

A Review of Hormonal Changes During Menopause and their Association with Mental Health in Women

Papu Majumder¹ and Dr. Beenu Sharma²

¹Research Scholar, Department of Physiology

²Research Guide, Department of Physiology

Sunrise University, Alwar, Rajasthan

Abstract: Menopause is a natural stage of reproductive aging characterized by progressive changes in ovarian function and substantial alterations in circulating sex hormones, particularly estradiol and progesterone. The menopausal transition is increasingly recognized as a period during which some women may experience changes in mood, anxiety, sleep, cognition, and overall psychological well-being. The relationship between hormonal changes and mental health is complex and cannot be explained solely by chronological aging or the cessation of menstruation.

Evidence suggests that fluctuations in estradiol during perimenopause, rather than simply low postmenopausal estrogen concentrations, may be particularly relevant to depressive symptoms in susceptible women. Progesterone changes may also contribute through effects on neuroactive steroid pathways and emotional regulation. Estrogen interacts with serotonergic, dopaminergic, noradrenergic, neurotrophic, inflammatory, and hypothalamic–pituitary–adrenal mechanisms that are important for mood and cognition..

Keywords: Menopause, estrogen, estradiol, progesterone, depression, anxiety, mental health, cognition, sleep, menopausal transition

I. INTRODUCTION

Menopause represents an important biological transition in women's lives and is associated with progressive changes in ovarian activity and reproductive hormones. The menopausal transition, commonly referred to as perimenopause, may begin several years before the final menstrual period and is characterized by increasing irregularity in ovarian hormone production. Estradiol concentrations can fluctuate considerably before eventually declining, while progesterone production becomes increasingly inconsistent as ovulatory cycles become less frequent.

Following menopause, ovarian estrogen and progesterone production remains substantially reduced. These endocrine changes occur alongside changes in thermoregulation, sleep, cognition, sexual function, and emotional well-being. Reviews published during the last decade emphasize that menopausal symptoms arise through interactions among hormonal, neurological, physical, psychological, and social factors rather than through hormonal deficiency alone (Monteleone et al., 2018; Stuenkel, 2021).

Mental health is an especially important component of menopausal health because women may report irritability, emotional instability, depressive symptoms, anxiety, sleep problems, reduced concentration, and subjective memory difficulties during the transition. A systematic review published in 2023 concluded that depression and anxiety are common during menopause and identified vasomotor symptoms and previous depressive illness among important risk factors. At the same time, the evidence does not suggest that every woman experiences clinically significant psychiatric symptoms, and psychosocial circumstances can substantially modify the relationship between menopause and mental health (Alblooshi et al., 2023).

HORMONAL CHANGES DURING THE MENOPAUSAL TRANSITION

The hormonal profile of menopause is characterized principally by changes in ovarian estradiol and progesterone, accompanied by compensatory increases in gonadotropins, particularly follicle-stimulating hormone (FSH). During early perimenopause, ovarian follicular activity becomes less predictable. Consequently, estradiol concentrations may show substantial variability rather than declining in a smooth linear manner. Later in the transition, ovarian estrogen production becomes consistently lower. Progesterone production also declines because ovulation becomes less frequent or absent. These changes distinguish perimenopause from the relatively stable low-estrogen state of established postmenopause (Monteleone et al., 2018; Stuenkel, 2021).

The distinction between hormone levels and hormone variability is particularly important. Research has suggested that rapid or pronounced changes in estradiol may be associated with mood vulnerability in some women. Gordon et al. (2015) reported that greater estradiol variability predicted greater depressive symptoms among women exposed to higher levels of stressful life events. Similarly, Gordon et al. (2019) found that greater estradiol variability and absence of ovulatory progesterone levels were associated with greater depressive symptom burden in perimenopausal women with depressive symptoms.

ESTROGEN AND MENTAL HEALTH

Estrogen, particularly estradiol, has extensive effects on the central nervous system. Estrogen receptors are distributed in brain regions involved in emotion, cognition, stress regulation, and reward. Estrogen can influence serotonin, dopamine, and norepinephrine systems and may also affect neurotrophic factors, cerebral metabolism, synaptic functioning, and inflammatory processes. Consequently, fluctuations in estrogen during the menopausal transition may influence emotional regulation in susceptible women (Hogervorst et al., 2022).

The association between estradiol and depression appears particularly relevant during perimenopause. Gordon et al. (2015) demonstrated that greater variability in estradiol was associated with depressive symptoms under conditions of greater psychosocial stress. A later study by Gordon et al. (2019) similarly reported an association between estradiol variability and depressive symptoms. A 2023 review further summarized evidence linking estrogen fluctuations with depression through potential effects on brain-derived neurotrophic factor, serotonin transmission, inflammatory responses, and metabolic activity (Weber et al., 2023).

