

### Review Article

## Pre, During, and After Pregnancy Care in Women with Multiple Sclerosis and Spine Disorder: A Systematic Review

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### ABSTRACT

**Introduction:** Several studies have investigated the association between Multiple Sclerosis (MS) and pregnancy. However, the reported results are contradictory, which has caused confusion of obstetricians and gynecologists as well as neurologists concerning pregnancy planning of women with MS. Hence, the present study aimed to investigate.

**Methods:** We systematically searched PubMed, Science Direct, Scopus, Web of Science, and Google Scholar databases and national databases (SID and MAGIRAN) to identify relevant studies published from 2000 to 2020, either in English or Persian, using the following keywords: autoimmune, hormonal disorders, pregnancy, menstrual cycle, multiple sclerosis, pre-pregnancy, post-pregnancy, and lactation. The keywords were combined using Boolean functions of AND and OR.

**Results:** In total, 46 studies were identified. The results of these studies were reviewed in terms of defining disease, hormonal changes, menstrual cycle disorders, pregnancy of MS patients, evaluation of pregnancy of MS patients, hormonal changes during pregnancy, changes in immune system responses and cells, serum exosome, disease screening during pregnancy, disease management and treatment (if needed), recommendations for pregnant women, labor care, points for breastfeeding, and disease activity after delivery.

**Conclusion:** Pre-pregnancy consulting for MS patients should be performed carefully to reduce recurrence rates during pregnancy. The symptoms of MS decrease during pregnancy, and there is no concern about medication. It should be noted that in nine months after delivery, the patient will return to normal condition, and special attention should be paid to drug therapy.

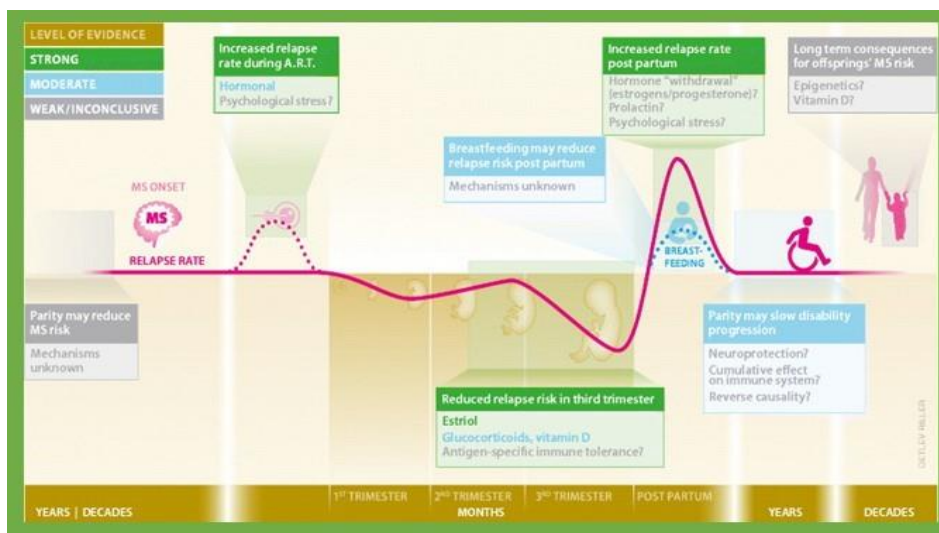
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## GRAPHICAL ABSTRACT



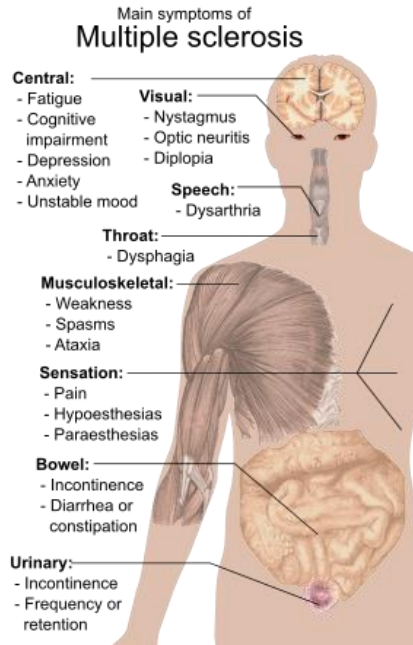
## Introduction

Multiple sclerosis (MS) (Figure 1) is a disease of the central nervous system that causes neurological disability, especially in young people [1-3]. Women at reproductive age are at increased risk of developing MS. Besides, MS is more common in women than men (1.77 to 1:0). Its peak incidence is between the ages of 40 and 50 years old. On the other hand, its clinical course is varied, ranging from a completely benign course to a progressive and debilitating course [4-6]. Most women with MS are concerned about the disease effect on their pregnancy and childbirth, as well as the effect of pharmacological interventions on the fetus. Previous studies reported that MS does not affect pregnancy outcomes [7-9]. Usually, the disease recurrence declines at the end of pregnancy, but increases in the postpartum period. Its exact reasons are not well identified yet, but previous studies have mentioned the sudden decline of estrogen after delivery and fading the immunosuppression caused by pregnancy. However, there are still many unknown causes concerning the association between MS and pregnancy [10-12]. Some

