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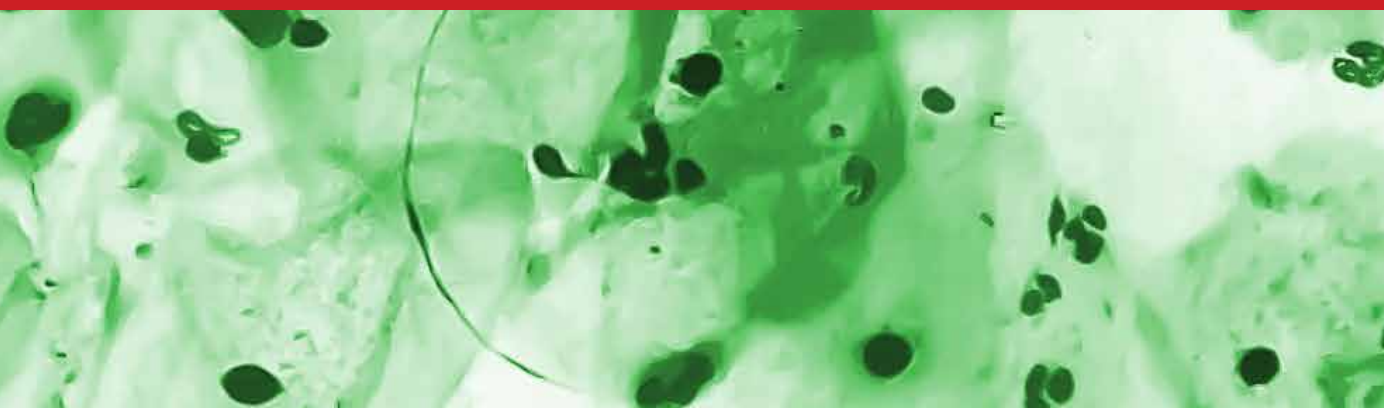
Postpartum Period for Mother and Newborn

Edited by Panagiotis Tsikouras, Nikolaos Nikolettos, Werner Rath and Georg-Friedrich Von Tempelhoff



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Volume 10

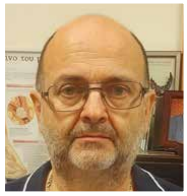
Aims and Scope of the Series

Obstetrics and Gynecology field typically covers several subspecialties that include maternal-fetal medicine, gynecologic oncology, reproductive endocrinology and subfertility, urogynecology and female pelvic reconstructive surgery, critical care medicine, complex family planning, pediatric and adolescent gynecology, menopausal and geriatric gynecology, and minimally invasive gynecologic surgery.
Apart from being diverse, obstetrics and gynecology is a challenging and demanding specialty. It combines medical and surgical skills.
The sequence of books in this series will have certain characteristics in common that will be recognized as part of the same informative multi-volume book programme.

Meet the Series Editor

Zouhair Amarin is a Professor of Obstetrics and Gynaecology at the Jordan University of Science and Technology. He was previously a lecturer at the University of Glasgow, Scotland, a senior lecturer at the University of Nottingham, England, and the dean of the Faculty of Medicine at Mutah University, Jordan. Professor Amarin is a fellow of the Royal College of Obstetricians and Gynaecologists, and the Faculty of Public Health, London. He holds master's degrees in medical science and medical education. He is a pioneer in IVF and was the first in the world to develop microsurgical epididymis sperm aspiration for clinical use. He also discovered a surgical procedure for critical ovarian hyperstimulation syndrome. Professor Amarin has edited books, authored book chapters, and published more than 130 papers. He is the recipient of eight awards.

Meet the Volume Editors



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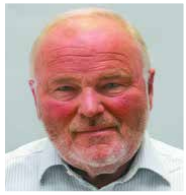

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Contents

Preface

This Edited Volume is a collection of reviewed and relevant research chapters concerning the developments within the obstetrics and gynecology field of study. The book includes scholarly contributions by various authors and is edited by a group of experts pertinent to obstetrics and gynecology. Each contribution comes as a separate chapter, complete in itself, but directly related to the book's topics and objectives.

The book has 5 chapters:

1. Navigating the Postpartum Period: Hormonal Changes and Essential Care for Women,

2. Prevention and Management of Puerperal Infection,

3. Mental Health Challenges in the Postpartum Period,

4. Bridging the Gap: Postpartum Care in Low- and Middle-Income Countries,

5. The Impact of Lactation on Genitourinary Health and Sexual Function.

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Chapter 1

Navigating the Postpartum Period: Hormonal Changes and Essential Care for Women

Erika Schwartz and Jill Ketner Villa

Abstract

This chapter examines the profound hormonal changes women undergo during the postpartum period in the context and along with the life altering essential care and changes necessary to support and provide optimal care for new mothers and how to encourage and optimize the chances for the development of more healthy babies. The chapter explores the role of the physiologic shifts in the key hormones estrogen, progesterone, oxytocin, prolactin and thyroid hormones in the holistic context of how to other significant external issues optimize both baby and mother's lives. This chapter addresses challenges such as postpartum depression and anxiety, physical recovery, breast feeding difficulties, sleep deprivation, fatigue, hair loss, pain, pelvic floor changes, managing newborn care, changes in body image, nutritional needs and deficiencies, alterations in sleep, attachment and connection, balancing family responsibility, relationship dynamics changes with partner and their impact on both maternal and child development, nutritional needs and challenges in accessing adequate healthcare and support. Additionally, the chapter underscores the lack of and imperative critical need for training in the medical field on not only women's health as a whole but overall maternal and fetal health, providing new focus and developing strategies specific to ensure the well-being of the mother and newborn.

Keywords: postpartum, pregnancy, maternal health, postpartum depression, postpartum anxiety, lifespan, breastfeeding, insomnia, oxytocin, prolactin, estradiol, progesterone, b-hCG, thyroid hormone, cortisol, HRT, bHRT, bioidentical hormones, prevention, healthspan, women, postpartum care, postnatal care, dyspareunia, relaxin, pelvic floor health, kegels, parenthood, childbirth, lactation

1. Introduction

From the time of conception to delivery and the following few years are critical and grossly understudied, minimally addressed and their importance to the health and general development of the baby and the mother minimalized in our society and medical education as well as entire health care system. Hormones play a critical role in the maintenance of metabolic homeostasis. Yet homeostasis while

it represents physiologic metabolic balance is a complicated and complex process involving psychological, emotional and lifestyle changes that are seldom connected or integrated into our care. The postpartum period is a critical time of transition for new mothers, marked by significant physical, emotional, and hormonal shifts. Understanding the role these hormonal changes play in both the development of the fetus and its impact on maternal health is essential, as they do represent a pivotal role in a mother's recovery and overall hormonal well-being after childbirth as well as being a proven determinant of the long term outcome of the baby's integration and development into society. During this time, fluctuations in hormones such as estrogen, progesterone, and oxytocin will directly affect how the pregnant woman feels, as seen subjectively and objectively in her mood, energy levels, and her body's ability to heal. The relationships with the partner and the cultural and community experience will provide the foundation for the next phase in the woman's life as well as in the child's.

From conception and throughout pregnancy, the future mother experiences extreme elevations in the hormones progesterone, estradiol (estriol), testosterone, glucocorticoids, and prolactin, of which many are normally released in short pulses at various times during the menstrual cycle but remain steady and continuously rise to very high levels for the entire duration of the pregnancy. These hormones are supplemented by additional pregnancy-specific hormones produced by the placenta, such as human chorionic gonadotropin (hCG) and chorionic somatomammotropin (also known as human placental lactogen, hPL). These placental hormones are released at key stages and play a critical role in driving adaptive changes in the mother. Please note the placenta is a foreign organ to the woman's body, it belongs to the fetus and its level of functional wellness determines how well the fetus thrives and represents one example of how the fetus takes control of the mother's hormonal as well as a multitude of general metabolic processes to support its development, invariably at the mother's expense [1].

This chapter focuses on how to better understand and support new mothers, the pregnancy's huge impact not only on the woman carrying the fetus but also indelibly connected on the new baby, how to navigate these changes, offering insights into the holistic impact of hormones on postpartum health and providing practical information and education to providers to become educated and adequately informed such as to best help and enhance the outcome for mother, new baby and everyone affected by the pregnancy. By increasing awareness of the interactions between hormones, physiology of pregnancy, social and interpersonal shifts, we can better prepare mothers to care for themselves and their babies during this phase of life as well as provide much needed education and enlightment for their support team and community. We also need to educate the providers to start focusing and become better informed about the monumental changes occurring during this period and their aftermath. We must stop treating pregnancy as a simple period in a woman's life. Pregnancy affects every aspect of everyone's life and if properly understood and supported, the newborn will thrive and our society will greatly benefit.

2. Overview of key hormonal changes

During pregnancy and the postpartum period, several key hormones have been extensively studied and have been connected to changes that influence a mother's physical and emotional state along with the outcome of the pregnancy.

The HPA axis, the control center and core channel of hormonal distribution in the human body is activated and goes into high gear as soon as a woman becomes pregnant. Much is still unknown about the hormone interactions, the maximum levels they attain, while much is known and helps us understand some of the hormonal transitions occurring during and after pregnancy.

