

FROM MENSTRUAL IRREGULARITIES TO MENTAL HEALTH; PREDICTING MOOD DISORDERS THROUGH HORMONAL AND LIFESTYLE PATTERNS IN WOMEN

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DOI: <https://doi.org/10.5281/zenodo.17470659>

Keywords

Changes in hormones,
Irregular menstruation, Mood
disorders, Lifestyle choices,
and Mental health.

Article History

Received on 10 September 2025

Accepted on 16 October 2025

Published on 29 October 2025

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Abstract

Menstrual irregularities are constantly known as predictive signs of implicit hormonal disruption that can significantly impact women's mental health. Hormonal changes involving estrogen, progesterone, cortisol, thyroid hormones, and prolactin control key brain areas such as the amygdala, hypothalamus, and prefrontal cortex; structures important for emotional management and stress maintenance. Disturbance in the endocrine system can change the serotonin and dopamine routes, which ultimately leads to stress, anxiety, and depressive episodes. Variations in these hormonal systems may be the cause of mood instability, anxiety, and depressive signs, mainly over reproductive landmarks such as menstruation, pregnancy, and menopause. This review examines the elaborate links between endocrine variations, lifestyle patterns, and psychological outputs to identify how hormonal and environmental aspects predict mood disorders in women. Moreover, lifestyle factors such as diet, physical activity, sleep patterns, emotions managing strategies and substance use, used as key moderators that either protect or worsen hormonal impact on psychological health. Poor diet, insufficient rest, or long-term stress can increase hormonal imbalance, while good habits develop neuroendocrine balance and psychological flexibility. Moreover, this review also points out psychological and behavioral patterns like self-confidence, self-perception, self-respect, and the ability of handle stress, which moderate the connection between hormonal fluctuations and mood changes. The women with hormonal abnormalities like Polycystic Ovary Syndrome (PCOS), Premenstrual Dysphoric Disorder (PMDD), or Thyroid Dysfunction illustrate improve emotional patterns, and higher susceptibility to sadness and anxiety. The combination of hormonal biomarkers with lifestyle represents a proclaiming foundation for early recognition of mood disorders. This paper highlights the value of a comprehensive and deterrent approach to women's psychological well-being. Advance identification of menstrual and hormonal changes, along with new strategies aiming for nutrition, handling of stress, and sleep management, can help in alleviate the beginning and extremity of mood disorders. Basically, this review upholds for versatile cooperation in clinical and research factors to evolve customized, hormone-related mental health approaches for women throughout their lives.

INTRODUCTION

Reproductive physiology has long been used to study women's health, frequently separating psychiatric and gynecological health as distinct clinical specialties. Menstrual irregularities, however, may be important markers of more serious systemic imbalances, such as psychological fragility, according to mounting interdisciplinary data. Mood disorders including depression, anxiety, and bipolar disorder frequently precede or coincide with menstrual cycle abnormalities, whether brought on by hormonal, lifestyle, or stress-related factors. Because of this intersection, both researchers and doctors are now reevaluating the menstrual cycle as a useful biological rhythm that could reveal information about the mental health paths of women. Women are disproportionately impacted by mood disorders, which are one of the main causes of disability globally, especially during the reproductive years. Major depressive disorder is more than twice as common in women's lifetimes as in men's, a difference that cannot be fully accounted for by social or cultural variables alone.[1] The cyclical pattern of the female sex hormones, progesterone and estrogen, has a significant impact on emotional control, stress response, and brain function. Mood, cognitive, and behavioral changes have been linked to fluctuations in these hormones during the menstrual cycle, postpartum, and around menopause. Simultaneously, it has been demonstrated that lifestyle factors including stress, physical exercise, food, and sleep quality affect both hormonal balance and mental health, making it more difficult to detect and treat mood problems in women. Menstrual and hormonal data are infrequently incorporated into mental evaluations in current diagnostic frameworks, despite growing awareness of these interdependencies. Considering the enormous potential for early detection and intervention, this gap in clinical practice is worrisome. Women's mental and reproductive outcomes may be improved if preventive and

treatment approaches are more precisely tailored if hormonal and lifestyle patterns can be utilized to predict mood disorders. Real-time tracking of lifestyle and menstruation factors is made possible by expanding availability of wearable technologies and digital health platforms. This could lead to the creation of predictive models that have the potential to revolutionize mental health treatment.[2]

The hypothalamic-pituitary-ovarian (HPO) axis is largely responsible for the intricate interplay of endocrine signals that make up the menstrual cycle. In addition to controlling ovulation and endometrial changes throughout a normal 28-day cycle, variations in estrogen and progesterone also affect neurotransmitter systems that are involved in mood regulation, including serotonin, dopamine, and gamma-aminobutyric acid (GABA). Premenstrual syndrome (PMS), premenstrual dysphoric disorder (PMDD), or more generally, irregular menstruation, including oligomenorrhea, amenorrhea, or menorrhagia, might be symptoms of dysregulation in this hormonal pattern. Significantly, a higher incidence of mood problems has been linked to irregular menstrual cycles. For example, research has shown that women with PCOS, a disorder characterized by irregular menstruation and hormonal imbalance, have far greater rates of anxiety and melancholy. In a similar vein, teenage girls who have irregular periods or early menarches are more likely to experience depressive symptoms as young adults. These correlations imply that menstrual cycle patterns may function as early warning indicators, especially when paired with psychological stress and lifestyle choices. However, when it comes to mental health screening, the menstrual cycle is frequently disregarded. Most psychological tests use self-reported symptoms instead of biological markers that could improve the accuracy of the diagnosis. For disorders like PMDD, which can resemble major depressive disorder but have a cyclical