studies reported no significant difference between women with MS and healthy women concerning pregnancy and neonatal outcomes [13-15]. However, few studies have reported such findings. As a result, obstetricians and gynecologists are confused [16]. Due to two important features of mostly affecting young people and cause incapacitation at reproductive ages, MS has particular importance [17-19]. Hence, further evidence is needed (6,7). While MS is an important disease, few studies are conducted in this field, particularly during pregnancy and labor. Regarding the pregnancy importance, the progressive nature of MS, and the rising incidence of MS all around the world, the current study aimed to Pre, during, and after pregnancy care in women with multiple sclerosis [20-22].

## Method

We systematically searched PubMed, Science Direct, Scopus, Web of Science, Google Scholar databases, and national databases (SID and MAGIRAN) to identify relevant studies published from 2000 to 2020, either in English or Persian, using the following keywords:



**Fig. 1.** MS

autoimmune, hormonal disorders, pregnancy, menstrual cycle, multiple sclerosis, pre-pregnancy, post-pregnancy, and lactation. The keywords were combined using Boolean functions of AND and OR. Inclusion criteria were access to full-text articles and reporting results on MS before, during, and after pregnancy. Exclusion criteria included not finding the full-text of articles, not relating to MS (before, during, and after pregnancy), and unclear results.

## Results

Initially, 591 articles were found. The second round of screening contained checking adherence to inclusion and exclusion criteria. In this step, we found 290 relevant articles of which 80 were excluded after reviewing the similar and repeated articles. Eventually, after a full-text review, articles were included.

## Definition

MS is an autoimmune disease of the central nervous system. All around the world, more than 2 million people suffer from MS. Generally, 80%

of MS patients live about 70 or 80 years. Hence, the majority of MS patients are women of reproductive age. MS damages the myelin sheath around neurons. This is why MS patients experience different levels of disability and present different neurological symptoms [23-25]. For example, reduced sensitivity, numbness, tingle, fatigue, movement disorders, difficulty in swallowing, dysphasia, intestinal and bladder disorders, muscle weakness and spasms, acute and chronic pain, vision problems, and ataxia are the most common symptoms. MS diagnosis is based on clinical findings and diagnostic tests such as MRI and CSF tests. Neurologists have categorized the MS into four categories, which in the following are briefly discussed [26-28].

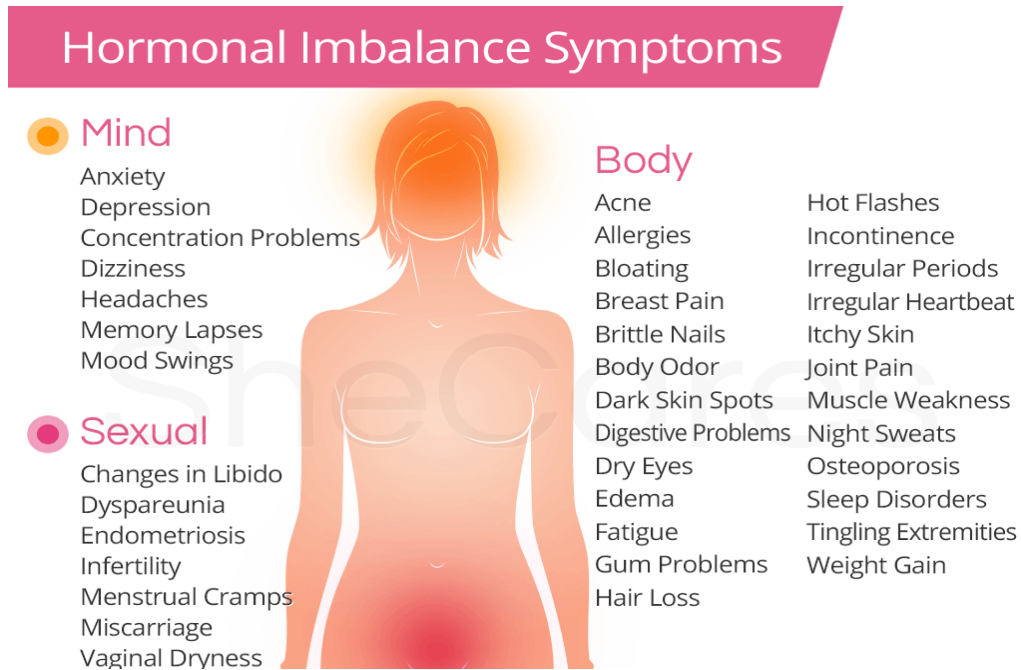
- ❖ Relapsing-remitting MS: is the most common type of MS (85% of patients). Patients experience sudden periods of suppression or recurrence of the disease [2-31].
- ❖ Primary progressive MS: Accounts for 10% of patients. These patients tend to have more disability [32-34].
- ❖ Secondary progressive MS: Comes after relapsing-remitting MS [35-37].
- ❖ Progressive relapsing MS: Accounts less than 5% of patients [38].

