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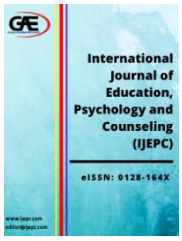


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# THE EFFECTS OF PHYSIOLOGICAL CHANGES ON EMOTIONS DURING POSTPARTUM PERIOD

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**Abstract:**

In this writing, we aspire to look into the effects of physiological changes during postpartum on emotions. It is found that postpartum depression has affected about 27% of Malaysian women. Therefore, in this review, we have

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looked into three different aspects which are: 1) hormonal changes 2) neurotransmitters, and 3) biological changes. These topics are studied to see how they affect the emotions among women during the postpartum period. It has been found that they may fall into an emotional state, depressive state or even become anxious when physiological changes happen. This writing also provided the treatments for certain issues while looking into the Islamic perspective and Islamic treatment that can help reduce the symptoms. It also emphasizes the need for more research on the topic to provide more explanations and interventions to help those suffering from baby blues syndrome.

**Keywords:**

Postpartum Depression, Postpartum, Emotional Changes, Physiological Changes, Literature Review

## Introduction

The current study focuses on describing the impact of physiological changes during postpartum on the mother's emotions. It is noted that women go through emotional problems after birth due to certain hormonal changes that affect their body and mental well-being. The most common mental health condition that women go through after birth is Postpartum Depression (PPD; Hairol et al., 2021). It has been found in several articles that the amount of percentage for this condition among women in Malaysia is around 3.9% and 22.8% (Azidah et al., 2006; Grace et al., 2001; Koo et al., 2003, as cited in Hairol et al., 2021; Mohamad Yusuff et al., 2016). However, according to Arifin et al. (2014), 7% to 27% of Malaysian women suffer from PPD. Other than that, problems such as anxiety and postpartum blues also occur in mothers after going into labor (Javadekar et al., 2023). This article should further increase the insights of the postpartum period about what is happening underneath the actions and behaviors. Moreover, this writing can increase the awareness of the public so that remedies for the issue can be improved. Ideally, this review aims to encourage caregivers to provide all the support needed to prevent mothers from any risks of PPD or postpartum blues since they are going through bodily changes. This review also focuses on the effects of physiological changes on emotions during postpartum. Published studies were analyzed between 2020 and 2023 to ensure the relevance of the evaluation. It also explores three main themes: the effects of physiological changes in hormones, neurotransmitters, and biology on emotion.

## Methodology

A structured and thorough search strategy using the academic search engine was performed to compile the literature related to the topic of interest. To explore this topic, a few terms were used such as "postpartum depression," "postpartum symptoms," "biological changes," "hormonal changes," and "emotional changes." These terms were browsed through Google Scholar, Springer PubMed and ScienceDirect. Additionally, Boolean operators (AND, OR) were utilized to specify the search results.

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***Inclusion and Exclusion Criteria***

All papers reviewed in this study were published between 2020 to 2023 to ensure recent information and valid evidence. Moreover, the papers included were original research papers and systematic reviews with studies on human, rat and hamster subjects. This range of subjects were of interest to understand biological and physiological changes where observing human subjects might not be pragmatic. Other types of papers, such as grey literature, dissertations, theses and unpublished papers were excluded to limit the scope of exploration. Additionally, studies on postpartum depression which are not related to hormonal, biological and emotional changes were excluded. Lastly, all papers reviewed were written in English to ensure clarity.

***Data Extraction***

The data was extracted from each study, into a structured form developed for this review. The emphasis was on study design, participant details, research findings and limitations as well as future research recommendation where applicable. The data was then synthesized and compared in a meaningful way.

**Findings**

To set the foundation for this review, it is important to look at the methods and measurement of the research studies that will be discussed to find the commonalities and differences that lead to the findings. First, to determine whether the drastic fluctuation in hormone level can contribute to depressive-like behavior, Ye et al. (2023) utilized hormone-stimulated pseudopregnancy (HSP) and hormone-stimulated postpartum period (HSPP) rat models. In order to mimic pregnancy hormones in the rats, release pallets containing 17β-estradiol (E2) and progesterone (P4) were implanted on the rats and removed after 21 days to induce a simulated postpartum period. Next, the rat's behavior was measured using Open Field Test to assess locomotor activity and anxiety-like behavior, Escaped Failure Test to mimic stress during postpartum period and Sucrose Preference Test to evaluate anhedonia before analyzing using One-way Anova and T-test.