pattern that calls for distinct treatment modalities, this is especially troublesome. Therefore, distinguishing between short-term emotional states and long-term mood disorders may depend on our capacity to comprehend how hormone changes lead to mood instability. [1,2] Menstrual health and psychological resilience are significantly shaped by lifestyle choices in addition to innate biological characteristics. For instance, long-term stress might throw off the HPO axis, resulting in luteal phase abnormalities and unpredictable ovulation. Menstrual problems and depressed symptoms have been associated with poor nutrition, especially diets lacking in B vitamins, magnesium, and important fatty acids. Lack of sleep, which is more common today, can lead to hormonal imbalances and changes cortisol cycles, which exacerbates mood disorders. Conversely, exercise provides a buffer of protection. Frequent exercise has been demonstrated to enhance mood and control menstrual cycles by raising endorphin levels and modifying stress chemicals. Crucially, lifestyle changes that focus on stress management, nutrition, and sleep hygiene have demonstrated potential in reducing mood symptoms and irregular menstruation. These results are consistent with a biopsychosocial paradigm, which holds that lifestyle and hormone influences work together to influence mental health outcomes. Some preliminary research has already shown that this strategy is feasible. Apps that let women monitor their mood and menstrual cycles, for instance, have shown clear emotional change patterns associated with different stages of hormones. It may be possible to differentiate between clinically severe mood disorders and typical premenstrual mood swings with the use of predictive analytics. Furthermore, compared to models that solely rely on mental symptoms, machine learning models trained on combined lifestyle and hormonal data might provide higher predictive accuracy. There are still major obstacles to overcome, though. These include differences in hormonal reactions, cycle length variations, and sociocultural taboo

that prevents candid conversations about menstruation and mental health concerns. Furthermore, it is important to carefully examine the ethical ramifications of predictive diagnostics, especially with regard to data privacy and the possible medicalization of typical emotional states. However, given the prevalence of untreated mood disorders in women worldwide, the potential advantages of early detection and focused intervention are significant. [2]

This review explains the complex relationship between menstrual irregularities, hormonal imbalances, and the onset of mood disorders in women. It explores how dysfunctions in the menstrual cycle can provide early indication of psychological conditions like depression, anxiety, and bipolar disorder. By evaluating the role of reproductive hormones like estrogen and progesterone, the review points out their impact on emotional regulation and brain functioning. It also considers lifestyle aspects including stress, sleep, diet, and physical activity that cope up with hormonal cycles to affect mental health. The significance is placed on recognizing patterns that may allow for early prediction and mediation. The review tells the importance of current discoveries from clinical and epidemiological studies to give a better concept. By combining the gynecological and psychiatric areas, it inspires a more cohesive approach to women's health. Eventually, the article's target is to provide customized strategies for prevention, diagnosis, and treatment of mood disorders.

OVERVIEW OF MENSTRUAL HEALTH:

Complete physical, mental, and social well-being in connection to the menstrual cycle is referred to as menstrual health. This definition emphasizes how complex menstruation is and how the ability of menstruating individuals to effectively manage their menstrual health can impact their life. Having the resources necessary to actively participate in all facets of life throughout one's monthly cycle is just as important to maintaining good menstrual health as having access to menstruation products.

Information, supplies, sanitary facilities, encouraging surroundings, and friendly medical professionals with training in menstrual health disorders are some examples of these interpretative resources. [3]

PHYSIOLOGY OF MENSTRUAL CYCLE:

PHASE 1: Follicular phase

The initial period of menstruation is known as the follicular phase. Ovulation marks the end of the varying-length follicular phase, which always starts on the first day of the monthly cycle, when menstrual bleeding starts. In a normal 28-day cycle, this phase consists of days 1 through 14. Follicle stimulating hormone, or FSH, stimulates a large number of primordial follicles to mature into Graafian follicles during the follicular phase. It also influences the synthesis of 17- β estradiol. The majority of estrogen is produced by the dominant follicle, according to research. By day 7, each ovary normally has 8 to 9 mm antral follicles. When 17- β estradiol and inhibin B offer negative feedback to lower FSH levels, nondominant follicles start to degenerate. [3]

PHASE 2: Proliferative phase

The growing follicles create 17- β estradiol, which deepens the spiral arteries supplying the endometrium and increases the endometrial stroma and glands from the endometrium's basal layer. The endometrium reaches its maximum development at the conclusion of the proliferative phase, often measuring 8 to 12 mm; however, this can also vary. After ovulation, which begins at the conclusion of the proliferative period, these alterations are prepared for the endometrium to have a healthy pregnancy. Additionally, 17- β estradiol changes the cervical fluid's flexibility and protein composition, creating openings for the smooth entry of sperm into the uterus. [3]

PHASE 3: Ovulation phase

Ovulation is phase three. Ovulation often takes place 14 days before the onset of menstruation. Consequently, ovulation starts on day 14 of a typical 28-day cycle. Estradiol concentrations rise during the follicular phase, and at the end of this

phase, 17- β estradiol changes its feedback from negative to positive. Although there are other contributing factors, this change usually happens when a particular amount of estradiol is reached. The pituitary gonadotrophic cells create more GnRH receptors in response to elevated estradiol levels, which increases the cells' sensitivity to GnRH. Additionally, estradiol reduces the amount of GnRH required to induce LH secretion and prevents GnRH from being broken down within pituitary cells. Around 36 to 44 hours after the start of the LH increase, ovulation often takes place. The cervical alterations that start during the follicular phase led to high, watery cervical mucus to allow sperm access. [7]

PHASE 4: Luteal phase

The next stage of the menstrual cycle is called the luteal phase. The corpus luteum function in the ovary and the mature endometrium's secretory function in the uterus are represented by its two stages, the luteal and secretory phases. When menstrual bleeding (menses) begins, this ovulation phase concludes. The luteal phase, which typically lasts for 14 days, is largely continuous within a person, in contrast to the preceding two phases' variable length. Progesterone, which is activated by the luteinizing hormone LH, is the predominant hormone during this period.[7]