As mentioned earlier, the majority of MS patients are women of reproductive age. They may develop several complications, such as poor sexual function, irregular menstruation, hormonal problems, and infertility. On the other hand, there are concerns about pregnancy complications and their consequences for the fetus and its growth and preterm labor [39].

Hormonal changes and menstrual disorders of MS patients Hormonal disorders (Figure 2), menstrual disorders, and infertility are among the most common problems of women with MS. According to the literature, MS patients have lower rates of fertility, which is natural. There are also minor disorders in these patients that

their exact cause has not yet been identified. It is argued that it is most likely related to disturbances in the hypothalamus-pituitary axis

caused by the immune attack, which may result in disrupted menstruation and infertility [40-42].



**Fig. 2.** Hormonal disorders

Patients with MS have significantly increased levels of prolactin and both total and free testosterone, as well as decreased levels of oestrone sulfate in their serum. Sometimes different treatments administered to improve patients' health may also cause endocrine disorders. In general, the possible reasons for menstrual irregularities include:

- 1- Disruption of Hypothalamus-Pituitary-Gonadal Axis,
- 2- Hormonal resistance, and
- 3- Effects of specific drugs and stress on the hypothalamus-pituitary-gonadal axis [43].

Studies reported a higher prevalence of menstrual irregularities in patients receiving disease-modifying drugs. Besides, they present higher rates of amenorrhea and oligomenorrhea [44]. They have increased levels of follicle-stimulating hormone (FSH) and luteinizing

hormone (LH). In addition, studies mentioned an association between enhanced levels of FSH and LH and premature ovarian failure. Moreover, some patients have autoantibody directed against peptides of the pituitary gland in their serum [18,45]. As mentioned earlier, women are at increased risk of developing MS. This gender difference can be attributed to higher androgenic levels in men, which naturally protects men against the disease. The exact protective role of this mechanism is not well-identified yet. However, it is argued that androgens can prevent the autoimmune response by binding to androgenic receptors. Hence, it increases the level and expression of autoantigens in the thymus, which increases the accuracy of the mechanism for selecting T-cells and prevents the removal of autoreactive T-cells from the thymus. Besides, the colony of autoreactive T-cells will be removed [19,20].

Some studies emphasized that MS activity changes with the seasons. Seasonal changes and, even, day hours impact melatonin production. Increased melatonin production reduces disease activity [46]. Even studies conducted using animal models of MS have reported that melatonin treatment was associated with the improved health status of MS patients [21]. Melatonin can inhibit the differentiation of pathogenic TH17 and TH1. Besides, it can inhibit the production of its inflammatory cytokine and increases the production of regulatory T cells and Interleukin 10, which is an anti-inflammatory cytokine. Indeed, it balances the immune system. Melatonin can cross the blood-brain barrier and has antioxidant, modulating, and anti-inflammatory properties [22]. Prolactin is secreted by lactotrophs in the anterior pituitary. According to the literature, it plays an important role in the MS progression and the experimental model of MS disease. Moreover, it has a crucial role in the reproduction and lactation of women [23]. MS patients usually have lower levels of vitamin D, which causes disabilities such as osteopenia and osteoporosis, and bone disorders. However, the reduced level

of vitamin D is a risk factor for developing MS because this vitamin contributes to reduce inflammatory cell proliferation and inflammatory cytokines [47-49]. In other words, it plays a protective role in MS patients. Studies have shown that steroid hormones reduce the disease severity, the length of relapses, and the frequency of injuries. Hence, these hormones can be used as a treatment line [24].

### Pregnancy of MS patients

Until 1950, women with MS were advised to avoid pregnancy because it was believed that pregnancy might have an adverse effect on disease activity. Further studies revealed that in only a few cases, it happens. Meanwhile, some believed that pregnancy is associated with better outcomes in MS patients, while some studies reported contradicted results [25]. On the other hand, some researchers believed that pregnancy does not cause the complications in MS patients. However, men and women with MS require medical consultations before deciding for pregnancy to be able to manage the potential problems that may arise [14] (Fig. 3).