Meanwhile, Weigl et al. (2020) used mother of preterm infants and mother of term infants in University Hospital Essen, Germany to gain the findings on the differences in effects of physiological changes on term and preterm mothers. This cross-sectional study employed exploratory research design and collected the data within a six-day postpartum period. The data were collected using questionnaires including Beck Depression Inventory (BDI) to measure depressive symptoms, State-Trait Anxiety Inventory (STAI-S) to assess state anxiety and Perceived Stress Questionnaire (PSQ) to evaluate stress level. Meanwhile, blood and saliva samples were collected for estradiol and progesterone hormonal measurement that use electrochemiluminescence immunoassays. The data collected were analyzed using SPSS version 25.

Study from Hedges et al. (2021), conducted an experiment and employed explanatory research design to explain that the loss of estrogen hormones in mothers can induce certain feelings such as anxiety. The researchers utilized Syrian hamsters in this experiment by giving and controlling the amount of the hamster's estrogen level. The hamsters were injected with estrogen and progesterone before being compared to those without the hormone after 22 days of injection. The comparisons were made with the anxiety measurement which is Elevated Plus Test and Open Field Test.

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Lastly, Stickel et al. (2021) conducted a longitudinal study using explanatory research design. Postpartum mothers were recruited one to six months after birth as participants. They were assessed by Edinburg Prenatal Depression Scale (EPDS) to measure depressive symptoms and Maternal Postnatal Attachment Scale (MPAS) to see mother-infant attachment every three weeks for 12 weeks. The data collected from these questionnaires were later analyzed using SPSS, applying ANOVA, mixed-design ANOVA and Chi-square tests.

Based on these, it can be seen that studies from Hedges et al. (2021) and Ye et al. (2023) used hormone-stimulated pseudopregnancy utilizing animals to find the effects of hormonal changes on emotions during postpartum. This allowed the researcher to control their research environment which was hormone level precisely and minimize confounding factors. However, the utilization of animals in the experiment might lead to lack of generalizability to humans which eventually limits direct applicability to human postpartum experience since the hormonal and emotional regulation between humans and animals differ significantly despite using hormone-simulation pseudopregnancy on animals to mimic human pregnancy. On the other hand, study from Weigl et al. (2020) and Stickel et al. (2021) focuses on human participants which ensure the validity and applicability to postpartum mother experience. Nevertheless, the reliance on self-report questionnaires from these two studies may introduce bias.

There are several research gaps in these studies that need to be addressed. The studies only focus on a limited range of hormones such as progesterone and estradiol while overlooking the importance of other hormones such as oxytocin in influencing emotions during the postpartum period (Hedges et al., 2021; Kim et al., 2023; Stickel et al., 2021; Weigl et al., 2020; Ye et al., 2023). In a study by Weigl et al. (2020), there is no clear establishment on how the level of estradiol and progesterone correlated differently with emotions during postpartum between preterm and term childbirth. Furthermore, cross-sectional studies that were conducted might need to extend follow up to get the emotional and hormonal changes during postpartum over months (Weigl et al, 2020). Moreover, the limited generalizability in human populations because of the utilization of animals instead of humans as participants (Hedges et al., 2021; Ye et al., 2023) and narrow and homogenous population (Stickel et al., 2021; Weigl et al., 2020) might not fully capture the complexity of human postpartum experiences.

***Hormonal Changes***

The researcher found a significant impact of hormonal changes during postpartum on mother's emotions as the ovarian hormones such as progesterone and estrogen decreased, leading to feelings of helplessness in the postpartum period. Specifically, it was found that progesterone and estrogen withdrawal may lead to reduced sucrose preference indicating anhedonia (loss of pleasure). Due to these changes in hormones, mothers experience depressive emotions during the postpartum period (Ye et al., 2023). This observation is supported by Weigl et al. (2020) who also found that the lower level of estradiol and progesterone hormone in mothers might contribute to a higher depression score since they feel higher psychological distress. However, the study also found that hormonal decrease correlated negatively with depression scores during the postpartum period among mothers who have preterm childbirth.