Two of the most important and well-studied hormones during pregnancy are estrogen (estriol) and progesterone. These hormones rise steadily during pregnancy to support the growth and development of the fetus, as well as to maintain and expand the uterine lining as well as maintain the mood, sleep patterns and general metabolic functions of the pregnant woman always with an eye toward the healthy development and growth of the fetus. After childbirth, however, estrogen and progesterone levels drop precipitously. This sudden cataclysmic decline is absolutely necessary since once the baby is born, the hormone levels of pregnancy are incompatible with the mother's life and this obligatory and precipitous drop may also cause a variety of subjective and objective symptoms, such as mood swings, anxiety, irritability, hot flashes, vaginal dryness, sleep disturbances and deprivation, loss of libido, breast pain including challenges with breast feeding and extreme fatigue and brain fog. The rapid and radical hormonal shifts can also contribute to postpartum depression, as the body tries to adjust to this rapid change.

Oxytocin, often referred to as the "love and connection hormone," plays a crucial role in both the physical and emotional aspects of postpartum recovery. Physically, oxytocin stimulates uterine contractions, which are essential for shrinking the uterus to its pre-pregnancy size and reducing postpartum bleeding. Starting with delivery, oxytocin fosters a sense of connectivity and bonding between the mother and her baby, enhancing the maternal-infant attachment. The introduction of the skin-to-skin contact as the first outside connection between the mother and baby in the delivery room stimulates the surge in oxytocin production and starts the first outside the womb step in the continuation of the attachment process that has been going on for months inside the uterus The release of oxytocin during breastfeeding further strengthens this bond, promoting feelings of calm and emotional well-being for both the mother and the baby. Oxytocin is the natural stress reliever, counteracting some of the emotional challenges that can arise in the postpartum period. It inadvertently helps with the de-medicalization of the entire process which we have been subjected to for decades now [2].

Prolactin is another important hormone whose levels rise after childbirth, primarily to support breastfeeding. Prolactin stimulates milk production in the mammary glands, ensuring that the mother provides adequate nutrition and immune protection for her newborn. Beyond its role in lactation, prolactin also affects a mother's energy levels and mood. It may lead to fatigue, as the woman's body must rapidly adjust to the demands of feeding and caring for a newborn. In some cases, the elevated levels of prolactin may contribute to mood swings, though its effects are often balanced by the calming presence of oxytocin during breastfeeding and associated mild rises in serotonin and dopamine [3].

Thyroid hormones also play a critical role in regulating metabolism and overall health during the postpartum period. After childbirth, some women may experience postpartum thyroiditis, a condition that affects thyroid function and can lead to deepening symptoms of fatigue, weight fluctuations, and mood changes. This condition may lead to either hyperthyroidism, where the thyroid is overactive, the woman becomes overly stressed, gets sweaty, tachycardic, loses weight and also has trouble sleeping, or hypothyroidism, where the thyroid is underactive, the woman gains weight, loses hair gets easily fatigued and feels like she is overcome with brain fog.

Both thyroid conditions will disrupt the mother's energy levels and emotional well-being, making it important for postpartum women to have their thyroid monitored and make sure it is not overlooked by the glib statement "Your bloods are normal" which certainly does not preclude the possibility of thyroid malfunctioning. At this point the presence of well trained and highly aware providers are crucial to the post-partum recovery of the mother [4].

Glucocorticoids, hormones manufactured by the adrenal cortex are crucial parts of the HPA axis. Like cortisol they are important hormones that are released by stress, regulate metabolism, and control immune responses. During pregnancy, their levels increase to support the maternal metabolism and the baby's development and maturation. After childbirth, glucocorticoid levels drop significantly and precipitously, which affect the mother in several ways, including increased reaction to stress, fatigue, emotional changes, all as part of the body's attempt to return to baseline metabolic and immune function. This sometimes-uneven hormonal shift can also make it challenging for some women to lose weight and may contribute to postpartum mood disorders like depression and anxiety.

By understanding the roles and interactions between estrogen, progesterone, oxytocin, prolactin, and thyroid hormones during and after pregnancy, healthcare providers can better support the physiology of mothers during the postpartum period. The rapid shifts in hormonal changes, while natural have a profound impact on a mother's post-partum recovery, metabolic processes, energy levels and emotional state, making it essential to recognize and address any imbalances that may arise and raising awareness to their significance. Being vigilant and present as a provider during this period is crucial to both mother and baby.

3. Physical and emotional challenges

Postpartum emotional challenges are widely recognized and often experienced by new mothers as they adjust to the physical and emotional demands of caring for a newborn. Symptoms of postpartum depression (PPD) and postpartum anxiety (PPA) often coined "baby blues" can vary but often include intense sadness, irritability, feelings of hopelessness and disconnection from the newborn. Hormonal fluctuations play a significant role in these emotional shifts. As mentioned, following childbirth, levels of estrogen and progesterone drop rapidly. These hormonal changes, combined with sleep deprivation and the pressures of new motherhood, create a unique set of challenges for many, sometimes intensifying into more severe emotional responses [5].

In addition to mood changes, new mothers often experience memory lapses and cognitive challenges, sometimes referred to as "pregnancy brain," "mommy brain," or "baby brain." These self-reported experiences of forgetfulness or fogginess are widely recognized among women during and after pregnancy and are now being acknowledged by researchers as part of the postpartum experience. This phenomenon, sometimes called "mumnesia," reflects the cognitive toll of hormonal shifts and exhaustion associated with the postpartum period, impacting both memory and focus. These experiences, while often temporary, can affect a mother's confidence in her ability to manage her new responsibilities, adding another layer to the emotional complexity many face in the early days of motherhood [1].

What is normal becomes a question of how a woman perceives the changes her body and mind have undergone during the pregnancy and after the delivery of the

baby. Normal may very well be the fatigue and brain fog all pervasive in the first few months post-delivery as long as physiologic body functions continue without major interruptions. Breast feeding and weight fluctuations can also be interpreted under the heading of normal and must be treated with kindness and respect of the new mother.

Because sleep is no longer as clear cut and as predictably continuous as prior to pregnancy, the circadian rhythm is no longer at the center of sleep duration and quality for post-partum women. The baby's sleep pattern directly affects the mother and becomes the main focus as she is trying to adjust to feeding the baby while taking care of the entire household and herself as well. Research has shown that women who get sleep while the baby sleeps and have enough support to maintain a schedule of 6–7 hours of sleep a night, recover faster and better than women without help who become more sleep deprived with the passage of time [6].

Multigenerational households and households with more than one child are more likely to provide the type of help beneficial to women in this immediate post-partum period while isolated women are more likely to develop postpartum depression and other difficulties with the transition [7].

As post-partum period continues well past the one-year mark, changes continue and more adjustments must take place to obtain optimal results for both mother and infant.

Diet, exercise, sleep, stress management and connection to both baby and other family members are critical in this period of time. Depending on cultural morays, geography and innumerable often unforeseen and poorly studied and understood factors, this period of time can lead to the creation of a new family unit, distinct from others or get integrated into the greater family structure.

The most important goal is to form a foundation based on mutual trust and support with the mother as the focus and the baby attachment period as front and center. Kindness and love must be the foundation for all interactions with a new mother and a new baby.

There often are issues that do not qualify as illnesses or pathological problems that do in fact interfere with proper attachment and baby development as well as maternal wellbeing.

If hormonally sound, the release of prolactin and oxytocin stimulate not only the return of the uterus to pre-pregnancy size, but also the release of milk from the breasts, starting a new phase in the woman's life. The one of physically nurturing the baby outside her body. However, not all women are able to lactate, and some have anatomically different nipples, inverted nipples, which preclude the baby from latching on and being able to adequately breast feed. In western cultures we have bypassed these problems with formula in bottles with various size nipples which provides adequate nurture to the baby. While that is a great advance and improves nutrition for lots of babies there are issues associated with this situation where the mother suffers from feelings of inadequacy and becomes depressed and is unable to attach to the baby or conversely the baby does not attach to her. These are issues that must be addressed and with the awareness from the health care system and providers including midwives and lactation experts, much must be improved, ensuring that women do feel whole without having to breast feed the infant. Women at this stage in life are vulnerable and need much positive reinforcement and it behooves the medical profession to help women navigate these issues and increase attachment to the baby rather than withdraw due to perceived inadequacies [5].

4. Managing postpartum changes

Of critical importance is the change in how women perceive themselves postpartum and what they can do to transition to the new life ahead of them a life no one has prepared them for. The following is a listing of areas that need to be addressed in detail with a well-trained provider and a caring support system. Medical schools, PA training and NP training along with social workers and any other health care providers who interact with pregnant women, newborn babies, mothers and families must become conversant and more so significantly knowledgeable and attune to the needs of the woman in this underserved and underrepresented area of health care.

The postpartum period often involves significant shifts in body image and many women find themselves facing a new relationship with their bodies, which all too often looks and feels different than before pregnancy. Stretch marks, changes in weight, and muscle tone will influence self-perception and may lead to feelings of self-consciousness. In our culture where superficial beauty and youth are of highest value, the young woman who just had a baby no longer feels adequate or noticeable. Strategies to foster a positive body image during this time include practicing self-acceptance, shifting focus to the role of mother, retreating from the societal pressures to look the same as before the pregnancy, engage in activities that improve maturity, self-love and ability to express feelings and sharing this new persona with family and partner as well as friends creating an environment of acceptance and love that far exceeds in self-reward, the early youth persona. By celebrating the body's resilience and capacity for recovery, new mothers can nurture a more positive outlook that supports overall mental well-being during this transformative phase [8].