MENSTRUAL DISORDERS:

Oligomenorrhea:

Less than eight cycles following two years of menarche is referred to as oligomenorrhea. Prolactin excess causes hypothalamic-pituitary axis dysfunction in ovarian insufficiency. This pattern is typically the secondary issue of the underdeveloped HPG axis after the first two years of menarche. [4]

Menorrhagia:

Excessive or prolonged uterine bleeding at regular intervals is known as menorrhagia. Menorrhagia is frequently caused by an underdeveloped HPA axis. These variables may manifest as coagulation defects, thrombocytopenia, and platelet

dysfunction, which lead to bleeding abnormalities. [4]

Primary amenorrhea:

By the time they are 14 years old, a patient can be classified according to chronological criteria as either having typical secondary sexual features or not having any further secondary sexual traits. By the age of 16, the latter is characterized by the cessation of uterine bleeding. [4]

Secondary Amenorrhea:

After at least six months of regular cycles, secondary amenorrhea happens when there is no menstrual cycle for ninety days. This should always be ruled out first because it is the most frequent cause of secondary amenorrhea during pregnancy. Endocrinopathies, structural lesions, and chronic inflammatory lesions are further differentials to take into account. Additionally, an acquired ovarian failure should be considered. [4]

Dysfunctional Uterine Bleeding:

Signs of abnormal uterine bleeding (AUB) include breakthrough or intermenstrual bleeding, excessive menstrual flow, and periods that happen more frequently than every 21 days or less frequently than every 45 days. Potential causes of AUB include PCOS, thyroid disorders, and pregnancy. Anovulation is the most common reason in adolescence, and if all other possible causes have been checked out, the diagnosis of dysfunctional uterine hemorrhage is frequently accepted. The primary goal is to prevent issues like anemia. Treatment options include a combination of oral contraceptives, nonsteroidal anti-inflammatory drugs, and progestins. [5]

Dysmenorrhea:

Adolescent girls frequently have severe cramps and menstrual pain during their periods. Primary dysmenorrhea, which typically starts in adolescence, is characterized by painful menstruation in women with normal pelvic structure. Dull, throbbing, aching, cramping pain in the lower abdomen, back, or thighs is a common symptom of severe menstruation pain in women. There may also be headaches, lightheadedness,

nausea, diarrhea, weakness, vomiting, and exhaustion. Period pain that is frequent and persistent leads to psychological harm and subpar academic performance. [5,9]

Premenstrual syndrome (PMS):

It is characterized by the recurrence of undesirable behavioral (like weariness), physical (like migraines), and psychological (like irritation) symptoms. Teenage girls are prone to PMS. 85% of women who menstruate experience one or more PMS symptoms. Premenstrual changes have a detrimental impact on these young girls' social activities, emotional health, academic performance, and family relationships. Finding the risk factors for dysmenorrhea is crucial since it affects a lot of women, lowers their quality of life, and causes them to miss work. Anxiety disorders, both with and without depression, are the most common conditions. Both sexes can experience anxiety and despair, but girls are far more vulnerable than males during puberty. Additionally, menstruation symptoms are linked to both smoking and mood swings. [5]

HORMONAL IMBALANCE AND NEUROPSYCHOLOGICAL FUNCTIONING:

Hormones like progesterone and estrogen affect a number of brain areas related to stress response, mood management, and cognitive performance.

Amygdala:

Stress reactions and emotional processing are mediated by the amygdala. The amygdala activity can be modulated by estrogen and progesterone, which affects mood and emotional response. Changes in these hormones during the luteal phase may cause mood swings and increased emotional reactions. [6,11]

Prefrontal Cortex:

Impulse control, decision-making, and executive functions all depend on the prefrontal cortex. During the follicular period, estrogen improves mood stability and cognitive function via enhancing prefrontal brain function. [6,11]

Hippocampus:

The development of memories and the control of stress response depend on the hippocampus. In the hippocampus, estrogen stimulates neurogenesis and synaptic plasticity, bolstering cognitive performance and stress tolerance. [6,11]

Hormonal Changes:

Progesterone:

Progesterone, which helps to preserve the endometrial lining, is secreted by the corpus luteum, the dominant follicle remnant, after ovulation. Progesterone levels peak in the middle of the luteal phase and thereafter decline if pregnancy is not achieved. [8,10]

Estrogen:

Estrogen levels also stay high at the beginning of the cycle and then progressively drop toward the end, even though progesterone is the primary hormone during the luteal phase. [8,10]

Neurobiological Mechanisms:

The neurological processes that relate mood and cognitive changes to the menstrual cycle are

supported by the interplay between hormones and neurotransmitter systems. [10]

Serotonin System:

Serotonin production is increased, serotonin receptor sensitivity is increased, and serotonin reuptake is inhibited by estrogen. Higher serotonin levels in the brain are the result, and these are linked to happier moods and less anxiety. [10]

GABAergic System:

Progesterone and allopregnanolone, metabolites of it, increase GABAergic activity, which results in sedative and anxiety-reducing effects. However, in vulnerable people, sudden fluctuations in progesterone levels might cause mood swings. [10]

HPA Axis:

Cortisol production and stress reactivity are influenced by hormonal changes that occur during the menstrual cycle. Mood disorders including anxiety and depression are associated with dysregulation of the HPA axis. [10]

HORMONES	MADE BY	PART IN CYCLE
GnRH	The Hypothalamus	It releases FSH and release LH
FSH	The Pituitary gland	It promotes growth of ovarian follicle
LH	The Pituitary gland	It usually causes ovulation