Furthermore, anxiety is another effect of hormonal changes on emotions during the postpartum period as explained by Ye et al. (2023) who show the decrease of central distance ratio in the Open Field Test that was conducted by them. This finding was supported by a study from

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Hedges et al. (2021) where it showed that women with estrogen withdrawal had increased anxiety-like behaviors. In support of this, Kim et al. (2023) discovered the relationship between changes in hormonal level and mood disturbances including anxiety. The mechanism for anxiety-like behaviors observed in postpartum females can be further explained by the changes in neurotransmitters experienced by them during this period. Specifically, the GABAergic mechanism has been shown to correlate with anxiety reduction and will be further discussed in the next section of this review.

Additionally, hormonal changes during postpartum will also affect emotional regulations among women. As stated by Kim et al. (2023), significant changes on estrogen, progesterone and cortisol hormones that women experience during the postpartum period led to greater difficulties in their emotional regulation and this is persistent especially among women who had more dramatic hormonal changes. In addition, study from Stickel et al. (2021), found that persistent dysregulation of stress hormones during postpartum happens because of the constant high glucocorticoid from the third trimester of pregnancy to week 12 postpartum which eventually results in depression.

***Neurotransmitters Changes***

Emotions of an individual during the postpartum period might also be influenced by neurotransmitter activities across the nervous system. One of the significant neurotransmitters that may affect emotional processes is the glutamate. Glutamate (Glu), known as an excitatory neurotransmitter, happens to have several kinds of receptors in the central nervous system (CNS), where its metabolism is important to maintain optimal amounts in the extracellular space, which is essential for mood regulation (Pal, 2021). The influence of Glu can be seen from a study conducted by Ghuman et al. (2022), where they aimed to examine the medial prefrontal cortex (MPFC), Glu levels and percentage gray matter (%GM) in healthy pregnant women (HPW) and high-risk women (HRW) for postpartum depression (PPD) from late pregnancy up to seven weeks postpartum.

The researchers recruited 41 healthy pregnant women alongside 22 high-risk women from through advertisements. This study has found the decline in MPFC Glu levels in HRW during pregnancy and early postpartum. Hence, the outcome of this research suggested that low levels of MPFC Glu may be one of the contributors in increasing the risk of experiencing PPD, as glutamate is essential in regulating emotions. However, they also stated the limitations of their research which is the small sample size used as well as some reported missing data points that might affect the reliability of the research, presenting as beneficial reference for future studies. Another neurotransmitter that may affect emotions during the postpartum period is GABA. Research done by Sabihi et al. (2021), where they hypothesized that increased GABAergic signaling in MPFC might help with the reduction of anxiety-like behavior during the postpartum period. This study was conducted with the sample of virgin male and female Sprague Dawley rats from Taconic, New York. The rats went through the breeding process for pregnancy and proceeded to the process of cannulation surgery that targets the MPFC area as it is consistently associated with anxiety-like behaviors. Next, the elevated plus maze (EPM) was utilized to observe the anxiety-like behavior of rats. As a result, they found that after the cannulation surgery to block GABA receptors, postpartum anxiety was not reduced, which suggested that the activation of GABA receptors was able to revitalize the mother's anxiety levels back to normal.

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These findings are aligned with the study by Hedges et al. (2021) that explained hormonal changes in females during this period can also increase anxiety-like behaviors. To tie up this premise, it can be understood that both GABAergic activities and hormonal changes work together to increase psychological anxiety during postpartum. Despite the significant results, it is important to note that this study has its limitations where the researchers only focus on one particular GABA receptors, instead of including two other types of GABA receptors, GABAB and GABAC. Thus, it is recommended for further research to explore the prospect of other types of GABA receptors towards postpartum anxiety and emotional regulations.

