: 10.1111/jog.14433. Epub 2020 Aug 20. PMID: 32820578.
- [18] Schmidt PM, Flores Fda T, Rossi AG, Silveira AF. Hearing and vestibular complaints during pregnancy. *Braz J Otorhinolaryngol.* 2010 Jan-Feb, 76(1):29-33. doi: 10.1590/S1808-86942010000100006. PMID: 20339686, PMCID: PMC9446035.
- [19] Aasfara J, Hajjij A, Bensouda H, Ouhabi H, Benariba F. A unique association of bifacial weakness, paresthesia and vestibulocochlear neuritis as post-COVID-19 manifestation in pregnant women: a case report. *Pan Afr Med J.* 2021 Jan 13, 38:30. doi: 10.11604/pamj.2021.38.30.27646. PMID: 33777298, PMCID: PMC7955605.
- [20] Sibbritt D, Ladanyi S, Adams J. Healthcare practitioner utilisation for back pain, neck pain and/or pelvic pain during pregnancy: an analysis of 1835 pregnant women in Australia. *Int J Clin Pract.* 2016 Oct, 70(10):825-831. doi: 10.1111/ijcp.12870. Epub 2016 Sep 12. PMID: 27620139.
- [21] Korda A, Sauter TC, Caversaccio MD, Mantokoudis G. Quantifying a Learning Curve for Video Head Impulse Test: Pitfalls and Pearls. *Front Neurol.* 2021 Jan 22, 11:615651. doi: 10.3389/fneur.2020.615651. PMID: 33551973, PMCID: PMC7862580.