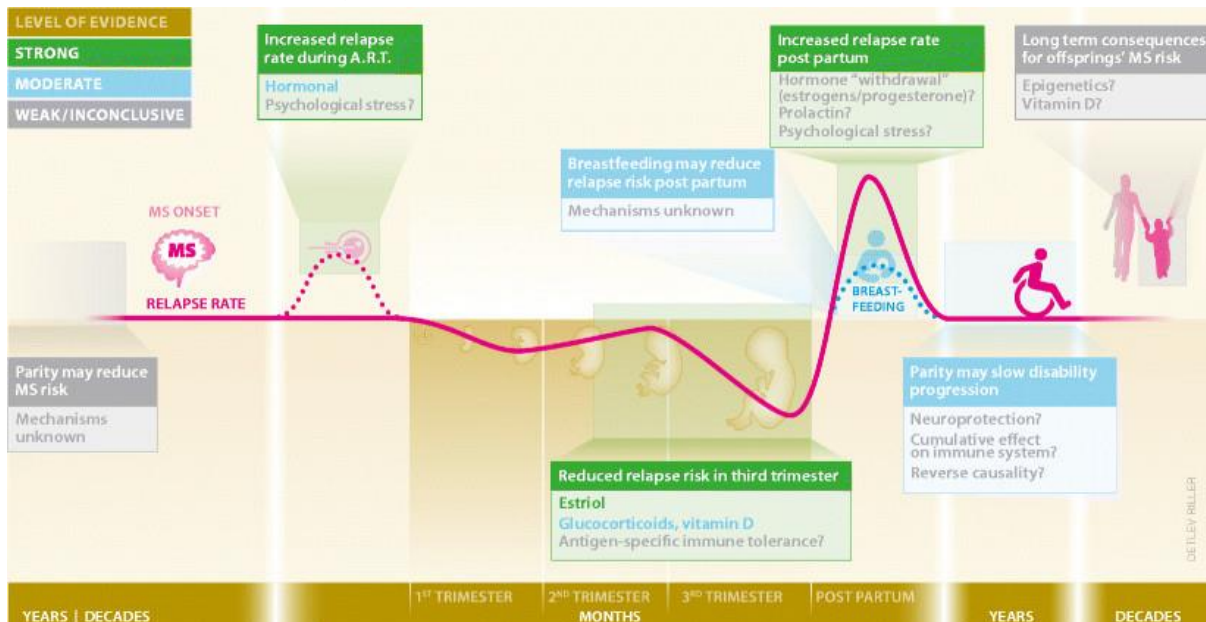


Fig. 3. Pregnancy and MS

A series of issues should be considered before pregnancy. For example, patients should be monitored to ensure that the MS won't have any significant effect on fetal development. Moreover, the genetic risk factors should be investigated MS in neonatal [26].

Although MS is not directly inherited, those who have a relative with the condition are more likely to develop MS [47-49]. The highest risk is for children whose both of their parents suffer from MS. Another important issue is the mother's ability to carry the fetus to term because MS has different types with various severities so that some types can quickly reduce the individual's ability and cause fatigue [27].

MS patients receive various treatments such as corticosteroids, along with disease-modulating drugs. Pharmacological interventions are important for both pregnancy and fertilization. Because of the possible teratogenic effects on the fetus, it is recommended that patients who receive treatment should at least have a two-year prevention period (ceasing medication before pregnancy). As pregnancy is a modulator of the disease, and usually the activity of the disease declines during pregnancy, it is better to avoid medication during pregnancy [50-52]. Of course, because the disease activity in all patients is similar, sometimes physicians may decide to prescribe medication to prevent MS relapses [28,29].

### **Evaluation of pregnancy in MS patients**

Pregnancy is an important period in young women's lives (30). On the other hand, they are at increased risk of developing MS [53]. Therefore, its management during pregnancy is of crucial importance. To have a successful pregnancy, adaptability and modulation of the immune system are very important [54]. In fact, successful pregnancy depends on the mother's immune system's ability to tolerate a creature that has a genetic difference of 50% [31]. One of the adaptations that lead to implantation and the ability to carry the fetus is to change the immune

system response of the mother. During pregnancy, the immune response, which is usually through cellular immunity and TH1, begins to change [32]. Besides, there would be changes in the hemorrhoids and TH2. Hence, women who suffer from autoimmune diseases associated with TH1, such as rheumatoid arthritis, and MS, experience partial recovery during pregnancy [55-57]. During pregnancy, certain factors regulate the immune system [58]. For example, specific serum proteins, signaling molecules that guide the adaptability, human G leukocyte antigen, Co-stimulatory molecules, Fas-L, CD200, and various hormone cells [33,59].

### **Hormonal changes during pregnancy**

Pregnancy is associated with hormonal changes. Also, hormones secreted by the placenta-(estrogen and progesterone) start to increase. Research showed that these two hormones are highly effective in modulating the immune response [60-62]. Estrogens cause a double-sided effect based on their concentration so that a lower concentration of estrogens stimulates cellular immunity, which is why women are more sensitive to MS [34]. At higher concentrations, estrogens inhibit cellular immunity and inflammation, which is why MS activity declines during pregnancy, particularly at the last days of pregnancy, as pregnancy is associated with a gradual increase in the estrogens secretion. Estrogens have receptors on immune system cells such as TCD4, TCD8, natural killer cells, and macrophages and are inhibited in high concentrations [35]. According to the recent studies, activation of estrogen-induced deaminase can stimulate humoral immunity, which is dependent on antibodies that, in turn, results in controlling MS [36]. Moreover, it can intensify autoimmune responses stimulated by antibodies. The antibodies respond through TH2 [63-65]. The anti-inflammatory effect of antibodies is confirmed by laboratory studies. Studies have shown that estrogens delay the development of

experimental autoimmune encephalomyelitis (EAE). During pregnancy, the production of estrogens and progesterone gradually increases, which in MS patients leads to a decreased number of lesions in myelin tissue [21]. Therefore, by entering the second half of pregnancy, the rate of recurrence gradually decreases, so that during the last trimester, recovery is very good [66]. In the postpartum period, due to the decreased level of estrogen and progesterone, the disease activity starts to increase, similar to before pregnancy [37].

