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Review article

Affective changes during the postpartum period: Influences of genetic and experiential factors

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ABSTRACT

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The postpartum period involves some truly transformational changes in females' socioemotional behaviors. For most female laboratory rodents and women, these changes include an improvement in their affective state, which has positive consequences for their ability to sensitively care for their offspring. There is heterogeneity among females in the likelihood of this positive affective change, though, and some women experience elevated anxiety or depression (or in rodents anxiety- or depression-related behaviors) after giving birth. We aim to contribute to the understanding of this heterogeneity in maternal affectivity by reviewing selected components of the scientific literatures on laboratory rodents and humans examining how mothers' physical contact with her infants, genetics, history of anxiety and depression and early-life and recent-life experiences contribute to individual differences in postpartum affective states. These studies together indicate that multiple biological and environmental factors beyond female maternal state shape affective responses during the postpartum period, and probably do so in an interactive manner. Furthermore, the similar capacity of some of these factors to modulate anxiety and depression in human and rodent mothers suggests cross-species conservation of mechanisms regulating postpartum affectivity.

Contents

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Introduction

Motherhood has a transformative effect on the world of female mammals. From laboratory rodents to humans, mothers undergo a host of remarkable physiological and behavioral changes. These changes lead not only to the expression of offspring caretaking activities, and in many species a close bond between mother and infant, but also fundamentally alter the way females perceive and react to their broader environment. It has long been suggested that early motherhood involves an emotional rebalancing that tempers the female's reactivity to potentially negative or aversive environmental events, while simultaneously promoting her attraction to neonates and ability to carefully attend to their needs (Pryce, 1992; Rosenblatt and Mayer, 1995). This has been best studied in laboratory rats, with most early postpartum females exhibiting a reduction of fear and anxiety-like behaviors compared to nulliparous females in several anxiety paradigms (Agrati et al., 2008; Ferreira et al., 1989; Fleming and Luebke, 1981; Lonstein, 2005; Miller et al., 2011). Similarly, most women experience decreased anxiety after giving birth as well as an increase in positive mood (for reviews see Lonstein, 2007; Macbeth and Luine, 2010).

However, not all females experience reduced anxiety and increased positive mood after giving birth. When specifically looked for within the larger population of mothers, a relatively small number of laboratory rats show increased anxiety after giving birth compared to beforehand (Ragan and Lonstein, 2014) and there is a subpopulation of women who experience considerable emotional lability during the first postpartum weeks or months (Barrett and Fleming, 2011; Leckman et al., 1999; Lonstein, 2007; Macbeth and Luine, 2010). As a result, the rates of some anxiety disorders such as obsessive–compulsive disorder (OCD) and generalized anxiety disorder (GAD) in postpartum women are at least twice those of the general population (OCD = 3–4 vs. 1–2%; GAD = 4–8% vs. 3–4%; (Ross and McLean, 2006)), but because screening for anxiety disorders in mothers is rare, the rates are probably much higher (Britton, 2008; Ross and McLean, 2006). The incidences of major or minor postpartum depression are also thought to be underreported, but appear to peak during the third month postpartum and affect at least 7–13% of women at any time postpartum (Gavin et al., 2005; O'hara and Swain, 1996).

At a broad level, this heterogeneity in maternal affectivity probably results from a general increase in the sensitivity of neural systems regulating affective states[1] that occurs during the postpartum period. Affect is a primary contributor to mother–infant bonding and the neurobiological substrates implicated in affective states and caregiving behaviors greatly overlap (Mayes et al., 2005; Swain et al., 2007; Pereira and Ferreira, 2016). These brain systems undergo tremendous plasticity across pregnancy and during the early postpartum period to increase women's sensitivity to infant affective and other cues (Rutherford et al., 2015), but these neurobiological changes may have the capacity to not only mediate the positive effects that the baby has on maternal anxiety and mood (Nitschke et al., 2004; Noriuchi et al., 2008), but also exacerbate maternal preoccupations about the infant that are common during the early postpartum period (Leckman et al., 1999, 2004). We propose here that whether motherhood drives females' affective states in a positive or negative direction is critically influenced by a collection of rather specific biological and environmental factors that differentially modulate the sensitivity of the neural systems involved. Trying to understand what biological and environmental factors contribute to postpartum affective states will help to elucidate why some females are susceptible to high postpartum anxiety and dysregulated mood while others are resistant. Determining this is of the utmost importance for humans because, while postpartum anxiety and mood disorders can be devastating for affected women, there is the additional toll that these disorders have on mothers' caregiving behaviors (Barrett and Fleming, 2011) and thus the physical and neurobehavioral development of their highly vulnerable infants (Brand and Brennan, 2009; Glasheen et al., 2010; Kinsella and Monk, 2009).