Estrogen	Ovarian follicles	It makes the uterine lining thicker
Progesterone	The Corpus luteum	It prepares and preserves the uterine lining

Figure 1: Table of hormones and their roles in the menstrual cycle [15]

Menstrual irregularities and mood disorders:

Because of their prevalence and detrimental effects on quality of life, mood disorders—which include a variety of affective illnesses like Bipolar illness, anxiety, and depression are major public health issues. Effective prevention and treatment of mood disorders depend on an understanding of their complex genesis. Menstrual diseases and hormonal imbalances in women have drawn more attention than any other biological, psychological, or social component linked to mood disorders. [12]

Women of reproductive age frequently suffer from menstrual disorders, such as Dysmenorrhea (painful menstruation), premenstrual syndrome (PMS), and premenstrual dysphoric disorder (PMDD). Many women suffer from dysmenorrhea, which frequently results in decreased quality of life and absenteeism. Approximately 75% of women who menstruate experience some kind of PMS, It is characterized by a variety of physical and mental symptoms that appear during the menstrual cycle's luteal phase. PMDD is a severe form of PMS that is characterized by severe mood problems include intense irritability, depression, and anxiety. The fact that these menstruation issues are cyclical suggests that mood swings and the menstrual cycle may be related. It has been demonstrated that fluctuations in estrogen and progesterone during the menstrual cycle have a significant impact on the neurotransmitter systems of serotonin and gamma aminobutyric acid (GABA), which are associated to

mood regulation. Therefore, menstrual issues characterized by hormonal imbalance may be a strong predictor of mood disorders. [12,13]

Beyond the menstrual cycle, hormonal imbalances can lead to menopause, thyroid issues, and polycystic ovarian syndrome (PCOS). PCOS, which is characterized by polycystic ovaries, hyperplasia, and ovulatory dysfunction, affects roughly 10% of women who are of reproductive age. Women with PCOS are more likely to suffer from mood problems, including anxiety and depression. Mood disorders are also closely associated with thyroid dysfunction, which includes both hyperthyroidism and hypothyroidism. While hyperthyroidism is frequently linked to agitation and anxiety, hypothyroidism is linked to depressive symptoms. Menopause, which signifies the end of reproductive life, is accompanied by significant hormonal changes, particularly a decrease in estrogen levels. An increased risk of mood disorders, such as anxiety and severe depressive disorder, is linked to this transition. The hypothalamic-pituitary-adrenal (HPA) axis may be impacted by the hormonal changes that occur during menopause, which could further exacerbate mood instability. [12,13]

LIFESTYLE FACTORS AS MODERATOR:

The link between hormonal oscillations and mood regulation is significantly moderated by lifestyle circumstances, which also affect how biological

changes translate into psychological effects. Maintaining hormonal equilibrium and neurotransmitter function requires a healthy, balanced diet. According to nutritional neuroscience, excessive consumption of sugar and caffeine can lead to insulin and cortisol imbalances, which exacerbate anxiety and stress. In contrast, serotonin production and mood stability are supported by omega-3 fatty acids, zinc, magnesium, and vitamins B-complex and D. [16] Through mechanisms described by the endorphin and neurotransmitter regulatory models, physical activity acts as another important moderator. Regular exercise improves emotional resilience by lowering cortisol levels and increasing the release of endorphins and serotonin. Like how the circadian rhythm theory explains healthy sleep patterns, melatonin and cortisol secretion remain synchronized, ensuring appropriate mood and stress response regulation; on the other hand, Lack of sleep disrupts the hypothalamic-pituitary-adrenal (HPA) axis, resulting in fatigue and emotional instability. In line with Lazarus and Folkman's transactional model of stress, which holds that adaptive coping techniques like mindfulness, relaxation, and social support can mitigate the consequences of increased cortisol and ongoing stress, stress and coping methods also reduce hormonal implications. On the other hand, ongoing psychological stress without adequate coping mechanisms could make dysregulation of the HPA axis worse. Use of drugs, including tobacco. By changing neuroendocrine signaling pathways, upsetting the balance of estrogen, dopamine, and cortisol, and causing mood disorders, alcohol use and oral contraceptives can also function as moderators. The impact of hormone fluctuations on mental health is either amplified or lessened by these lifestyle factors taken together, highlighting the integrative importance of environmental and behavioral factors in determining psychological well-being and emotional stability. [16]

Furthermore, there is mounting evidence that people who lead balanced lives are more hormonally adaptive and less susceptible to stress-related illnesses. Under ideal circumstances, the body's capacity for neuroplasticity and resilience is highlighted by the interaction between endocrine regulation and lifestyle choices. Therefore, lifestyle-modification-focused interventions—such as stress management, organized exercise, sleep hygiene, and dietary correction—offer viable methods for fostering emotional well-being and hormonal balance. In addition to advancing the biopsychosocial understanding of mood regulation, the identification of lifestyle factors as important moderators directs the creation of comprehensive, preventative, and therapeutic approaches to diseases connected to hormones and mood. [17]

Psychological and Behavioral Correlates: Self-Efficacy, Self-Esteem, and Body Image During Menstruation

Women's psychological health, especially their sense of self-efficacy, body image, and self-esteem, is greatly impacted by hormonal changes that occur during the menstrual cycle. Neurotransmitters that control mood and motivation, including serotonin and dopamine, are impacted by changes in progesterone and estrogen levels. Hormonal decline during the luteal or premenstrual phases is often linked to negative body image, low self-esteem, and irritability. The mid-cycle spike in estrogen, on the other hand, tends to improve motivation, mood, and a more positive view of oneself. These cyclical shifts highlight how women's cognitive and emotional self-evaluation can be influenced by hormonal rhythms. [18]