The recovery of the pelvic floor is another critical aspect of postpartum healing. Hormonal changes, particularly the decline in relaxin, which loosens joints and ligaments during pregnancy, influence how quickly and effectively the pelvic floor recovers after childbirth. Gentle exercises, like Kegels, and professional support, such as physical therapy for pelvic health or Emsella chair can aid in restoring pelvic strength and function. Open communication and teamwork are essential for maintaining a supportive relationship dynamic with one's partner during this time, as hormonal shifts can also impact intimacy and communication. Building trust, sharing responsibilities, and prioritizing moments of connection can help strengthen the partnership, which ultimately supports the mother's and baby's well-being. During this transitional delicate period, building a solid, caring relationship will help raise healthy children and strengthen the bond between the partners [8].

Nutritional needs in the postpartum phase are equally significant in managing hormonal balance, energy levels, and recovery. Emphasizing the use real, nutrient-dense foods like lean proteins, whole grains, and vegetables aids in replenishing essential vitamins and minerals, which support both the mother's physical recovery and complements the body's needs for lactation demands. Avoiding processed foods, excess sugar, and alcohol will promote better metabolic function and higher energy levels as well as better quality sleep, weight control and mood. Supporting the body with balanced nutrition helps new mothers establish a healthy foundation during the recovery post-partum period as well as prepare her to meet the demands of motherhood and sets the much needed and often overlooked foundation for healthy habits that benefit the entire family. Consumption of nutritious foods leads to healthy families and is a critical part of the global health.

Avoiding processed foods, complex carbohydrates, alcohol and sugars will help the baby developmentally and the mother with recovery of pre-pregnancy metabolic

functions. Allowing babies and young children to eat high carbohydrate meals, fast food and not notice the connection to disease like diabetes and hypercholesterolemia in the young is a sad situation that needs to change in order to provide our society with early prevention and wellness focus from the beginning of life [9].

5. Challenges in accessing healthcare and support

Accessing postpartum healthcare and support for the post-partum period presents significant challenges for many new mothers, largely due to structural barriers within the healthcare system. Issues such as limited insurance coverage for postpartum maternal care, lack of education in nutrition, integration of baby and mother into the family, education for partners and other family members in the changes associated with the arrival of a new baby in a family structure, high medical costs that are always associated with medical diagnosis, testing and surgical procedures, and a lack of standardization of prioritizing postpartum well care create obstacles for women in need and being unbale to find the much needed quality care. While many healthcare plans emphasize prenatal and childbirth services, postpartum care receives little if no attention, leading to a terrible paucity of support and care in this critical phase of life and no follow-up support. Not only is there no education and no focus on post-partum preventive and integrative care, but there also seem to be many other hurdles including geographic and socioeconomic factors that limit access, particularly for those in rural or underserved areas, where maternity care providers may be scarce and education has left those few providers with no knowledge and poorly equipped to help with the significant changes post- partum care demands. Medical education provides no help here. Healthcare providers play a crucial role in addressing these gaps by recognizing the importance of postpartum care, screening for mental and physical health concerns, and advocating for improved access to resources for all new mothers. For now, they are alone in this area and the results reflect the care delivered by some and not by others [10].

A clear result of our chapter is the unmet need for a robust support network that is essential in the postpartum period, providing both emotional and community assistance that is presently rarely if ever available through medical care alone. In some communities and cultural groups, family and friends provide comfort and help with day-to-day responsibilities, diminishing at least temporarily some of the stress associated with new parenthood. Community organizations, such as mother support groups or local parenting classes, also serve as valuable resources where new mothers can connect and share experiences. Professional support, including lactation consultants, postpartum doulas, and mental health counselors, can and do address specific needs and focus on promoting and integrated and holistic healing approach. Building a strong support network empowers mothers to navigate postpartum challenges more effectively, reducing feelings of isolation and stress [9].

Establishing this support network requires proactive steps, especially in the absence of readily available resources. In our society of isolation there are ways of connecting with other parents through community events or social media groups that may help foster a sense of community. Additionally, family members and close friends may be encouraged to participate in caregiving responsibilities, allowing the mother more time for self-care and recovery. These strategies contribute to creating a supportive environment that enhances postpartum well-being and resilience, which is crucial for the overall health of both mother and child.

6. Training and strategies for healthcare providers

Specialized training in postpartum health is crucial, as current medical education often lacks a comprehensive focus on the unique needs of new mothers. While much emphasis is placed on prenatal care, medical training frequently overlooks the postpartum period, leaving gaps in provider knowledge and skill. These gaps can result in missed opportunities to identify and address issues such as postpartum depression, anxiety, pelvic floor dysfunction, and breastfeeding challenges, not to mention the total change in a woman's life the birth of a child represents. Adding this area to medical education will equip healthcare providers with a much-needed understanding of postpartum health and thus will improve the quality of care for mothers, helping them navigate both physical and emotional challenges more effectively [11].

A holistic approach to postpartum care recognizes that recovery extends beyond physical healing, involving emotional and social well-being as well. Health care training must emphasize the interconnected nature of these needs, encouraging providers to approach postpartum care with empathy, open communication, and an honestly patient-centered mindset. Healthcare providers must be prepared to address diverse aspects of a mother's experience, from managing sleep disturbances and hormonal shifts to mental health and coping with body image changes. This holistic approach must also involve coordinating care across a multidisciplinary team, including mental health counselors, lactation consultants, physical therapists, and social workers, to ensure that mothers have access to comprehensive support [12].

Ensuring maternal well-being requires clear strategies and actionable recommendations that providers can implement in their practice. For example, establishing routine follow-ups beyond the typical six-week checkup allows for ongoing monitoring of both mental and physical health as well as maintaining the relationship with the mother beyond her usefulness as the pregnant woman who delivered the baby. Respecting mothers and creating resources, such as support groups or counseling, will empower them to seek the help they need. Integrating postpartum health into the broader conversation of women's health education, such as through continuing medical education programs, will enhance provider competency and increase awareness. These strategies not only improve individual patient care but also contribute to a more supportive healthcare system for all mothers [13].

7. Conclusion

In conclusion, understanding and supporting the hormonal and emotional dimensions of the postpartum period are essential for successful new chapter in the new mother's life. This chapter has emphasized the complex interplay between hormonal changes, physical recovery, mental health, and the mother's support systems, highlighting the need for comprehensive and specialized postpartum care. A commitment to improved training and holistic strategies for healthcare providers is key to addressing these needs and ensuring that mothers receive compassionate, knowledgeable, and effective care. By enhancing postpartum support and prioritizing maternal well-being, healthcare providers will play an essential role in the overall health of mothers and their newborns, laying a foundation for healthy families and communities, a role much needed they do not play at the moment. This chapter contributes to this goal by outlining insights and calling for systemic changes to elevate postpartum healthcare and a critical component of not only women's health but global health.

Navigating the Postpartum Period: Hormonal Changes and Essential Care for Women
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Chapter 2

Prevention and Management of Puerperal Infection

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Abstract

The risk of endometritis and puerperal fever can be decreased by reducing the upward infection of the vaginal bacterial load, even in patients with ruptured membranes. The use of prophylactic antibiotic treatment for puerperal sepsis remains under investigation. Sepsis during pregnancy and the postpartum period accounts for 11% of maternal deaths and ranks third globally. Its global incidence has been increasing, in countries with a maternal mortality rate of 8%, and is caused by multisystem dysregulation resulting from an infection, which can develop during pregnancy, abortion, childbirth, or in the postpartum period and is considered an obstetric emergency. Sepsis is a state of multisystem dysfunction, which is caused by a dysregulated host response to infection. Several factors influence the severity, clinical manifestations, and progression of sepsis, such as immunological heterogeneity, cell signaling pathways, and dynamic regulation of cell signaling pathways.

Keywords: preventative care, primordial prevention, postpartum sepsis, pregnancy complications, hospital infections

1. Introduction

The rationale for this chapter is based on the importance of the prevention of puerperal infections and their complications in order to reduce maternal mortality.

Puerperal sepsis is a pathology that significantly affects maternal health, increases morbidity, and complicates childbirth [1].

Sepsis during pregnancy and the postpartum period accounts for 11% of maternal deaths [2] and ranks third globally [3]. Its overall incidence has been increasing [4]; in countries such as France, they have a maternal mortality rate of 8% [5]. The overall incidence grouped in studies was 3.9% [6]; the prevalence is higher in countries such as Ethiopia (14.81%) [7] and other regions of sub-Saharan Africa (19.21%) [8].

It occurs as a consequence of a multisystem dysregulation resulting from an infection, which can develop during pregnancy, abortion, childbirth, or in the puerperium [9] and is considered an obstetric emergency, being one of the main causes of morbidity with high mortality; therefore, it is necessary to treat it early, a paradigm represents it, viral infections such as COVID 19, during the pandemic, which caused sepsis in pregnant patients, with the main complications being: premature birth, preeclampsia, maternal and perinatal death [10].