***Biological Changes***

The postpartum period is characterized by significant biological changes that can affect women's emotions and mental health. These changes, including alterations on the immune system, inflammation, and stress responses, have an important role in shaping a woman's emotional condition after childbirth. The research demonstrated that these biological shifts can contribute to the development of mood disorders such as PPD and anxiety. Szpunar et al. (2021) highlighted the role of inflammation in PPD. They found that higher levels of inflammatory cytokines, such as interleukin, was linked to an increased risk of depression after childbirth. This suggested that inflammation in the body might contribute to emotional challenges during the postpartum period. The study stated the need to consider the immune system's response to childbirth as a potential factor that influences emotional health (Szpunar et al., 2021).

Ghuman et al. (2022) also found that the biological changes in the brain were linked with PPD by examining Glu levels and gray matter volume in the MPFC in women at high risk for postpartum depression (HRW) and healthy pregnant women (HPW). The study found that Glu levels in the MPFC were significantly lower during late pregnancy and early postpartum in HRW rather than in HPW. These lower levels by five weeks postpartum suggested that reduced Glu levels may contribute to the early condition of postpartum depression in women at higher risk. In contrast HPW showed stable Glu levels throughout pregnancy and the postpartum period. In addition, the study also examined the percentage of gray matter in MPFC and found that both HRW and HPW experienced a decrease during pregnancy, which progressively increased during the postpartum period.

These findings suggest that while changes in brain chemistry and structure affected the postpartum period, the trajectory of Glu levels may be an important factor in understanding the vulnerability to PPD in high-risk women (Ghuman et al., 2022). Thus far, the influence of all three changes may work together to increase anxiety-like behaviors in females during postpartum. The hormonal changes may lead to increased depressive feelings and anxiety. Together with this change, the interplay of biological and neurotransmitter mechanisms, especially Glu levels is also related to the levels of anxiety experienced during this period.

Nunn et al. (2021) examined changes in the vaginal microbiome from pregnancy to postpartum, highlighting the point of biological changes. During pregnancy, the vaginal microbiome was mainly made up of Lactobacillus gasseri. However, during the postpartum period, there was a significant drop in Lactobacillus, and the vaginal microbiome became more diverse. New bacteria, such as Streptococcus anginosus and Prevotella Bivia increased. The vaginal microbiome shifted to a less Lactobacillus state, known as community state types (CST) III and IV, which have more variety of bacteria. In addition, changes in vaginal fluid biomarkers were observed. These findings show that significant biological changes occur in the vaginal

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microbiome and related biomarkers during the postpartum period, which can influence both physical and emotional recovery (Nunn et al., 2021).

## Discussion

### *Application To Current Issue*

To correlate it with physiological psychology, these mental health conditions can be caused by various changes like increase of cortisol, drop of estrogen and fluctuation of several other components in a mother during postpartum (Hedges et al., 2021; Stickel et al., 2021). According to Maclean (1949, as cited by Kalat, 2023), emotions are mainly produced in the limbic system part of the brain including the forebrain areas around the thalamus which plays an important role. It was also mentioned by Phan et al. (2002), that the cortical areas of the brain are activated when a person shows emotions which means that behind the emotions shown by women during postpartum, is an active brain that stimulates arousal to cause an impulsion for them to act upon their emotions.

One of the most frequent traits women have during postpartum is anxiety which is linked to fear and given that Phan et al. (2002) had done research on which brain part is activated on certain emotions, fear can be seen to be having an engagement with the amygdala. The causes of the arousal to occur in the brain however, is due to the neurotransmitters and hormonal activities that took place in the body, that simultaneously lead to changes in the brain trajectory. In relation to this, there are several remedies that could help the patients to get through this period of time. Firstly, women with low estrogen and progesterone may be treated through combined Hormone Replacement Therapy (HRT) as it increases the missing hormones that most PPD women go through due to hormonal imbalance. Hormone Replacement Therapy can be done through various ways, most commonly via tablets (Hoffman & Key, 2024). Next, women that struggle with depression during postpartum are also advised to be treated with antidepressants (MHG center for Women's mental health, 2007). It is known that antidepressants are used to improve the neurotransmitters like serotonin in the brain (Informed Health, 2006). Some examples of antidepressants are Selective serotonin reuptake inhibitors (SSRIs) and Selective serotonin noradrenaline reuptake inhibitors (SNRIs). Both SSRIs and SNRIs work the same way, which is to block the reuptake of serotonin and norepinephrine which prolongs their effects to allow them to act on their functions longer. Another function of SNRIs is that it could also reduce anxiety.