Patterns of Thought and Feeling in Hormonal Unbalances

Cognitive and affective disorders are common in women with hormonal abnormalities, such as those who suffer from polycystic ovarian syndrome (PCOS), premenstrual dysphoric disorder (PMDD), or thyroid malfunction. According to research, these hormonal imbalances impact parts

of the brain like the prefrontal cortex and amygdala, which affect working memory, attention, and emotional regulation. An increased susceptibility to anxiety, irritability, and depressive symptoms may result from elevated cortisol or a disturbed estrogen-progesterone balance. As a result, sustained cognitive and emotional functioning depends heavily on hormone balance. [18]

The relationship between emotional dysregulation and perceived stress

A dynamic feedback link between the endocrine and psychological systems is seen in the way that perceived stress both causes and results from hormonal variations. Prolonged stress causes emotional instability and makes it harder to control negative effects by raising cortisol levels and interfering with the hypothalamic-pituitary-adrenal (HPA) axis. Emotional dysregulation during hormonal transitions is more common in women who have poorer stress tolerance or inefficient coping strategies. Higher levels of self-efficacy, adaptive coping, and social support, on the other hand, serve as buffers that keep psychological balance. This interaction highlights the fact that individual variances in psychological resilience and stress perception considerably attenuate mood disorders, which are not solely determined by hormonal fluctuations.

All things considered, the behavioral and psychological implications of hormone fluctuation demonstrate a reciprocal relationship between the mind and body. While psychological elements like stress, coping, and self-efficacy influence an individual's hormonal responses, hormonal changes also impact cognitive-emotional patterns and self-perception. Developing holistic approaches to women's mental health that integrate behavioral, psychological, and biological viewpoints requires an understanding of these relationships. [18]

Connection between Menstrual Cycle and Patterns of Mood

Framework that is linking the mood patterns and menstruation cycle that shows that the fluctuations in hormones throughout the adolescence affects the brain parts and therefore there is an imbalance of hormones that can lead to various more disorders such as depression, anxiety and PMDD.

Conceptual Framework:

Menstruation includes imbalance in hormones mainly in levels of estrogen and progesterone. Fluctuations in these hormones can affect neurotransmitters like serotonin and dopamine, which are directly linked in regulating mood patterns. These fluctuations occur in a cycle typically ranging from 26 to 35 days, that is called the follicle phase and the luteal phase which includes the changing in estradiol levels; it also changes the level of LH. For instance: some research reflects that imbalance in progesterone and GABAergic may lead to mood swings in few phases. When there is an imbalance in the menstrual pattern, this is a clear sign that there is an imbalance in hormones. When serotonin levels are increased mood Patterns stay stable. But in the luteal phase of the menstruation cycle, when the level of progesterone increases and the estrogen level decreases it causes anxiety, depression and irritability among adolescents. PMDD is directly connected to sadness and anxiety. [19]

Estrogen is a mood relaxing hormone, but the progesterone levels affect GABA receptors that affect mood increasing anxiety and calmness. This kind of early signs can be a prediction that there may be some mood disorders like depression, anxiety, ADHD and premenstrual dysphoric disorder in life later. A recent study says women with Imbalanced menstrual cycles report higher stress or depression symptoms than those women with normal and regular menstrual cycles. Another large study on digital media reflects the time duration and variability change with the age as it peaked in young women. But many studies also show that not everyone with irregular menstruation cycles had mood disorders and also not all mood disorders are because of the

menstruation cycle. As many studies are self-reported so it is obvious that there may be some subjectivity or biasness in the results. [19,26]

Predictive Analytics and Machine learning:

The mood patterns that were overlooked by traditional detection methods are now easily identified by using predictive analytics. In context of mood patterns and psychological wellbeing the researchers and Clinical workers are predicting that this psychological and emotional imbalance is because of the fluctuations in hormones like estrogen and progesterone. Menstruation time involves crucial changes in hormones that badly affect the more swings because of changes in brain areas. [20] Machine learning includes a large number of databases to make predictions about behavior and mood disorders. When machine learning got the data from wearable tools and apps It tries to detect the disorders. Machines process the data by processing the variables like stress levels and ovulation timing, etc., it can predict the increase in mood sensitivity and vulnerability. One of the best applications for predictive analytics is the identifying of mood disorders which includes depression, anxiety, ADHD and premenstrual dysphoric disorder.

This helps in preventing these disorders at early stages. Data from different populations can help identify the symptoms of different age groups. In this modern era, health research uses predictive analytics to better understand the hormone's health. In machine learning, there is prediction potential like you can find out the imbalance in cycles such as finding the severity of symptoms, bleeding length, etc. You will be able to predict mood fluctuations and emotional imbalance in individuals. After gathering a big amount of menstruation cycle data and also gathering information about mood swings through previous research or medical reports, future psychological and emotional challenges can be predicted earlier by machine learning models. As an example, we can say, imbalanced menstrual cycles and mood swings can be easily detected by algorithms. [20,27]

Clinical Case Trends:

Many studies are reflecting that most of the women who faced imbalanced menstrual cycles in early adolescence are at higher risk of facing mood disorders in their adulthood. For example: menstrual irregularity in early adolescence is linked with higher chances of going through depression in young women. Premenstrual dysphoric disorder is highly linked with anxiety or irritability. There is an increase in the cases of premenstrual dysphoric disorder which is a severe form of premenstrual syndrome also known as PMS.

Women with these reports' symptoms like depression, anxiety, ADHD and emotional imbalance before two weeks of menstruation cycle. Premenstrual dysphoric disorder is now added in DSM5 as a psychiatric disorder which can make a standardized diagnosis possible. These types of patterns can be warning signs for critical interventions. In many cases hormonal imbalance can lead to mood sensitivity. When there are fluctuations in the level of progesterone and estrogen, it influences serotonin levels which completely regulate the mood. Studies have shown that the irregularities in menstrual cycles in adulthood may cause stress and anxiety. The standard treatments are SSRIs and Hormonal therapies which include GnRH agonists and oral contraceptives.