1.1 Etiology of puerperal infections

The causes of infection during pregnancy or puerperium in puerperal sepsis are characterized by cardiovascular, respiratory, renal, and hepatic dysfunction and disseminated intravascular coagulation. The main causes of puerperal sepsis are: surgical wound infection, endometritis, and chorioamnionitis as a consequence in some cases of genital tract infections (**Figure 1**). Other causes include pneumonia, urinary tract infections—pyelonephritis, and digestive tract infections, in 50% of cases being caused by Gram-negative bacteria [11].

Table 1 lists the bacteria most frequently observed in puerperal infection. There are less common cases of infection such as acute endocarditis in pregnancy [14].

In cesarean section, episiotomy and morphological changes in pregnancy are associated with an increased risk of puerperal infection [15]. Endometritis and surgical site infection complicate the postpartum period and require longer hospital stay and the need for antibiotics. Other infections include infection of the mammary region such as abscesses or necrotizing fasciitis, which are less common (**Figure 2**) [16].

In puerperal sepsis, it is necessary to apply the following recommendations: firstly, the recognition of maternal sepsis, always maintaining a high index of suspicion and activating the hospital sepsis code, in addition to implementing a rapid tool for the detection of maternal deterioration. Second: The golden hour in which sepsis packages or groupers should be applied, which are: serum lactate, blood cultures, administration of

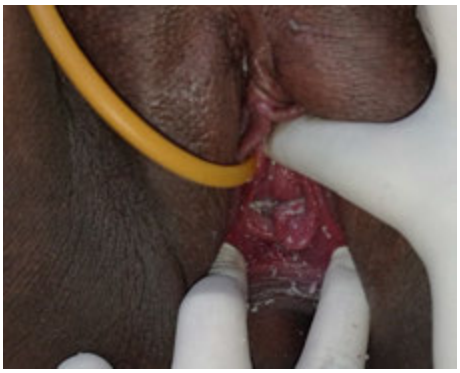

Figure 1.
Description: Genital tract infection in a pregnant patient with Müllerian malformation (double vagina), with presence of Candida vulvovaginitis. Source: Dr. María Fernanda Calderon León.

Author	Etiology of puerperal infection
Liu et al. [11]	He isolated 91 microorganisms cultured in blood, vaginal discharge, and discharge from infected surgical wounds; 6 were fungi and 85 bacteria. *Escherichia coli* was the most cultured bacterium in 30.6% of the total microorganisms affecting 37.5% of patients, including third- and fourth-generation cephalosporin-resistant strains: *Enterococcus coli, Enterococcus faecalis* (8%), *Acinetobacter baumannii* (7%), *Klebsiella pneumoniae* (6%), *Staphylococcus spp*. (5%), and *Listeria monocytogenes* (4%). *Candida* was the most common fungus, accounting for 83.3% of all cultivated mushroom strains.
Harris et al. [12]	Group A streptococci
Calderón et al. [13]	Gram-positive *Streptococcus pyogenes,* group B Streptococcus, Gram-negative E. *coli* and anaerobic

Elaboration: Dra. María Fernanda Calderón León.

Table 1.
Description: Etiologic agents of puerperal infections.

Figure 2.
Description: Panel A: necrotizing fasciitis in a pregnant patient with malignant tumor of the left breast. Panel B: left breast abscess in 30 days of puerperium of vaginal delivery. Source: Dra. María Fernanda Calderón León.

fluids, antibiotics, and initiation of vasopressors in case of hypotension in the first hour of the registration of puerperal sepsis, in addition to laboratory and radiological studies, which are key to the search for the etiology and control of the source. Recognize the most common germs and their likely origin. Choice of antimicrobials must be adapted to diagnosis [17]. Broad-spectrum empiric antibiotic treatment is given as soon as possible, within 1 hour, to any pregnant woman in whom puerperal sepsis is suspected [18]. Fluid resuscitation should be initiated promptly in patients with a blood lactate greater than 2 mmol/L or a mean arterial pressure less than 65 mm Hg. After the golden hour: Stepping up attention is critical to survival. Once the patient is stabilized, the source of the problem should be sought to anticipate and prevent adverse pregnancy outcomes.

Sepsis is a state of multisystem dysfunction that is caused by a dysregulated host response to infection. There are a number of factors that influence the severity, clinical manifestations, and progression of sepsis, such as immunological heterogeneity, cell signaling pathways, and dynamic regulation of cell signaling pathways.

Pathophysiologically, sepsis begins with the recognition of microorganisms through receptors present, generating an amplification of the inflammatory response,

due to the identification of endogenous molecules, associated with damage PAMP (Molecular Patterns Associated with Pathogens) and DAMP (Molecular Patterns Associated with Damage), causing an alteration of the respiratory chain, which is known as mitochondrial dysfunction secondary to sepsis.

Septic shock is defined as a state of acute circulatory failure, associated with an infection, characterized by hypotension or hypoperfusion.

The ability to predict mortality from sepsis is measured using the Acute Physiology and Chronic Health Evaluation (APACHE) II, III, IV classification system. Another scale that measures mortality and organ dysfunction is through the Sequential Assessment of Organ Failure (SOFA) score during the first 24 hours after admission to the intensive care unit (ICU) [19].

Norepinephrine is the first-line drug in the early onset of vasopressor support, even before the end of initial fluid resuscitation. In cases of mean arterial pressure < 65 mmHg, vasopressin should be added [19]. Infections are associated with adverse maternal outcomes, in the puerperium untreated infections such as genital infections, chorioamnionitis, breast abscesses are of great importance since they can have negative results and complicate the normal evolution of the puerperal period [20, 21].

2. Methodology

A search was carried out in databases and medical journals such as Pubmed, Mendeley, Intech Open, Latindex, and LILACS; puerperal sepsis and puerperal infections were used as a search pattern; clear, precise, and concise articles that addressed the subject, published in the last 5 years, were included.

3. Important aspects of puerperal sepsis

See **Table 2**, current management to prevent puerperal infections after caesarean section with the administration of antibiotics, a single dose of antibiotic outperforms placebo in vaginal delivery to prevent infections, prophylactic antibiotics do

Author	Population	Pharmacological intervention	Conclusions
Igwemadu et al. [22]	Prevention of postpartum cesarean section infections	Ceftriaxone and metronidazole versus cefuroxime for 5 days	Single-dose ceftriaxone and metronidazole is as effective as multiple-dose antibiotic prophylaxis in preventing post-cesarean section infections
Knight et al. [18]	Infection after vaginal delivery	Amoxicillin and clavulanic acid versus placebo	The use of a single dose of prophylactic antibiotic after vaginal delivery is beneficial
Voon et al. [23]	Prevention of endometritis in ruptured placental membranes	Amoxicillin-clavulanic acid 625 mg three times daily VERSUS watchful waiting	Preventive use of antibiotics after vaginal delivery in women with irregular placental membranes did not result in a reduction in endometritis.

Author	Population	Pharmacological intervention	Conclusions
Abdelfattah et al. [24]	Azithromycin for the treatment of premature rupture of membranes before delivery	Single dose of 1 g of azithromycin compared to 500 mg accompanied by doses of 250 for four days	Single-dose high azithromycin was associated with improved maternal and neonatal outcomes.
Ureña et al. [25]	Patients with ruptured membranes	The use of 4% chlorhexidine for vaginal cleansing before a cesarean delivery	Patients with ruptured membranes reduced the risk of endometritis and puerperal fever.
Mohammed et al. [26]	Prophylactic antibiotics after a cesarean section	2 x 1.2 g doses of amoxicillin-clavulanic acid compared to 7 days of amoxicillin-clavulanic acid and metronidazole	No statistically significant differences were found in infectious morbidity

Elaboration: Dr. Javier Aquiles Hidalgo Acosta.

Table 2.
Description: Antibiotic management in puerperal sepsis.

not reduce endometritis, single-dose high-dose azithromycin in premature rupture of membranes exceeds low doses by several days, The use of 4% chlorhexidine for vaginal cleansing before caesarean section in patients with premature rupture of membranes reduces endometritis.

4. Conclusions

Puerperal sepsis is a pathological entity of high mortality, which can be prevented through the prophylactic management of promising measures that prevent bacterial progression and ascent in the period of pregnancy, childbirth, and puerperium. In the present research, it is concluded that vaginal antiseptic solutions before cesarean delivery decrease the risk of endometritis by reducing ascending infection through a reduction of vaginal bacterial load, including patients with ruptured membranes, even if bacteria have already ascended and colonized the uterus prior to cleaning.

The use of prophylactic antibiotic treatment for puerperal sepsis, in a single dose of higher amounts, has better results than the use of doses of lower amounts in milligrams, divided and applied over several days.

The level of lactate in the blood is a useful marker of the severity of sepsis or multi-organ failure, as higher levels predict higher mortality and allow us to better identify high-risk patients; an elevated lactate level was associated with a higher level of hypoperfusion. It is currently recommended as part of the package within the first hour in patients with sepsis.

According to guidelines for surviving sepsis, appropriate dosing and administration of antimicrobials should be applied. In the first hour, blood cultures should be performed, in addition to taking into account alterations in pharmacokinetics and pharmacodynamics and characteristics such as multiple comorbidities, mainly in those who receive organ life support or are in a state of shock, applying the precise dose. In a multicenter study, prolonged antibiotic administration was found to be associated with higher mortality; in contrast, rapid antibiotic administration was associated with lower in-hospital mortality.