However, the relationship should not be interpreted as a simple cause-and-effect relationship in every woman. Individual sensitivity to hormonal change varies considerably. A review by Hantsoo and Epperson (2021) proposed that women may differ in their sensitivity to increases, decreases, or general changes in estradiol. This helps explain why some women experience substantial mood symptoms during perimenopause whereas others experience relatively few psychological effects despite comparable reproductive aging.

PROGESTERONE AND PSYCHOLOGICAL SYMPTOMS

Progesterone is another important ovarian hormone affected during the menopausal transition. As ovulatory cycles become irregular, progesterone production becomes less predictable and eventually declines substantially. Progesterone and its neuroactive metabolites can influence the brain through pathways involving gamma-aminobutyric acid, a major inhibitory neurotransmitter system. Changes in progesterone-related neurosteroid activity may therefore influence emotional regulation, anxiety, sleep, and stress responses.

Evidence concerning progesterone and anxiety is more limited than evidence concerning estrogen and depression. Experimental and observational research indicates that progesterone may be associated with anxiety-related experiences, although these findings largely come from reproductive-cycle research rather than directly from postmenopausal populations (Toffoletto et al., 2018). During perimenopause, the combination of inconsistent ovulation, changing progesterone production, and fluctuating estradiol may therefore contribute to changes in emotional stability in susceptible women.

Importantly, Gordon et al. (2019) found that the absence of progesterone levels consistent with ovulation was associated with greater depressive symptoms in their sample of perimenopausal women. This finding suggests that changes in both estradiol and progesterone may contribute to mood disturbances rather than estrogen acting in isolation.

HORMONAL CHANGES AND DEPRESSION

Depression is among the most extensively investigated mental health outcomes associated with menopause. The menopausal transition may represent a period of increased vulnerability to depressive symptoms, particularly among women with previous depression, substantial vasomotor symptoms, stressful life events, or other psychosocial difficulties. Llana et al. (2012) emphasized that the relationship between depressive disorders and menopause involves hormonal, psychological, sexual, and physical factors rather than a single mechanism.

A systematic review by Alblooshi et al. (2023), which examined 22 studies, found evidence that depression and anxiety commonly occur during menopause and identified previous major depression and vasomotor symptoms as important risk factors. The review also emphasized psychosocial contributors, demonstrating that hormonal changes should be considered within a broader biopsychosocial framework.

The relationship between vasomotor symptoms and depression may be bidirectional. Gordon et al. (2017) found evidence for associations in both directions, although some studies suggested that vasomotor symptoms preceded depressive symptoms more strongly than the reverse. This indicates that hot flashes and night sweats may contribute to psychological distress, while depression may also affect the perception or experience of menopausal symptoms.

MENOPAUSE, ANXIETY AND EMOTIONAL REGULATION

Anxiety symptoms may increase during the menopausal transition, although evidence is less consistent than for depressive symptoms. A 2011 systematic review concluded that the evidence available at that time was insufficient to establish a specific diagnostic entity of “menopausal anxiety,” partly because studies differed substantially in their measurement of anxiety and menopause status (Bryant et al., 2012).

More recent evidence has strengthened the possibility that some women experience increased anxiety during the transition. Alblooshi et al. (2023) found that anxiety and depression are common during menopause, while also emphasizing the contribution of psychosocial circumstances. Hormonal fluctuations may affect neurotransmitter systems and stress-response pathways, while hot flashes and sleep disruption can amplify anxiety-related experiences. Thus, anxiety during menopause is best conceptualized as the product of interacting endocrine, neurological, physical, and psychosocial processes rather than as a uniform hormonal disorder.

HORMONES, SLEEP AND MENTAL HEALTH

Sleep disturbance is a major pathway connecting hormonal changes with mental health. Declining and fluctuating ovarian hormones can influence thermoregulation and sleep physiology, while hot flashes and night sweats may cause repeated awakenings. Poor sleep, in turn, can worsen mood, irritability, anxiety, concentration, and emotional regulation. The resulting relationship can become cyclical: hormonal changes contribute to vasomotor symptoms and sleep disruption, while poor sleep increases vulnerability to psychological symptoms.

A systematic review by de Zambotti et al. (2015) highlighted important relationships among menopause, sleep, vasomotor symptoms, mood, and ovarian hormones. More recent evidence indicates that both estrogen and progesterone are positively associated with aspects of sleep during the menopausal transition, while estrogen and/or progesterone therapy can improve sleep in selected women (Baker et al., 2023).

A 2022 systematic review involving 86 studies concluded that postmenopausal reductions in estrogen and progesterone contribute to sleep disturbances and that appropriately selected hormone therapy may improve sleep quality through direct and indirect mechanisms, including reduction of vasomotor symptoms (Joffe et al., 2022).