It is shown women with weak neurobiological response to different hormonal changes are more likely to have mood disorders. Research has reflected that mood swings start two weeks before the menstruation cycle and end at the onset of the menstruation cycle. Studies show that 30 to 50% of menstruating women are affected by premenstrual dysphoric disorder and 3 to 8% of total average affected by PMDD. [19] Also, studies are showing hormonal imbalance is influencing neurotransmitters like serotonin and GABA which regulate seen mood patterns.

Women with PCOS often have low mode and social isolation mainly in periods of hormonal instability. Mood swings are at peak in the late

luteal phase but become minimal after menstruating begins. In adulthood, more patterns become predictable and stable compared to adolescence. Due to surges of hormones in adolescence, hormones start fluctuating, and mood swings begin due to these fluctuations (Minkin). [19,20]

Social Cultural Influence:

Stigma around Menstruation:

Stigma about menstruation moves around negative beliefs, low self-esteem, and feeling of shame. Qualitative research reflects that stigmatization about menstrual cycles hinders daily activities because it causes psychological burden on individuals. Lack of hygiene products and stigmatization can lead to anxiety and depression. It can also increase irritation or careless behavior towards the women facing mood swings like saying “it’s just periods, get over it” this type of behavior can also increase low self-esteem and depression among individuals facing mood disorders.

Menstruation is considered a taboo or a kind of stigma in many societies, which can lead to the sentiments of guilt, shame or embracement, which can cause: Avoiding the open debating on menstrual cycles. It can also enhance stress and feeling of solitude. The individual can feel isolation. People can also demotivate women to go for medical check-ups or seek emotional support. All the research (qualitative and quantitative) says menstruation cycle stigma that includes shame, secrecy and negative norms increase emotional stress, discouraged the thought of help seeking. This stigmatization increases social isolation and that can worsen the mood too. Proper campaigns about awareness of menstruation cycle health at community level should be done to reduce this stigmatization. [21]

Cultural and societal expectations:

Women are always expected to be calm and compose despite their change in hormones. It pressurizes the women to suppress their feelings such as anxiety, irritation, pain etc. Which makes them internalize anxiety, that can make the mood

patterns fluctuate badly. It can increase the emotional burden because when an individual feels like suppressing the mood swings because of hormonal changes, it will surely enhance the anxiety or irritability among them.

In some cultures, menstruation is considered dirty and a thing to hide from others. Such an attitude can lead to less chance to get psychological or menstrual health help. Because families of individuals feel shame in it to go healthcare workers. In some societies, individuals are not allowed to do certain activities during menstruation like cooking food or performing rituals. This can lead to isolation, shame, or guilt that can accelerate mood swings.

In our society women are expected to do all house chores despite having a Menstruation cycle. Sometimes the fear of judgment can also lead to depressive symptoms and stress. Societal pressure to appear good even in menstruation can also increase anxiety or low mode because in mensuration there is a huge chance of fatigue and hormonal changes. Societies want individuals facing mood swings to not talk about it, behave normally and compose, also not show any type of anxiety or irritability and stay silent about their body changes. Also, people say women are emotionally unstable during the menstruation cycle, which can cause guilt when their behavior changes during menstruation [21,28]

Access to reproductive healthcare and awareness:

Women in different areas have different types of access to hygiene products and mental healthcare services. It varies across regions. In rural or low resource societies there is a lack of awareness about menstrual pattern health and mood swings. That’s why there is always a delay in detecting disease and its treatment.

Even today, most hygienic products are out of reach for most individuals. Healthcare services can need better treatment, detection and diagnosis of problems related to psychological, emotional and menstrual wellbeing. As the hormonal fluctuations are affecting the neurotransmitters such as

serotonin that can badly affect the mood, when the adolescent and young women do not have access to health services regarding the reproductive system. They may be an imbalance in mode-related hormones so therefore most of the time they often go untreated and unrecognized. Adolescent access to early screening for different premenstrual disorders can be better thing because early diagnosis can lead to better treatment. Access to different hygienic products, reproductive health care services are less in many areas because of many social and political reasons like lack of education, lack of awareness, considering it against their religious values and due to lack of resources and awareness in many societies. So therefore, most of the individuals having more disorders and menstrual discomfort are left untreated which leads to depressive symptoms that can lead to various psychological disorders. Public service campaigns about menstrual health can decrease this stigma and increase the psychological wellness of women. The menstrual stigma should be addressed and there should be an increase in the menstrual health services to minimize the delay in treatment and care. [22,29]

Intersectionality: The role of age, genetics and environment

Intersectionality identifies how different social factors such as gender culture and ethnicity influence different kinds of experience, including mood patterns and emotional health. Age, genetics and environment all are affecting mood swings and psychological health in different ways. In early adolescence hormonal imbalance is at its peak. But in adulthood there is stability in mood patterns. Genetic disposition refers to the individual family history about more disorders because the individuals whose family history reflects any person having any psychological or mood disorder may fall prey to that disorder. And environmental factors such as pollution and chemicals can also have any effect on mood swings because exposure to such chemicals can lead to severe mood swings.