Current standards for resuscitation in septic shock indicate following the goals of clinical resuscitation and appropriate use of antibiotics, fluids, and vasoactive drugs. Blood lactate level is a useful marker of the severity of sepsis or multiple organ failure, as higher levels predict higher mortality, allowing us to better identify high-risk patients. Puerperal sepsis is associated with an increased risk of death, secondary to various causes, such as insulin use or acute adrenal insufficiency.

Intravenous fluid doses should be tailored to the patient's condition, and guidelines for surviving sepsis suggest resuscitating sepsis-induced hypoperfusion patients with at least 30 mL/kg of intravenous crystalloids within the first 3 h. In patients with puerperal infection who progress to acute renal failure, multiorgan failure, or septic shock, intermittent or continuous renal replacement therapy is part of intensive care unit management of severe cases.

Conflict of interest

The authors declare no conflict of interest.

Recognitions

A special thank you to my mother.

Appendices and nomenclature

ICU	intensive care unit
APACHE	acute physiology and chronic health assessment classification system
SOFA	sequential organ failure assessment

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Chapter 3

Mental Health Challenges in the Postpartum Period

Argyro Athanasiadi

Abstract

The postpartum period presents significant mental health challenges, with many women experiencing mood and anxiety disorders that can greatly impact both maternal and infant well-being. Early and accurate screening for mental health conditions is crucial for ensuring timely diagnosis and intervention. Postpartum depression (PPD) is the most common, affecting up to 15% of new mothers, characterized by persistent sadness, fatigue, and feelings of inadequacy. Anxiety disorders, often underdiagnosed, manifest as excessive worry, intrusive thoughts, and panic. Left untreated, both can impair a mother's ability to bond with her infant. A psychiatric emergency in the postpartum period is postpartum psychosis, a rare but severe condition that may involve delusions, hallucinations, and risk to both mother and baby, requiring immediate medical attention. Additionally, post-traumatic stress disorder (PTSD) can develop after a traumatic birth or the loss of an infant, further complicating recovery and maternal mental health. Prompt identification and treatment of these conditions through universal screening and targeted care can mitigate long-term consequences and improve outcomes for both mothers and their families. This manuscript highlights the critical importance of mental health care in the postpartum period and calls for greater awareness and resources to support new mothers during this vulnerable time.

Keywords: postpartum mental health, postpartum depression, postpartum anxiety, postpartum psychosis, traumatic birth, maternal psychiatric care, perinatal mood disorders

1. Introduction

While pregnancy was once thought to be a time of emotional stability and even "protective" against mental illness, recent research indicates that it does not shield women from the onset or persistence of mood disorders [1, 2]. The postpartum period is a particularly critical and vulnerable phase for both mothers and infants, marked by significant physical, emotional, and psychological changes. This time carries a high risk for both the exacerbation of pre-existing psychiatric conditions and the emergence of new mental health issues. Factors such as hormonal changes, sleep deprivation, and the demands of caring for a newborn can intensify existing mental health problems or trigger new ones. Notably, first-time mothers have an increased risk of being hospitalized for any mental disorder in the first 3 months postpartum, with the peak risk occurring between 10 and 19 days after childbirth [3].

Research suggests that up to 20% of women experience postpartum depression, along with other mental health issues such as anxiety and postpartum psychosis. The prevalence of postpartum mental illnesses varies significantly based on regional and population factors, with postpartum depression (PPD) affecting many new mothers worldwide. Refugee and asylum-seeking women have an even higher prevalence of PPD, with 22.5% affected compared to 17.5% among non-refugee women [4].

Postpartum mental illness encompasses more than just depression. For example, anxiety rates have been observed to increase from 13.1 to 17.9% between 4 and 18 months postpartum [5]. Early identification and treatment of these conditions are crucial to the well-being of both mother and child, as untreated mental health issues can negatively impact maternal-infant bonding and child development in the long term.

Despite its high prevalence, postpartum mental illness is often underdiagnosed, especially among minority groups. Socioeconomic challenges, cultural stigmas, and limited healthcare access contribute to this disparity, leaving many women without the necessary support and treatment. Even when postpartum depression is identified through screening, there is often a lack of appropriate referrals for treatment, worsening the situation. Minority women face additional obstacles, including language barriers, mistrust of healthcare providers, and systemic biases, which further impede their access to adequate mental health care [6]. Addressing these issues requires culturally sensitive care, improved screening practices, and ensuring that follow-up treatment referrals are made to enhance mental health outcomes for all postpartum women.

1.1 Negative effects of untreated maternal mental disorders

Untreated maternal mental health disorders can significantly impact a child's development, starting with the formation of insecure attachments, which may lead to difficulties in establishing stable relationships later in life [7]. Behavioral issues are often observed, with children showing increased aggression, hyperactivity, and social withdrawal [8]. Cognitive development can also be negatively affected, resulting in poorer academic performance and learning difficulties [9]. Additionally, there is an increased risk of substance use and neglect, with neglect further contributing to developmental delays and emotional instability [10]. Antenatal depression has been linked to behavioral and emotional problems in children, partly mediating the effects seen postnatally [11].

1.2 Risk factors for mental illness in the postpartum period

Depression during pregnancy is a strong predictor of postpartum illness. Additionally, a history of recurrent major depressive disorders (MDD) can increase the risk of postpartum depression (PPD) by up to 40% [12, 13]. Women with bipolar disorder who discontinue their medication are at a higher risk of relapse (85.5 vs. 37%) and tend to experience longer periods of illness, particularly early depressive and dysphoric states [14]. Family history is also a significant factor: in a recent study, 53% of women with a family history of PPD developed the condition, compared to only 11% of those without such a history [15, 16].

There are plausible explanations for the link between gestational diabetes and PPD, which may involve the effects of hyperglycemia and hormones on the thyroid and stress response system, as well as the stress associated with managing chronic

Medical	Psychiatric	Social
Endocrinopathies (gestational diabetes and thyroid abnormalities)	History of mental illness	Pregnant women give birth to boys
Cesarean section	Depression/anxiety during pregnancy	Domestic violence
Obesity	Postpartum sleep disruption	Poor social support
Postpartum medical complications	Family history of postpartum depression	Immigration status
Preterm and low-birth-weight infants	Traumatic birth experience	Traditional dietary pattern
Multiparity	Comorbid sleep disorders	Stressful events during perinatal period
Postpartum anemia	History of trauma	Unwanted/unplanned pregnancy

Table 1.
Risk factors for postpartum mood disorders [12, 13, 18].

conditions during pregnancy and the postpartum period [17, 18]. A meta-analysis of more than 14,000 participants, supported by follow-up studies with nearly 10,000 individuals, revealed that the most significant predictors of postpartum depression include depression or anxiety during pregnancy, stressful life events during pregnancy or early postpartum, low social support, and a previous history of depression [19].

Several risk factors for PPD are still debated, including serum cortisol levels, thyroid peroxidase autoantibody status, cultural practices, and traditional confinement practices. Additionally, some factors, such as assisted reproductive technology and hormonal contraception, have not been found to be associated with PPD (**Table 1**) [20].

2. Postpartum depression

2.1 Epidemiology

Roughly 10–15% of women experience major depressive episodes after delivery, and that percentage increases to 25–40% for women with prior histories of major depression earlier in their lives [21]. Higher rates are more common in low to middle-income countries [22–24].

2.2 Screening

The Edinburgh Postnatal Depression Scale (EPDS) is the most widely used tool for screening perinatal depression and has been validated through multiple systematic reviews [25–28]. Unlike other tools, such as the Patient Health Questionnaire (PHQ-9), which ask general questions about sleep disturbances, the EPDS specifically relates sleep difficulties to feelings of unhappiness and excludes questions about appetite and fatigue. The EPDS is designed to screen not only postpartum women but also those who are pregnant [29]. A score of more than 9 on the EPDS suggests that a mood episode is unlikely, while a score above 13 indicates a moderate to severe depressive episode that requires further assessment. It is important to note that screening alone does not improve outcomes; it must be paired with referrals, treatment engagement, and effective interventions.

2.3 Diagnosis

According to the Diagnostic and Statistical Manual of Mental Disorders, 5th ed. (DSM-5), postpartum depression (PPD) is a major depressive episode that begins within 4 weeks of delivery or during pregnancy. The diagnosis is based on the severity of the depression and the length of time between delivery and its onset. In order to diagnose a person with Major Depressive Episode with Peripartum Onset, five of the nine criteria listed in **Table 2** are required to be present during the same 2-week period (DSM-5). Although onset within 4 weeks postpartum likely captures those women for whom parturition is a biological trigger for symptoms, it fails to identify the subgroup of women who are hormonally sensitive and may have onset later as a result of psychological triggers or hormonal disruption due to weaning from breastfeeding and resumption of menstruation [30].