### **Changes in immune system responses and cells**

During pregnancy, the humoral immune response will dominate, which causes reduced inflammation that in turn suppresses the MS. Likewise, the secretion of natural killer cells increases, which in MS patients are mainly NK CD16<sup>high</sup>CD56<sup>low</sup> and cytotoxic, but during pregnancy the concentration of NK CD16<sup>high</sup>CD56<sup>low</sup> increases, which reduces inflammation [38]. Moreover, the production of another type of natural killer cells, named UNK, starts to increase, which has an important role in maintaining the fetus's adaptability in the uterus [67-69]. Similarly, the concentration of T reg cells increases, which causes modulation of immune responses and prevents activities of autoreactive T-cells [39].

### **Serum Exosome**

Exosomes include a series of lipid-attached vesicles that increase in the serum of pregnant women. Researches have shown that these exosomes inhibit the activity of T cells, and also cause maturation of oligodendrocyte progenitor and inhibition of inflammation. Pregnancy exosomes increase the migration of oligodendrocytes into myelin. Experimental studies on mice also reported that exosomes increase the EAE activity. During pregnancy, exosomes modulate the immune system and improve MS [40,41].

### **Screening during pregnancy**

For MS patients, pregnancy is not a completely immune factor, and recurrences may occur during pregnancy. Hence, patients should regularly be consulted concerning the disease activity, such as MRI and CFSs that usually are used along with clinical examination [21].

It worth to note that, due to concerns during the first trimester, it is better to avoid MRI, because animal tests revealed that contrast agent is a type of teratogenesis. Sufficient evidence is not available about the effects of this substance in humans, but to prevent fetal abnormalities, it is recommended not to use this substance during pregnancy. However, the final decision rests on the physician. Lumbar Puncture is also not recommended because of harming the mother during pregnancy [42].

### **Disease management and treatment (if needed)**

To prevent fetal abnormalities, it is recommended to prevent pharmacological interventions during pregnancy. However, sometimes using these interventions is inevitable. In general, pharmacological interventions include short-term use of high-dose corticosteroids to avoid recurrence of the disease and disease-modulating drugs [43]. It is reported that interferon beta is associated with an increased risk of preterm labor, spontaneous abortion, and the birth of immature infants (i.e. stunting). Furthermore, a case of Pierre-Robin syndrome is reported among those who received mitoxantrone [70].

Besides, it is a teratogen, which increases the risk of amenorrhea [31]. Also, it's identified in the semen of men with MS who have taken teriflunomide. In addition, this drug has caused teratogenic effects in animals. Concerning fingolimod, it is also recommended that pregnancy be delayed until its full excretion from the body. Furthermore, there are reports that Natalixumab increased abortion in animal studies, and its consumption during the third

trimester increases the risk of hematologic diseases such as thrombocytopenia and hemolytic anemia in the fetus. In addition, for those in the first trimester of pregnancy, it is recommended to avoid high-doses of corticosteroids [29].

### **Recommendations for mothers**

According to the literature, girls born to mothers who did not consume milk during pregnancy or were less exposed to sunlight are more likely to develop MS. This indicates that maternal vitamin D affects the fetus, and higher serum levels of vitamin of mothers are a determinant factor in the health of the mother and her child to prevent MS [44,45].

### **Delivery**

The physician, based on the midwifery criteria, decides whether to use Cesarean Section or vaginal delivery [46,47]. Besides, the mother's condition and her disability rates are effective in this decision. Bladder and intestinal disorders, as well as fatigue increase with pregnancy. For deliveries that require surgery, epidural anesthesia won't cause any problem. Major concerns are associated with spinal anesthesia, which may increase damages in myelin after childbirth due to toxicity of anesthetics for axons. Some studies reported that women who suffer from MS have longer durations of hospitalization (due to labor) compared to healthy women. Meanwhile, some studies reported contradicting results. Length of hospital stay is important for nosocomial infections and has a direct impact [48].

### **Lactation period**

Studies have reported that mothers with MS living in Northern Europe have a longer duration of lactation compared to those living in Southern Europe. Another study in California has shown that mothers with MS who breastfeed their babies experienced lower rates of recurrence. Meanwhile, breastfeeding is useful for improving the relations between the mother and

the baby, and also reduces infection and allergies in the baby. However, it cannot be argued certainty that breastfeeding improves MS in mothers. In addition, as mentioned above, the activity of the disease gradually increases after childbirth, and the patient should start treatment again. Since ingredients of disease-modulating treatments can penetrate the breast milk, these drugs should not usually be used during breastfeeding. Instead, high-dose corticosteroids should be used, which the mother should avoid breastfeeding for 24 to 48 hours after injection of corticosteroids.