Other than medications, psychotherapies are helpful in lessening the burden on mothers. It has been found that most women that suffer from PPD are more likely to be without a partner, from a low-income family, or have little to no family support (Stickel et al., 2021). It is suggested that social support would be suitable for them as they need someone to depend on (Davis et al., 2020). Islam also provides a non-pharmacological approach to treat this problem. Studies have shown that acts of worshipping Allah, like recitation of the Al-Quran, praying and doing dhikr can effectively decrease anxiety and depression symptoms (Simonovich et al., 2022). In regards to this issue, it is recommended that future research can directly examine what is causing these negative emotions to arise among postpartum patients and how it can be generalized among other women globally to further ensure ecological validity. Furthermore, other researchers should do more experiments and longitudinal research in order to provide more insights in this issue.

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***Integration of Islamic Perspective***

In Islam, a mother's status is elevated in the eyes of Allah as reported in Mu'awiyah ibn Jahimah who came to Prophet Muhammad PBUH and said, "Messenger of Allah, I intend to join the military expedition, and I seek your counsel." The Prophet said, "Do you have a mother?" He said yes. The Prophet said, "Stay with her, for Paradise is beneath her feet." (Sunan al-Nasai) (Elias, 2012). It emphasizes the amount of respect and honor given to mothers as a recognition for their sacrifice and unwavering love.

Those sacrifices include challenges during the postpartum period as it affects the emotional well-being due to biological changes happening to their bodies. It is stated in Surah Maryam, verse 23: "And the pains of childbirth drove her to the trunk of a date-palm. She said, "Would that I had died before this, and had been forgotten and out of sight!" From this verse, the Quran acknowledges the struggles faced by women during and after childbirth, emotionally and physically.

Next, postpartum is also related to an Islamic term called nifas which is the blood that emerges after the womb is clear of any fetus, even if it takes the shape of mudghah (a piece of meat) or alaqah (a clot of blood), and before the 15-day minimum period of purity (after giving birth). Blood is not regarded as nifas if it is discovered more than 15 days after giving birth (Source: 1/112 Hasyiyah Qalyubi). It is an important period for a woman's overall wellbeing to ensure that as a mother, she is stable and ready to care for the baby (Mazri, 2021).

Lastly, emotions are regarded as a part of human nature, also known as fitrah. Islam encourages dhikr and salah as means for the remembrance of Allah to stabilize emotions and reduce stress. These spiritual practices can help to regulate mood and increase our connection with Allah. As stated in Surah Ar-Ra'd, verse 28: Those who believed (in the Oneness of Allah - Islamic Monotheism), and whose hearts find rest in the remembrance of Allah: verily, in the remembrance of Allah do hearts find rest.

## Conclusion

This review focuses on the effects of physiological changes that include hormonal, neurotransmitters and biological changes on the emotions of women after childbirth. In conclusion, the effects of physiological changes on emotions during the postpartum period shows diverse results. Different research has shown that the physiological mechanisms work together to induce different psychological changes in mothers during postpartum. Hormonal changes during the postpartum period were shown to affect emotion which leads to depressive, anxiety and difficulties of emotion regulations. In relation to this, the neurotransmitter especially Glu has shown to affect the biological changes in the brain that leads to the state of emotional instability. Therefore, in this case, it can be said that the biological, neurotransmitter and hormonal trajectory all play an important role in influencing the emotionality of mothers during postpartum. Much of this interplay is yet to be discovered to understand the full physiological mechanisms pertaining to the emotional changes in mothers. Overall, by addressing and understanding these findings, it can provide significant insights on the opportunities for future interventions, as well as ensuring the better outcomes for the mothers and their offsprings.

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