Age difference:

Throughout life, there is a difference in the regulation of mood hormones. Studies show that there is an irregularity in cycles and mood swings are increased because of immature regulation of hormones in adolescence. In adults, cycles can be predictable, but anxiety and depression can affect mood patterns. Also, childbirth and stage of menopause can badly affect the mood. But adults can stable hormones than adolescents and do not face severe mood swings like them. But premenopausal is another crucial stage where hormonal changes again went to peak and affect mood patterns of women. Adolescence is a sensitive period of life because many physical, psychological, and emotional changes occur in the body. Rapid shifts in psychological and social changes increase vulnerable behavior in adolescents. So therefore, mood swings can occur. Mental health support can be understood better by understanding these age-related differences. Mood swings are the strongest in an adolescence. There is a hormones stabilization in young adults ranging from 18 to 30 years. Because their hormones got stabilized and mood swings don't occur frequently. But in people age ranging from 45 to 55 years there is a hormonal decline especially of estrogen and progesterone. So, there is a higher risk of mood swings, sleep disturbance, and anxiety. In women above 55 years hormonal fluctuations are at their lower level. This is the post menopause era. Where most patterns of mood are linked to psychological factors rather than menstrual factors.

Adolescents vs. adults' Hormonal mood regulation

The disturbance in the level of hormones is affecting the regulation of mood patterns in both adolescents and adults. But the mood swings vary in all life stages due to a change in the pattern of hormones and emotional factors. Adolescence is the start of puberty and therefore there is an increase in risk of mental health issues in adolescents because there is an increase in fluctuation of hormones like estrogen, LH and progesterone that directly affected serotonin that is

related to mood, emotions and stress. In adults there is a stability in hormonal changes but still there is an impactful change in hormonal levels 2 weeks before menstruation starts. Hormones regulations are totally different between adults and adolescents due to the different endocrine hormones. [21]

In early adolescence, the imbalance of some hormones such as testosterone, estrogen and progesterone makes individuals more sensitive to mood swings as the reproductive system is getting mature at the time. These mood swings can cause sadness and anxiety. The prefrontal cortex intensifies emotional reactions. But in adulthood there is a stability in hormones, and it makes mood patterns more predictable. But sometimes the individuals feel change due to menstruation and more symptoms, but adults basically have better regulation skills, and they can manage the imbalance of hormones and mood fluctuations maturely. A study reflects a review of regulation of emotion in adolescents reflects that the regulatory system is not fully developed in adolescents. Therefore, they are not fully stable emotionally and have mood swings. Also in early adolescence, there is a rapid increase in hormonal fluctuations as puberty initiates at that stage. Adolescents have more vulnerability because of the immaturity of hormones and adults don't face this vulnerability because their hormones are more mature. [21,22]

Genetic predispositions:

Mood disorders are also influenced by the history of the family. Premenstrual dysphoric disorder is more likely to happen to those individuals who have family histories in mood disorders. Different disorders like premenstrual dysphoric disorder, bipolar disorder or depression can be increased by genetic factors. The rate of mood disorders will be high in those women, whose mother or sister had faced mood patterns in past. People can prevent these mood disorders by identifying the genetic risk of mood swings. Research named as twin studies says about 50 percent of premenstrual dysphoric disorder symptoms are heritable, which means

imbalance of hormones are a source of genetic risks to affect mood patterns. There is an example of genetic disposition. If any family member of an individual like her mother or sister has any history of any disorder like bipolar disorder or anxiety so there are more chances that individual to have mood disorders. This kind of genetic predisposition can affect neurotransmitters to make hormonal imbalance that can affect more patterns of moods. Also, genetic makeup can make some individuals more likely to get more disorders because of family history. [22,30]

Environmental influences:

Hormonal imbalance may be caused by many environmental factors like pollution, chemicals and bad lifestyles. Hormones like estrogen and progesterone are affected by endocrine disruptions. As an example, BPA is plastic. Many external factors and disruptors such as bisphenol and other chemicals or heavy metals can change the level of hormones, the regulation of the menstruation cycle, and development of the reproductive system. Many studies show that EDC exposure plays a vital role in changing the timing of puberty, also responsible for imbalance menstrual cycles. These environmental factors are linking the menstruation of imbalance and mood disorders in individuals. External factors like attachment style can also affect the emotional and psychological responses to imbalance in hormones.

Mood patterns can also be badly influenced by poor sleep cycles, poor diet plans, and stress. Mental and menstrual health both can get better by addressing environmental health campaigns. Chronic stress maybe HPO axis which can lead to imbalance of menstrual cycles and can accelerate pre-menstrual mood swings. Distress may be due to external factors such as family conflicts, job pressure, or exams. A poor diet routine can also be a reason for the imbalance menstrual cycle or can lead to mood disorders. For example, an imbalanced diet plan can increase PMS symptoms and instability of mood during menstruation.

Poor lifestyle and lack of daily exercise can also increase stress and depression, which can lead to various emotional disorders, whereas doing exercise daily helps in regulating the hormones and regulates the mode of patterns. Irregular sleep patterns or insomnia can also affect mood patterns, which can lead to worse irritation, anxiety, or depression.

Different kinds of climate factors such as short day-like periods in winter can increase the depressive symptoms during the menstruation phase. Social relationships such as a supportive relationship can also increase depression and isolation, which can increase the imbalance of hormones and can lead to emotional imbalance.

Exposure to different types of chemicals, plastic, pesticides or cosmetics can worsen mood patterns. These toxins come across with estrogen and progesterone functions leading to irregular menstrual cycles and disturbance in more patterns. When there is pressure to maintain the social image despite the discomfort individual face during menstruation, it can increase anxiety and irritation influencing mode patterns. [29,30]

Diagnostic and assessment framework:

A standardized diagnostic framework is necessary in getting how menstruation affects mood patterns and identifying disorders. It includes clinical assessment, self-reports, and biological measurements to provide a complete assessment. Clinical assessment includes finding history about past events, mood swings and other medical or gynecological issues as past events can be onset of mood disorders.