Postpartum anxiety and mood in humans, and their related behaviors in non-human mammals, are complex and multiply determined. Not only is motherhood itself relevant, but a host of other maternal factors including her genetics (Cryan and Holmes, 2005; Eley, 1999; Macbeth and Luine, 2010), personality or traits (Britton, 2008; Milgrom et al., 2008), and past and current life experiences (Correia and Linhares, 2007; Hillerer et al., 2012; Ladd et al., 2000; van Bussel et al., 2009; Vesga-Lopez et al., 2008) are essential to consider. In the present review, we highlight selected studies on laboratory rodents and humans that have examined some of these individual-level factors influencing maternal affective states. Of course, women's lives are complex and contain features that cannot be analogous to those found in the lives of other mammals, but research on laboratory animals has still provided insight into some salient factors that can be studied to better understand postpartum anxiety and depression in humans. For this reason, we will mostly focus here on studies that have explored similar factors in both women and female laboratory rodents. We will begin by examining the effects of physical contact with infants on maternal affective states, as the cues received from infants and the maternal behavioral and physiological responses to them are essential to motherhood. We will then review how factors not directly related to the postpartum state — including females' genetic background, individual traits or personality, and early and recent life experiences — further contribute to maternal affectivity and the likelihood of postpartum anxiety and depressive symptoms or behaviors. Finally, the potential interactive effects of these factors on affectivity during the postpartum period will be discussed.

We will not here discuss the relationship between ovarian steroid hormones and postpartum affectivity. There is ample experimental and correlative evidence that estradiol and progesterone have short-term and long-term effects on anxiety and depressive outcomes in parous laboratory rodents and women, including the intriguing evidence that some women are particularly sensitive to such effects of hormones (Bloch et al., 2000), but this evidence has been examined and reviewed many times before and can be found elsewhere (Bloch et al., 2003; Brummelte and Galea, 2010; Buckwalter et al., 1999; Dennis et al., 2008; Hendrick et al., 1998; Lonstein, 2007; Payne, 2003; Schiller et al., 2015). Furthermore, the work in this realm is sometimes equivocal and often has not examined individual differences in naturally occurring ovarian steroid levels, their change across long periods of time, or individual differences in females' responses to exogenous steroids that would best speak to our focus here on factors underlying susceptibility or resilience. We also will not discuss in detail the neurobiological systems involved in postpartum anxiety and depression, as numerous thorough recent reviews have been devoted to this goal (Gobinath et al., 2014; Krishnan and Nestler, 2008; Lonstein, 2007; Lonstein et al., 2014; Macbeth and Luine, 2010; Nestler et al., 2002). We hope that examining some of the often ignored non-hormonal factors affecting anxiety and depressive responses in human and rodents mothers will broaden the perspective on this topic, inform us about cross-species conservation of the determinants underlying postpartum affective states, and ultimately help alleviate the negative consequences of anxiety and depressive disorders on affected women and their children.

Contact with infants

Probably the most salient and novel factor in a new mother's environment is the infant itself, which offers a constellation of sensory stimuli that are in many ways (but certainly not all ways!) simply irresistible. Of those stimuli, only the sense of touch is indispensable for mother–infant interactions (Stern, 1996). Women spend most of

[1] In this review we refer to affective states, both in humans and other animals, as emotional experiences associated with internal brain states. Different affective states are thought to reflect different types of global neurodynamics within the brain and the rest of the body (Burgdorf and Panksepp, 2006; Panksepp, 2005, 2011).