### **Postpartum disease activity**

After childbirth, due to decreased concentration of estrogen and progesterone hormones and changed immune response and conversion of the humoral response to cellular, the person's condition gradually returns to pre-pregnancy conditions, and the rate of inflammation and injuries in myelin increases and the activity of disease rises, so that it returns to prenatal conditions until 9 months after delivery. Hence, appropriate treatments should be administered.

### **Conclusion**

According to the literature, pregnancy modulates the immune system, and by changing the cellular response to humoral, it leads to decrease inflammation and decreased disease activity. Gradually by entering the second half of pregnancy, the rate of disease recurrence decreases so that in the last trimester of pregnancy, there may be no recurrence, and women who have experienced several stages of pregnancy have a lower risk of developing MS. Previously, women with MS were advised to avoid pregnancy. However, nowadays, it is proved that pregnancy is effective in improving the disease; it is no longer considered a concern. In the post-pregnancy period, the disease



recurrences indicate the need for treating the patient.

### Limitations

Lack of specific attention to the administered drugs and lack of accurate knowledge of the best medications used during pregnancy, which led to not accurately mention the drug used during lactation.

### Recommendations

The authors recommend implementing programs intended to increase the awareness of young women at reproductive age who suffer from MS by healthcare centers to enhance their knowledge concerning pre-, during, and post-partum care.

### References

- [1] S.M. Haghdoost, M.K. Gol, The necessity of paying more attention to the neurological and psychological problems caused by the COVID-19 pandemic during pregnancy. *Health*, 3(4) (2020) 8(3):243-44
- [2] M. Purabdollah, F.M. Tabrizi, A. Khorami Markani, L.S. Poornaki, Intercultural sensitivity, intercultural competence and their relationship with perceived stress among nurses: evidence from Iran. *Mental Health, Religion & Culture*, 24(7) (2021) 687-697.
- [3] D. Aghamohamadi, M.K. Gol, Checklist for determining severity of pain and type and dosage of analgesics administered to patients undergoing breast surgeries. *Int J Womens Health Reprod Sci*, 8(2) (2020) 227-31.
- [4] M. Khanbabaei Gol, N. Mobaraki-Asl, Z. Ghavami, M. Zharfi, A. Mehdinavaz Aghdam, Sexual violence against mastectomy women improved from breast cancer. *The Iranian Journal of Obstetrics, Gynecology and Infertility*, 22(5) (2019) 52-60.
- [5] M.H. Abdollahi, K. Foruzan-Nia, M. Behjati, B. Bagheri, M. Khanbabayi-Gol, S. Dareshiri, A. Pishgahi, R. Zarezadeh, N. Lotfi-Naghsh, A. Lotfi-Naghsh, M. Naghavi-Behzad, The effect of preoperative intravenous paracetamol administration on postoperative fever in pediatrics cardiac surgery. *Nigerian medical journal: journal of the Nigeria Medical Association*, 55(5) (2014) 379.
- [6] B. Nazari, L. Amani, L. Ghaderi, M. Khanbabayi Gol, Effects of probiotics on prevalence of ventilator-associated pneumonia in multitrauma patients hospitalized in neurosurgical intensive care unit: a randomized clinical trial. *Trauma Monthly*, 25(6) (2020) 262-268.
- [7] R. Eghdam-Zamiri, M. Khanbabayi Gol, Effects of ginger capsule on treatment of nausea and vomiting in patients receiving cisplatin undergoing mastectomy: a randomized clinical trial. *The Iranian Journal of Obstetrics, Gynecology and Infertility*, 22(11) (2020) 15-21.
- [8] R. Mohammadian, E. Sharifipour, R. Mansourizadeh, B. Sohrabi, A.R. Nayebi, S. Haririan, M. Farhoudi, S. Charsouei, S. Najmi, Angioplasty and stenting of symptomatic vertebral artery stenosis clinical and angiographic follow-up of 206 cases from Northwest Iran. *The neuroradiology journal*, 26(4) (2013) 454-463.
- [9] M. Nikanfar, S. Charsouei, Z. Miabi, S. Sha'afi, M. Hashemilar, M. Farhodi, A.A. Ebrahimi, A. Khabbazi, R.R. Ghiasi, Evaluation cervical cord changes in the patients with MS and their comparison with vasculitis patients. *Life Science Journal*, 9(4) (2012).
- [10] M. Farhoudi, H. Ayromlou, E. Sharifipour, S. Charsouei, E. Sadeghihokmabadi, M. Ahmadi, A. Afrough, Does low dose contraceptive pills increase stroke rate? A cross sectional study in North-West Iran. (2012) 28(3):501-505
- [11] K. Komlakh, N. Mohseni Kabir, M. Zamani Esfahlani, S. Sadeghi, M. Zarei, Designing a Guideline for Elective and Emergency Spinal Cord Surgeries During the COVID-19