2.4 Clinical presentation

Symptoms are similar to non-puerperal major depressive episodes, including depressed mood, low motivation and anhedonia, feelings of helplessness or hopelessness and even suicidal ideation. Changes in appetite, energy levels, sleep and libido are also typical signs of pregnancy and postpartum women and may be misinterpreted as false negative [2]. Anxiety features can also be prominent, with intrusive and ruminating thoughts regarding baby's health or fear of contamination, even to the point of illness anxiety disorders, with specific worries about mother's or baby's health [31, 32]. Depression can cause significant impairment to different facets of a person's life, such as work, school, social and family relations. When evaluating a woman for depression, it is important to understand not only whether she meets the criteria for the diagnosis but also how to talk with them about difficult and painful feelings that potentially carry a lot of stigma and shame and assess for safety concerns.

2.5 Maternity blues

Depressive disorders with peripartum onset need to be differentiated from the more common "maternity blues" or "baby blues." The maternity blues are not

1. Depressed mood
2. Loss of interest in activities
3. Appetite changes
4. Sleep disturbances (insomnia or excessive sleep)
5. Restlessness or retardation
6. Low energy
7. Feelings of worthlessness or excessive guilt
8. Poor focusing
9. Suicidal ideation

Table 2.
Clinical features of postpartum depression.

classified as a mental disorder and are marked by abrupt mood changes, such as sudden tearfulness without underlying depression. These mood shifts do not lead to functional impairment and are likely due to physiological changes after childbirth. This condition is temporary and self-resolving, usually improving within a week without the need for treatment. Additional symptoms may include sleep disturbances and confusion shortly after delivery.

2.6 Pathophysiology

There is strong suspicion that reproductive hormones play a significant role in the development of postpartum depression, as they are crucial for regulating emotion processing, arousal, cognition, and motivation. However, no single hormone has been definitively linked to PPD, and research findings on this topic have been inconsistent [33–35]. Studies using hormone withdrawal models to mimic the postpartum drop in estrogen and progesterone have shown that depressive symptoms can be induced in women with a history of PPD, as demonstrated in small-scale research [36]. Research has indicated that peripartum fluctuations in allopregnanolone, a key metabolite of progesterone, may be a significant factor in the development of PPD [34]. Allopregnanolone, a modulator of γ-aminobutyric acid (GABA) receptors, influences anxiety and depression, with research suggesting its sharp decline after childbirth may contribute to PPD [34]. Exciting evidence of genetic contribution has emerged from family and twin studies suggesting that PPD clusters in families [37]. Lastly, women with PPD appear to have different gene expression that is functionally related to immunity; however, its exact role remains unclear [38, 39].

2.7 Course/prognosis

The duration of PPD varies. While most cases improve within a few months with treatment, 24% of women remain depressed 1 year after childbirth, and 13% continue to experience depression after 2 years [40]. Around 40% of women with PPD will experience a relapse, either during a future pregnancy or independently of pregnancy. If left untreated, PPD often recurs as depressive episodes, leading to persistent challenges for the mother, child, and family [41, 42]. In a prospective cohort study of 201 women, an overall relapse rate of 43% during pregnancy was reported [43]. It showed that women who stop medication during pregnancy are at a higher risk of relapsing into major depression compared to those who continue treatment. Additionally, studies indicate that PPD can persist in some cases, with over 10% developing a chronic course lasting years after the initial episode [44–46].

2.8 Management

2.8.1 Non-pharmacologic interventions

Postpartum depression treatment depends on severity, treatment history, and patient preference. For new or mild to moderate cases, non-pharmacological approaches are recommended, aligning with the guidelines from the American Psychiatric Association and the American College of Obstetrics and Gynecology (ACOG) [47]. All women benefit from psychosocial strategies aimed at improving self-care, strengthening social and emotional support, and mitigating the effects of

stress or negative life events. Educating new mothers that prioritizing their sleep is a powerful and crucial intervention to support the health of the whole family, which would include sharing childcare duties with other family members and recruiting help when possible [48]. Systematic reviews indicate that interpersonal therapy, cognitive-behavioral therapy (CBT), and psychodynamic therapy can be effective psychological treatments for postpartum depression [49].

2.8.2 Pharmacological interventions

The postpartum period is a time for heightened risk for depression, both for women with previously diagnosed illness and for those with new-onset PPD. Many women are fearful of the possible risks of medication exposure through breast milk; this can be particularly true for those who have not been on any psychotropic medication in the past. Fortunately, the necessary considerations around the use of antidepressant medications in lactation are few. The American Academy of Pediatrics considers a relative infant dose of <10% to be acceptable in lactation use. All selective serotonin reuptake inhibitors (SSRI) antidepressants fall below this level and can be used safely [50]. Measuring drug levels in breastfeeding mothers or infants is not generally recommended but may be useful if the infant shows behavioral changes (e.g., irritability, sedation, feeding, or sleep issues) or if the mother takes a high medication dose. High infant drug levels may warrant suspending breastfeeding.

In general, all SSRIs and selective noradrenergic reuptake inhibitors (SNRIs) can be used for the treatment of postpartum depression, as can tricyclic antidepressants (TCAs). A 2014 Cochrane Review highlighted that SSRIs were more effective than placebo in treating postpartum depression [51]. More importantly, it has been suggested that postnatal SSRI treatment may bring benefits in the long term to women with postnatal depression and their offspring [52]. Although there is sufficient evidence supporting SSRI use during pregnancy, data on other antidepressants like bupropion and mirtazapine is more limited, but the available findings are reassuring [53–55]. SNRIs, such as venlafaxine and duloxetine, could be an alternative for the treatment of postpartum depression, especially if targeting concomitant neuropathic pain, with data suggesting safety during lactation so far [56].

Another promising development in the treatment of PPD involves allopregnanolone analogs, which target GABAergic systems. These novel antidepressants have shown efficacy and potential for rationally designed treatments, providing a new avenue for PPD treatment [57, 58]. Brexanolone, the first U.S. Food and Drug Administration-approved medication, is a positive allosteric modulator of the GABA-A receptor administered via a 60-hour infusion in a medical setting. Recently, its oral analog, zuranolone, was approved and brexanolone is slowly withdrawing from market. Lastly, electroconvulsive therapy (ECT) is a highly effective option for severe depression, high suicide risk, catatonia, medication-resistant cases, psychotic agitation, severe physical deterioration, and other critical conditions [59].

When prescribing medications during pregnancy, efforts should focus on simplifying the regimen and avoiding polypharmacy. For example, a sedating antidepressant may be chosen for a woman with depression and insomnia, rather than combining an activating antidepressant with trazodone or a benzodiazepine.

3. Postpartum anxiety disorders

3.1 Epidemiology

Anxiety disorders in women most commonly begin in the mid-to-late 20s, coinciding with childbearing years [60]. Given the high prevalence of mood and anxiety disorders in women, many are likely to experience symptoms and could benefit from treatment during pregnancy and postpartum. Anxiety disorders affect an estimated 8.5% of postpartum mothers, underscoring the need for increased research and clinical attention due to the potential negative consequences on both women and their families [42]. Research suggests that women may be particularly susceptible to developing obsessive-compulsive disorder (OCD) during the postpartum period [61, 62]. More importantly, an increase in symptoms may also be noted in women with OCD [63].

3.2 Screening

Screening for postpartum anxiety is a critical aspect of maternal healthcare, aimed at early identification and intervention to mitigate adverse outcomes for both mother and child. The ACOG issued a recommendation that obstetricians, gynecologists and other obstetrical providers screen at least once during the perinatal period for depression and anxiety [2]. However, the clinical presentation of postpartum anxiety can vary and co-exist with other psychiatric disorders, as well as include distinctive features pertinent to that specific time period, difficult to be caught using only one screening tool. Overall, comprehensive screening protocols for postpartum anxiety that integrate both psychological and social factors are essential for early identification and effective management, ultimately improving outcomes for mothers and their families (**Table 3**).

3.3 Diagnosis

Diagnosing perinatal anxiety can be complex, despite their high prevalence and significant impairment in functioning, because of the absence of formal DSM criteria in the literature and limited data on what distinguishes perinatal women experiencing normal worry versus those with clinical worry. There is often a presentation of symptoms of anxiety symptoms that do not meet the threshold for a DSM diagnosis but would generate high scores on anxiety scales (i.e., OCD symptoms with other anxiety symptoms but not meeting formal diagnosis of OCD) (**Table 4**).

1. Edinburg Postnatal Depression Scale Anxiety Subscale
2. Perinatal Anxiety Screening Scale
3. Generalized Anxiety Disorder-7
4. Hospital Anxiety and Depression Scale
5. Perinatal Obsessive-Compulsive Scale
6. Yale-Brown Obsessive-Compulsive Scale

Table 3.
Screening tools for anxiety disorders [2].

Generalized anxiety disorder	Obsessive-compulsive disorder	Panic disorder
Excessive uncontrollable anxiety and worry	Obsessions: intrusive and recurrent thoughts	Abrupt surge of intense fear
Restlessness	Compulsions: repetitive behaviors or rituals to reduce stress	Heat sensations
Fatigue	Time consuming	Palpitations
Difficulty with concentrating	Significant functioning impairment	Sweating
Irritability		Tremors
Muscle tension		Chest pain
Sleep disturbance		Difficulty breathing

Table 4.
Clinical features of anxiety disorders.