Screening tools for menstrual and mood disorders:

Screening tools are important for finding out that their mood disorders are linked to the imbalance of hormones across the menstruation cycle. This can help in identifying the premenstrual mood symptoms from other mood disorders. Standardized tools and instruments are used by health professionals to identify mood disorders related to menstruation. The DRSP is a kind of

diary that notes the daily symptoms which are used to detect and diagnose the disorders. It finds out the behavioral and physical symptoms such as fatigue, depression, irritability, sadness and stress before 2 weeks of menstruation.

It is best to find out the time and severity of disorders related to mood swings. The PSST is an instrument that is the type of questionnaire which has different questions regarding PMS and PMDD. It is best for clinical and research purposes. It can also have subject biases. HDRS is a tool which is used to find out mode of severity. It can also help in identifying depression and anxiety, but it cannot track the timing of the menstruation cycle. Modern research is sure that the impact of mobile apps in detecting the symptoms. This kind of tools can find out the patient's engagement and accuracy in menstrual cycle patterns.

A scale known as premenstrual dysphoric disorder scale is used to see mood and other physical symptoms before the menstrual cycle starts. Symptoms of depression can be analyzed by beck depressed inventory. For clinical use many mood charts and apps are used to record everyday mood changes and menstrual changes. Many longitudinal studies say that imbalance in the Menstruation cycle can talk about future patterns of mood, including PMDD and depression. [22]

Clinical vs. self-report diagnostic methods:

In clinical diagnostics, standardized testing is used. These are conducted by professional healthcare workers who use lab tests, physical exams, and psychological assessment, which predicts objective scoring of mood patterns. But in self-report, the individuals themselves report their symptoms, giving enough data for diagnosis through journals or apps. Screen individuals presenting with recurrent menstrual problems for mood symptoms (use BDI/other validated mood scales + prospective cycle symptom tracking). Consider early intervention for adolescents with severe menstrual pain or mood shifts. Self-report instruments are the first step in finding out the mood patterns regarding menstruation cycle

This may include the questionnaire that records the pre-menstrual symptoms and mood swings. This has many advantages like daily rating of fluctuations of mood cycle in the entire menstrual cycle, that can help in distinguishing between the normal mode and mood disorders, but self-report can be influenced by biases and stigmas you can also be influenced by underreporting or over-reporting of symptoms. But professional healthcare does structure interviews in clinical assessment; PMDD and other disorders are diagnosed by standardized tests. The combination of both methods (clinical and self-report) gives the best results, ensuring early diagnosis and treatment. Psychological assessment provides better diagnosis and helps in treating these psychiatric or medical conditions, but it is more time consuming as they require specialized and standard tests, and it also gets affected by cultural sensitivity.

Therefore, much research emphasizes the result that both clinical and self-report testing should be used for better results. Using both at the same time improves precision and ensures that treatment strategies should be done properly. Clinical assessment methods include objective scoring. These are standardized tests conducted by professionals. For example, a clinical interview for DSM-5 to detect PMDD. Blood testing for checking hormones levels. Clinical assessment of depression, anxiety, and ADHD. [23-25]

Conclusion:

Women's psychological and physical health is affected completely by menstrual health. It plays a vital role in the mental wellbeing of women across the world. Imbalance in Menstruation affected the hormonal changes that influence emotional regulation. Psychological health issues can also increase by the imbalance in menstrual irregularity which causes premenstrual dysphoric disorder, dysmenorrhea, PMS, PCOS etc. Imbalance in hormones like estrogen, LH levels or progesterone and FSH levels regulate the menstrual pattern also affect some parts of the brain, including amygdala and prefrontal cortex, which the parts that

regulates emotions, stress etc. Changes in these hormone levels are linked to changes in serotonin level, increasing cortisol levels, disturbing the HPA axis, which is linked to mood swings. Many recent studies have proved that irregularities in Menstruation relate to mood disorders which includes depression, anxiety, ADHD and premenstrual dysphoric disorder. Longitudinal studies reflect that these mood swings can lead to severe mood disorders. To find out hormonal changes, hormonal biomarkers (cortisol, testosterone, estradiol) are widely used in clinical assessments. These types of biomarkers are good for early diagnosis and treatment strategies.

Lifestyle factors also played a vital role in psychological and menstrual health disturbance. Diet plans, sleep cycles, physical activity, substance use affect the balance of hormones and mood patterns. For instance: deficiency of nutrients, poor sleep patterns, lack of exercise in daily routine and anxiety or stress can badly affect menstruation symptoms and mood instability. On the other hand, a healthy lifestyle can help in balancing mental and menstrual health. It can help in balancing hormonal levels to maintain health. Different kinds of psychological aspects such as body image and self-respect also interact with hormone regulations. Sometimes accelerate the mood swings. Modern studies reflect the importance of the predictive value of the menstruation cycle in finding out the psychological risks. To find out mood disorder reasons predictive analytics are being used to hormone data. Many social and cultural factors involving taboos and stigmas around menstruation, cultural expectation, and not having access to reproductive healthcare services can disturb the emotional state of individuals in the low source populations. Also, age, gender and genetic dispositions are also affecting the hormonal balance and emotional balance. Its diagnosis including clinical assessments and self-reports scales such as Beck depression scale etc. are used.

Treatment for hormonal imbalance can be pharmacological such as using SSRIs and also hormonal therapy to non-pharmaceutical methods such as CBT, yoga and diet plans can decrease the mental health consequences. Today's research is using modern tools such as AI based apps and other wearable tools to see hormonal and mood patterns. This type of invention is best for diagnosis and personal care of women. But recent research lacks longitudinal data and also includes the representation of many cultural groups. For better results, collaboration between endocrinology, psychology and other sciences is necessary to make predictive models and make a policy to empower women's psychological and menstrual wellbeing all over the world.

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