- Pandemic. *Trauma Monthly*, 27(Especial Issue (COVID-19 and Emergency Medicine)) (2022) 1-7.
- [12] S. Charsouei, M.Z. Esfahlani, A. Dorosti, R.E. Zamiri, Effects of COVID-19 pandemic on perceived stress, quality of life, and coping strategies of women with breast cancer with spinal metastasis under chemotherapy. *Int. J. Women's Health Reprod. Sci*, (2021) 55-60.
- [13] B. Nazari, M.Z. Esfahlani, A. Dorosti, F. Mirzaei, Prevalence and risk factors for low back pain in primiparous women visiting maternity hospitals during different months of pregnancy. *International Journal of Women's Health and Reproduction Sciences,[Online]*, 8(4) (2020) 401-5.
- [14] L. Sadati, Z.N. Khanegah, N.S. Shahri, F. Edalat, Postoperative pain experienced by the candidates for gynecological surgery with lithotomy position. *Iranian Journal of Obstetrics, Gynecology and Infertility*, 24(12) (2022) 29-34.
- [15] A. Nurmeksela, S. Mikkonen, J. Kinnunen, T. Kvist, Relationships between nursing management, nurses' job satisfaction, patient satisfaction, and medication errors at the unit Level: A correlational study. *Research Square*, 1(1) (2020) 1-22.
- [16] A.A. Ghahroudi, A.R. Rokn, A.R. Shamshiri, N. Samiei, Does timing of implant placement affect esthetic results in single-tooth implants? A cohort evaluation based on mPES. *Journal of Esthetic and Restorative Dentistry*, 32(7) (2020) 715-725.
- [17] A.R. Hosseini-Khalili, J. Thompson, A. Kehoe, N.S. Hopkinson, A. Khoshbaten, M.R. Soroush, S.E. Humphries, H. Montgomery, M. Ghanei, Angiotensin-converting enzyme genotype and late respiratory complications of mustard gas exposure. *BMC Pulmonary Medicine*, 8(1) (2008) 1-5.
- [18] D. Birman, Investigation of the Effects of Covid-19 on Different Organs of the Body. *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 2(1) (2023) 24-36.
- [19] F. Karimzadeh, S.M. Sajedi, S. Taram, F. Karimzadeh, Comparative evaluation of bacterial colonization on removable dental prostheses in patients with COVID-19: A clinical study. *The Journal of Prosthetic Dentistry*. (2021) 1-3
- [20] F. Najafi, F. Kermansaravi, E. Gangoozehi, The relationship between general health and quality of work life of nurses working in Zahedan teaching hospitals. *Iranian Journal of Rehabilitation Research in Nursing*, 4(2) (2018) 53-9.
- [21] H. Daneste, A. Sadeghzadeh, M. Mokhtari, H. Mohammadkhani, F. Lavaee, J. Moayedi, Immunoexpression of p53 mutant-type in Iranian patients with primary and recurrence oral squamous cell carcinoma. *European Journal of Translational Myology*. (2023).
- [22] H. Kalantari, A.H.H. Tabrizi, F. Foroohi, Determination of COVID-19 prevalence with regards to age range of patients referring to the hospitals located in western Tehran, Iran. *Gene reports*, 21 (2020) 100910.
- [23] I. Karampela, M. Dalamaga, Could respiratory fluoroquinolones, levofloxacin and moxifloxacin, prove to be beneficial as an adjunct treatment in COVID-19?. *Archives of medical research*, 51(7) (2020) 741-742.
- [24] J.P. Montani, B.N. Van Vliet, General physiology and pathophysiology of the renin-angiotensin system. *Angiotensin vol. I*, (2004) 3-29.
- [25] K. Goyal, P. Chauhan, K. Chhikara, P. Gupta, M.P. Singh, Fear of COVID 2019: First suicidal case in India!. (2020) 49: 101989.
- [26] M. Alijanzadeh, The frequency of medication errors and factors influencing the lack of reporting medication errors in nursing at teaching hospital of Qazvin University of Medical Sciences, 2012. *Journal of Health*. (2015) 6 (2): 169-79.