3.4 Clinical presentation

3.4.1 Generalized anxiety disorder

Generalized anxiety disorder (GAD) is the most common perinatal anxiety disorder and is defined by excessive anxiety and worry for the majority of days, to the point of causing significant functional impairment to the person for at least 6 months [64]. Women with GAD appear to experience a more restricted range of worry content during pregnancy and the postpartum period. Their predominantly perinatal-themed worries may go unrecognized as having GAD due to the normalization of these types of worries.

3.4.2 ObsessiveCompulsive disorder

OCD involves obsessions—persistent, intrusive, and distressing thoughts, images, or impulses—or compulsions, which are repetitive mental or physical actions that significantly impact the person's functioning. In perinatal women, obsessions often focus on concerns about harm to the infant [65]. Compulsions, though less common, often involve checking and seeking reassurance. Perinatal OCD can negatively impact fetal, newborn, and infant health while also disrupting parenting, relationships, and daily life during the postpartum period [66]. Harming obsessions are common in this population; however, they are not associated with a risk of violence, and many primary care providers may have difficulty differentiating perinatal OCD from psychosis [62]. The most important differentiating factor is that those thoughts are highly disturbing and shameful to patients with OCD, who often develop several avoidant activities in order to minimize their interactions with the newborn for fear of harming them.

3.4.3 Panic disorder

Panic disorder involves sudden, recurrent, and unpredictable panic attacks accompanied by ongoing fear of future attacks. Symptoms include dizziness, nausea, palpitations, rapid breathing, trembling, sweating, and fear of dying or losing control (DSM-5). During the postpartum period, it can manifest through fear of leaving their houses with the baby. Women with postpartum panic disorder showed weaker

bonding, greater rejection and anger toward their infants, and stricter parenting rules. Their infants were more likely to have lower birth weights and shorter gestational ages [67]. During panic attacks, women experience an abrupt decline in cognitive functioning, while between attacks, the decline is more gradual, and women have difficulty maintaining composure, leading to exhaustion. These challenges can negatively affect their lifestyles, lowering self-esteem and causing feelings of failure, fearing of the long-term effects their panic might have on both themselves and their loved ones [68].

3.5 Pathophysiology

The pathophysiology of perinatal anxiety involves complex interactions between genetic, hormonal, neurobiological, and environmental factors. Many anxiety disorders have a level of hereditability, though both genetic and environmental factors can contribute to its prevalence. Hormonal changes, particularly in estrogen and progesterone, significantly influence neurotransmitter systems such as serotonin and GABA, and the role of allopregnanolone was described earlier [34]. Additionally, the immune system may be implicated, as alterations in immune cell populations and cytokine expression during pregnancy and postpartum are linked to anxiety symptoms [69]. Lastly, pregnancy-related and psychological factors can also play a role, such as pregnancy and traumatic delivery, limited social support, prior history of mental illness as well as parental-themed worries [64].

3.6 Course/prognosis

Maternal antenatal anxiety may pose a significant risk for children's development. Postpartum anxiety or stress has been linked with physical defects in the child [70], low birth weight [71], fetal activity and development [72] and behavior/emotional problems [11]. Anxiety in pregnancy was associated with a substantially increased likelihood of postnatal depression, even after controlling for antenatal depression [73].

3.7 Management

3.7.1 Non-pharmacologic interventions

The approach for perinatal anxiety disorder is similar to the general population. For mild to moderate anxiety, non-pharmacological interventions should be the initial approach and are recommended alongside medication for moderate to severe cases. Effective treatments for perinatal anxiety include cognitive-behavioral therapy (CBT), interpersonal therapy, psychodynamic therapy, and group therapy, with exposure-based CBT being especially beneficial for managing panic attacks [42, 74–76]. Some data support the use of yoga, music therapy, massage by partners, self-guided book reading with professional telephone assistance, and other mindfulness techniques in the postpartum period [77]. Overall, encouraging women to identify their support networks and decrease external stress are components of an optimal treatment plan.

3.7.2 Pharmacological interventions

SSRIs and SNRIs are the first-line treatment for anxiety in pregnant and lactating women, with the SSRIs being more commonly used. Overall, side effects, reproductive and lactation safety, tolerability, and past response to medication should guide

medication choice. Women with moderate to severe anxiety may need additional medication to manage symptoms, particularly when severe anxiety disrupts antenatal care, daily functioning, or sleep. Benzodiazepines can be useful in the short term as either anxiolytics or hypnotics. There is reassuring information regarding their use during breastfeeding; however, when they are used as an adjunctive medication to other central nervous system (CNS) depressants, there exists the potential for drug-drug interaction and increased risk for sedation [78].

Other options include buspirone, gabapentin, antihistaminic medications, such as hydroxyzine or diphenhydramine, second-generation antipsychotics such as quetiapine or olanzapine and sedating antidepressants like trazodone or mirtazapine. Although sedating antihistamines may temporarily lower prolactin levels, current understanding indicates that their use at standard doses is unlikely to significantly affect breastfeeding [79, 80]. Although avoiding polypharmacy is optimal, some women might benefit from the short-term use of adjunctive medications in addition to SSRI or SNRI agents.

Like postpartum depression, lack of sleep is a significant risk factor for psychiatric decompensation and requires proactive treatment. Developing a plan with patients and their families to support consolidated sleep, including assistance with nighttime feedings, benefits both mother and infant. When prescribing insomnia medications, clinicians should advise women to arrange overnight infant care to prevent sleep disruption and reduce the risk of unintentional harm due to maternal sedation.

4. Postpartum bipolar disorder/psychosis

4.1 Epidemiology

Postpartum psychosis (PPP) is a rare but severe perinatal psychiatric complication that is considered a true psychiatric emergency. The incidence of first-lifetime onset postpartum psychosis from population-based register studies of psychiatric admissions varies from 1 to 2 per 1000 births [81]. While the overall prevalence is low, the relative risk of experiencing a first onset of psychosis is 23 times greater within the first 4 weeks postpartum compared to any other time in a woman's life [3]. Importantly, in postpartum patients with a history of bipolar disorder, the risk of recurrence was three times greater: 70% as compared to 24% in the non-pregnant women who discontinued their mood stabilizer for the same amount of time [14]. Prior history of postpartum psychosis and personal or family history of bipolar disorder are the greatest risk factors for postpartum psychosis; others include primiparity and sleep deprivation (**Table 5**) [83].

Risk Factor	Postpartum Psychosis
Hospitalization for psychotic episode during pregnancy	44%
Hospitalization for psychotic episode prior to pregnancy	14.5%
Any previous psychiatric hospitalization	9.2%
Previous hospitalization for bipolar disorder	2.0%
Baseline population risk	0.07%

Table 5.
Risk factors for postpartum psychosis [82].

4.2 Screening

The Mood Disorder Questionnaire (MDQ) is the most widely studied screening tool for bipolar disorder and has been validated for the postnatal period [84]. However, without screening for bipolar disorder, there is a high risk of misclassifying bipolar depression as unipolar depression if only using EPDS to assess for postpartum depression [85]. MDQ is recommended for women who have a history of hypomania, psychosis, anxiety disorders, or substance abuse, or who have a family history of bipolar disorder, especially if antidepressants are being considered [86]. If there is a concern that the patient is suicidal, homicidal, or psychotic, the patient should be referred for immediate evaluation.

4.3 Diagnosis

DSM-5 does not recognize postpartum psychosis as a separate psychiatric disorder; therefore, there are no specific diagnostic criteria. It is crucial to determine whether the patient is experiencing their first-ever episode of psychosis or has a history of depression, hypomania, or mania, as this distinction influences prognosis, and many previous episodes may have gone unnoticed [87]. Evaluations should include screening for treatable causes of psychosis, such as infections, peripartum blood loss and anemia, and the worsening of pre-existing endocrine or autoimmune conditions. Therefore, physical and neurological exam should be part of the diagnostic procedures, as well as comprehensive metabolic profile, complete blood count, TSH, free T4, TPO antibodies, ammonia level, urinalysis and urine drug screen. Lastly, if neurological symptoms are present, brain imaging, cerebrospinal fluid analysis and antibody screening for encephalitis are indicated [87].

4.4 Clinical presentation

The typical time of symptom onset is between 3 and 10 days after birth and can be even earlier for women with a history of bipolar disorder, sometimes during or immediately after delivery [88]. The clinical picture usually includes mania or mixed episodes with and without psychotic features, depressive episodes with psychotic symptoms or nonaffective psychotic episodes [87]. Insomnia, mood swings, and irritability can be early signs of postpartum psychosis which often progress to mania, depression, or a mixed state. Disorganized or unusual behavior and obsessive thoughts about the newborn are common. Postpartum psychosis is characterized by a delirium-like presentation, including cognitive symptoms such as disorientation, confusion, disorganization, and fluctuating mental status. Delusions of altruistic homicide, where a mother believes ending both her own life and her baby's will spare them from a "fate worse than death," may occur and should be thoroughly assessed during clinical evaluations. It is estimated that 4% of women with postpartum psychosis commit infanticide, though actual rates are likely under-reported [89]. Symptoms may last between 1 month for women with manic features and 2.5 months for patients with mixed or depressed symptoms (**Table 6**) [87].