HORMONAL CHANGES AND COGNITIVE FUNCTION

Many women report “brain fog,” forgetfulness, difficulty concentrating, and changes in memory during perimenopause. These subjective complaints may be associated with both hormonal changes and other menopausal symptoms such as insomnia, depression, anxiety, and hot flashes. Research does not indicate that menopause inevitably produces pathological cognitive decline; instead, cognitive experiences vary across individuals and across cognitive domains.

Gurvich et al. (2022) reviewed 33 studies and found relationships among cognitive symptoms, menopausal symptoms, sleep, affective symptoms, and demographic and lifestyle factors. Similarly, Weber et al. (2021) reviewed 19 studies and reported that cognitive complaints increase across the menopause transition and may be associated with changes in attention, verbal memory, working memory, and medial temporal lobe measures.

Estrogen may contribute to cognitive functioning through effects on cerebral blood flow, metabolism, synaptic plasticity, neurotransmitter systems, and neurotrophic factors. Nevertheless, the evidence for long-term objective cognitive impairment attributable specifically to menopause remains less consistent than evidence for subjective cognitive complaints (Hogervorst et al., 2022).

BIOPSYCHOSOCIAL PATHWAYS LINKING HORMONES AND MENTAL HEALTH

The association between menopause and mental health can be understood through several interconnected pathways. First, ovarian hormone fluctuations can directly affect neurotransmitter systems and brain regions involved in mood regulation. Second, hormonal changes can produce physical symptoms such as hot flashes and sleep disruption, indirectly affecting psychological well-being. Third, menopause frequently occurs during midlife, when women may simultaneously experience occupational pressures, relationship changes, caregiving responsibilities, changing family roles, and concerns regarding aging and health. Fourth, previous psychiatric history may increase vulnerability to mood disturbances during reproductive transitions.

The 2023 systematic review by Alblooshi et al. identified previous major depression, vasomotor symptoms, stressful life events, and psychosocial characteristics as relevant risk factors. Therefore, hormonal changes should be viewed as one component of a multidimensional model.

Table 1. Summary of Hormonal Changes and Potential Mental Health Associations During Menopause

Hormonal/physiological change	Major biological change	Potential mental health association	Evidence from literature
Estradiol fluctuation during perimenopause	Irregular and sometimes pronounced variation in estradiol	Depressive symptoms, emotional instability, stress sensitivity	Gordon et al. (2015); Gordon et al. (2019)
Progressive estrogen decline	Sustained reduction in ovarian estrogen after menopause	Mood changes, cognitive complaints, sleep problems	Stuenkel (2021); Hogervorst et al. (2022)
Reduced/irregular progesterone	Increasing anovulatory cycles and reduced progesterone exposure	Possible effects on mood, anxiety and sleep	Gordon et al. (2019); Toffoletto et al. (2018)
Increased FSH	Compensatory pituitary response to reduced ovarian function	Indirect association through menopausal transition and sleep changes	Baker et al. (2023)
Reduced estrogen and progesterone	Postmenopausal endocrine state	Sleep disturbance and secondary effects on mood and cognition	Joffe et al. (2022)
Vasomotor symptoms	Hot flashes and night sweats associated with reproductive aging	Sleep disruption, distress and depressive symptoms	Gordon et al. (2017); Alblooshi et al. (2023)

Hormonal variability + psychosocial stress	Interaction between endocrine fluctuations and stressful events	Greater vulnerability to depressive symptoms	Gordon et al. (2015)
Hormonal changes + sleep disturbance	Altered sleep associated with reproductive hormone changes	Irritability, anxiety, poor concentration and reduced well-being	de Zambotti et al. (2015); Baker et al. (2023)

II. CONCLUSION

Menopause involves profound changes in ovarian hormone activity, particularly fluctuations and eventual decline in estradiol and progesterone. These endocrine changes are associated with important changes in brain function, sleep, cognition, mood, and emotional regulation in some women. Evidence from 2010–2023 suggests that the menopausal transition can represent a period of increased vulnerability to depressive symptoms and, to a lesser extent, anxiety symptoms. Estradiol variability appears particularly important, while progesterone changes may contribute to mood and anxiety through neuroactive steroid pathways. Vasomotor symptoms and sleep disturbance provide additional pathways through which hormonal changes may affect mental health.

Nevertheless, menopause should not be regarded as a universal cause of mental illness. Psychological outcomes are shaped by interactions between endocrine changes, previous psychiatric history, physical symptoms, stress, social circumstances, lifestyle, and individual biological sensitivity. Future research should prioritize longitudinal designs, repeated hormone measurements, standardized psychiatric assessments, and greater representation of women from diverse cultural and socioeconomic backgrounds. A comprehensive approach combining hormonal, psychological, behavioral, and social assessment is likely to provide the most appropriate framework for understanding and supporting women's mental health during the menopausal transition.

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