- [27] M. Barzideh, A. Choobineh, S.H. Tabatabaei, Job stress dimensions and their relationship to general health status in nurses. *Occupational Medicine Quarterly Journal*, 4(3) (2012) 17-27.
- [28] M. Mileski, U. Pannu, B. Payne, E. Sterling, R. McClay, April. The impact of nurse practitioners on hospitalizations and discharges from long-term nursing facilities: a systematic review. In *Healthcare* (Vol. 8, No. 2 (2020) 114). MDPI.
- [29] M.G.S. Borba, F.F.A. Val, V.S. Sampaio, M.A.A. Alexandre, G.C. Melo, M. Brito, M.P.G. Mourão, J.D. Brito-Sousa, D. Baía-da-Silva, M.V.F. Guerra, L.A. Hajjar, Effect of high vs low doses of chloroquine diphosphate as adjunctive therapy for patients hospitalized with severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection: a randomized clinical trial. *JAMA network open*, 3(4) (2020) e208857-e208857.
- [30] M.J. Gadlage, J.S. Sparks, D.C. Beachboard, R.G. Cox, J.D. Doyle, C.C. Stobart, M.R. Denison, Murine hepatitis virus nonstructural protein 4 regulates virus-induced membrane modifications and replication complex function. *Journal of virology*, 84(1) (2010) 280-290.
- [31] N. Alrabadi, S. Shawagfeh, R. Haddad, T. Mukattash, S. Abuhammad, D. Al-rabadi, R. Abu Farha, S. AlRabadi, I. Al-Faouri, Medication errors: a focus on nursing practice. *Journal of Pharmaceutical Health Services Research*, 12(1) (2021) 78-86.
- [32] N. Asadi, F. Salmani, S. Pourkhajooyi, M. MahdaviFar, Z. Royani, M. Salmani, Investigating the relationship between corona anxiety and nursing care behaviors working in corona's referral hospitals. *Iranian Journal of Psychiatry and Clinical Psychology*, 26(3) (2020) 306-319.
- [33] N. Zaimzadeh, S. Ziaie, N. Mohammadzadeh, H. Alizadeh Otaghvar, A. Mottaghi, Comparison of vitamin D dietary intake among four phenotypes of polycystic ovary syndrome and its association with serum androgenic components. *Razi Journal of Medical Sciences*, 25(2) (2018) 87-96.
- [34] N. Zaimzadeh, S. Ziaie, N. Mohammadzadeh, H. Alizadeh Otaghvar, A. Mottaghi, The study of dietary intake of micronutrients in four phenotypes of polycystic ovary syndrome separately based on Rotterdam criteria. *Razi Journal of Medical Sciences*, 25(3) (2018) 59-68.
- [35] S Azizi Aram, S Basharpour, The role of rumination, emotion regulation and responsiveness to stress in predicting of Corona anxiety (COVID-19) among nurses. *Quarterly J of Nursing Management* 2020; 9 (3): 8-18.
- [36] S. Ghorbanizadeh, Care and precautions in performing CT Scans in children. *Journal of Pharmaceutical Negative Results*, 12(1) (2021) 54-58.
- [37] S. Maghsoodi, M. Hesabi, A. Monfared, General health and related factors in employed nurses in Medical-Educational Centers in Rasht. *Journal of Holistic Nursing and Midwifery*, 25(1) (2015) 63-72.
- [38] S. Musaei, The Effect of Pregnancy on the Skin. *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 2(1) (2022) 17-23.
- [39] S.H. Salehi, K. As'adi, S.J. Mousavi, S. Shoar, Evaluation of amniotic membrane effectiveness in skin graft donor site dressing in burn patients. *Indian Journal of Surgery*, 77 (2015) 427-431.
- [40] S.H. Salehi, M.J. Fatemi, K. A'sadi, S. Shoar, A. Der Ghazarian, R. Samimi, Electrical injury in construction workers: a special focus on injury with electrical power. *Burns*, 40(2) (2014) 300-304.
- [41] S.Z. Nazardani, S. Nourizadeh Dehkordi, A. Ghorbani, A comprehensive evaluation of the Sports Physiotherapy curriculum. *Eurasian Journal of Chemical, Medicinal and Petroleum Research*, 2(1) (2022) 10-16.

- [42] T.S.H. Abadi, M. Askari, K. Miri, M.N. Nia, Depression, stress and anxiety of nurses in COVID-19 pandemic in Nohe-Dey Hospital in Torbat-e-Heydariyeh city, Iran. *Journal of Military Medicine*, 22(6) (2020) 526-533.
- [43] Y.A. Helmy, M. Fawzy, A. Elasad, A. Sobieh, S.P. Kenney, A.A. Shehata, The COVID-19 pandemic: a comprehensive review of taxonomy, genetics, epidemiology, diagnosis, treatment, and control. *Journal of clinical medicine*, 9(4) (2020) 1225.
- [44] Z. Malekpour-Dehkordi, M. Nourbakhsh, M. Shahidi, N. Sarraf, R. Sharifi, Silymarin diminishes oleic acid-induced lipid accumulation in HepG2 cells by modulating the expression of endoplasmic reticulum stress markers. *Journal of Herbal Medicine*, 33 (2022) 100565.
- [45] AA Esmailzadeh, MM Yaseen, U Khudaynazarov, ME Al-Gazally, et al. Recent advances on the electrochemical and optical biosensing strategies for monitoring microRNA-21: a review (vol 14, pg 4449, 2022), *ANALYTICAL METHODS*, 15 (1) (2022) 132-132
- [46] AA Esmailzadeh, M Kashian, HM Salman, MF Alsaffar, et al., Identify Biomarkers and Design Effective Multi-Target Drugs in Ovarian Cancer: Hit Network-Target Sets Model Optimizing, *Biology*, 11 (12) (2022) 1851
- [47] AA Esmailzadeh, S Rasoolzadegan, AR Arabi, et al., Cytotoxic study of green synthesized pure and Ag-doped  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> nanoparticles on breast cancer (MCF-7) cell line, *Nanomedicine Research Journal*, 7 (4) (2022) 370-377
- [48] AA Esmailzadeh, Mohammad Ghenaat, Pishah Sanani, et al., Study of Silybinin Plant Effective Substance for use in targeted liposomal nanoparticles in the treatment of liver cancer, *Archives of Pharmacy Practice*, (2020) 11 (1) 35

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