4.5 Pathophysiology

Although childbirth can trigger postpartum psychosis, the underlying etiology of PPP is poorly understood. Presumably, the mechanism of onset is related to specific

Postpartum OCD	Postpartum Psychosis
Good insight	Poor insight
Disturbed by thoughts	Rarely distressed by thoughts
Avoid contact with newborn	No avoidant behaviors
Very common disorder	Rare disorder
Low risk of harm to baby	High risk of harm to baby

Table 6.
Differentiating postpartum OCD and Psychosis [90].

physiological changes at birth in genetically vulnerable women [87]. The pathophysiology of postpartum psychosis is a topic of ongoing research, involving factors such as genetics, hormonal fluctuations, immune system responses, and disruptions in circadian rhythm. Genetic variants of the serotonin transporter gene (5-HTT) and a signal at chromosome 16p13 in patients with a history of bipolar disorder and postpartum psychosis have been discovered [91]. The abrupt concentration change in reproductive hormone levels associated with parturition has also been implicated in the etiology of postpartum psychosis, and while the peripheral levels are not different among affected and unaffected patients, women at risk for PPP may be more vulnerable to rapid hormonal changes [92]. Postpartum activation of the immune system could also be implicated due to co-occurrence of PPP with thyroiditis, preeclampsia and autoimmune encephalitis [93–95]. Finally, the sleep disruption caused by labor and delivery may trigger circadian rhythm disturbances, potentially leading to the onset of mania or a mixed state, particularly in first-time mothers who experience more frequent awakenings [96, 97].

4.6 Course/prognosis

Most patients with PPP show significant or complete recovery in areas such as work, interpersonal relationships, and recreation, particularly if the acute episode is of shorter duration [98]. Individuals experiencing first-onset postpartum psychosis have a better prognosis than those with first episode of affective psychosis outside the postpartum period [98, 99]. However, following an episode of postpartum affective psychosis, there is a 50–80% chance of experiencing another serious psychiatric episode, often within the bipolar spectrum. For 20–50% of women, these episodes are confined to the postpartum period [99–101]. Experiencing PPP typically does not prevent most women from having more children, although older and multiparous women are less likely to pursue additional pregnancies [102].

4.7 Management

4.7.1 Non-pharmacologic interventions

Postpartum psychosis is a psychiatric emergency that necessitates immediate evaluation. While only a limited number of mother-infant joint psychiatric facilities exist in the United States, postpartum women typically receive care in general mental health settings. Family or significant other involvement is a crucial aspect of treatment. The primary aims of treatment include not only alleviating psychiatric

symptoms but also enhancing self-esteem, fostering confidence in motherhood, improving social and family dynamics, and supporting the infant's health and emotional growth [87]. Sleep deprivation from frequent nighttime breastfeeding can trigger or sustain manic episodes, making the restoration of regular sleep patterns essential for recovery. Therefore, strategies like having someone else feed the baby at night or using medication to aid sleep are vital for the mother's well-being.

4.7.2 Pharmacological interventions

The goals of pharmacological treatment are promoting sleep, improving psychosis and stabilizing mood. The largest evidence base exists for treatment with benzodiazepines, lithium monotherapy and lithium adjunctive treatment, ECT and antipsychotics [87]. Short-term use of benzodiazepines might be indicated for sleep restoration as this alone can lead to recovery in a subgroup of patients. Lithium is strongly recommended during the acute phase of postpartum psychosis, except when contraindicated (e.g., due to impaired thyroid or kidney function). Evidence from a naturalistic cohort study of 64 women shows that lithium is highly effective for the acute treatment of postpartum psychosis and offers significant protection against relapse with maintenance therapy [103]. It was also observed that the majority of the patients responded to adjunctive lithium treatment and achieved complete remission (98.4%), with a median episode duration of 40 days.

Antidepressants are not recommended for the acute treatment of postpartum depression with psychotic features, especially without proper mood stabilization, due to the risk of worsening mood lability and mania [104]. For women with psychosis limited to the postpartum period, maintenance treatment with lithium should be continued for 9 months after initial stabilization (target plasma level, 0.6–0.8 mmol/L), after which time a gradual and monitored taper can be considered [103].

ECT should be considered as a treatment option for postpartum depression with psychotic features, as this condition typically has a longer median duration of illness compared to postpartum mania [105]. However, the decision between pharmacotherapy and ECT should be made in collaboration with the patient, considering their preferences, particularly about breastfeeding.

5. Reproductive loss/traumatic delivery

Reproductive loss and pregnancy-related trauma, such as preeclampsia or a difficult delivery, can result in symptoms of post-traumatic stress disorder (PTSD). Women who experience instrumental deliveries, such as those involving forceps with an unplanned episiotomy under local anesthesia, report more PTSD symptoms compared to those who have spontaneous vaginal or cesarean deliveries [106]. A larger study indicated that women who underwent an emergency cesarean section or instrumental deliveries were 6.3 and 4.8 times more likely, respectively, to meet PTSD criteria 4 weeks postpartum compared to those who had spontaneous vaginal deliveries [107]. However, the researchers also found that, in numerical terms, more women with normal vaginal deliveries met PTSD criteria than those with emergency cesarean or instrumental deliveries, suggesting that both the nature of the birth event and individual characteristics play a role in the risk for postpartum PTSD. The perception of childbirth as traumatic may actually be a stronger predictor of PTSD than the delivery method itself [108].

Grief and bereavement are common responses to perinatal loss, affecting up to 80% of patients [109]. Of greater concern is the high incidence of persistent complex grief, formerly referred to as complicated grief; about 25–30% of parents experiencing perinatal loss exhibit this persistent form of grief, which is three times higher than other types of grief reactions [110]. Screening for the severity of grief is essential, but additional screening for psychiatric conditions is also crucial since counseling alone may not suffice for effective treatment. Especially during the first 4–6 months after the loss, regular follow-up is crucial for differentiating grief from other mental health conditions. Early referral to therapy can be beneficial, and prioritizing mental health and stress reduction in future pregnancies is essential.

6. Conclusion

In conclusion, the postpartum period presents significant mental health challenges for many women, with postpartum depression, anxiety, and psychosis being the most prominent conditions. Postpartum depression is often characterized by persistent sadness, fatigue, and difficulty bonding with the baby, while postpartum anxiety may involve excessive worry, irritability, and restlessness. Postpartum psychosis, though less common, is a severe condition that may include hallucinations, delusions, and confusion, requiring immediate medical intervention. Additionally, a traumatic delivery or the loss of a child can have profound psychological effects, heightening the risk for mental health disorders during this critical period.

Obstetricians and gynecologists play a crucial role in the early identification and management of these conditions. They are often the first healthcare providers to interact with new mothers postpartum, making them well-positioned to screen for mental health concerns. Through regular follow-up visits, OB/GYN providers can offer support, provide appropriate referrals to mental health specialists, and initiate timely interventions to improve outcomes for both the mother and child. Their proactive involvement is key to addressing postpartum mental health challenges effectively.

Conflict of interest

The authors declare no conflict of interest.

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Chapter 4

Bridging the Gap: Postpartum Care in Low- and Middle-Income Countries

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Abstract

Postpartum care in low- and middle-income countries (LMICs) remains a critical area of concern due to significant disparities in healthcare access and outcomes. This chapter examines the challenges and opportunities in postpartum care, focusing on the dual burden of "Too Little Too Late" (TLTL) and "Too Much Too Soon" (TMTS). These paradigms highlight the inadequacies in timely and appropriate care, particularly for women in underserved areas. The chapter also explores the potential of Respectful Maternity Care (RMC) and mobile health (mHealth) technologies as innovative approaches to improve postpartum outcomes. By addressing these issues, the chapter aims to bridge the gap in postpartum care, ultimately enhancing maternal and neonatal health in LMICs.

Keywords: postpartum care, postpartum disparities, low- and middle-income countries, respectful maternity care, maternal mortality

1. Introduction

Postpartum care is a critical aspect of maternal health, particularly in low- and middle-income countries (LMICs), where maternal mortality rates remain high. The postpartum period, often called the "fourth trimester," is vulnerable for the mother and newborn, with significant risks of morbidity and mortality. In many LMICs, postpartum care is neglected, with limited access to quality healthcare services, inadequate follow-up care, and a lack of awareness among women about the importance of postpartum health.

This chapter examines the challenges and opportunities in postpartum care within LMICs, focusing on the disparities in healthcare access, the dual burden of "Too Little, Too Late" (TLTL) and "Too Much, Too Soon" (TMTS) in maternal healthcare, and the potential of innovative approaches such as Respectful Maternity Care (RMC) and mobile health (mHealth) technology to improve outcomes. By addressing these issues, the chapter aims to provide insights into bridging the gap in postpartum care in resource-limited settings.

2. The challenge of disparities in postpartum care

The postpartum period is characterized by significant health disparities, particularly in LMICs, where socioeconomic factors play a crucial role in determining access to care [1, 2]. Women in rural and remote areas often face substantial barriers to accessing postpartum services, including distance, lack of transportation, and cultural practices that discourage seeking care outside the home [3, 4]. In many LMICs, improving postnatal care (PNC) coverage, especially during the early postnatal period, remains a significant challenge due to factors at the individual, household, and system levels [5, 6]. Key barriers to PNC coverage include the high prevalence of home deliveries in certain areas, the desire for mothers to leave health facilities shortly after an uncomplicated delivery due to staffing and infrastructure limitations, and the limited reach of community health workers (CHWs) to provide timely home visits [7, 8].

In contrast, women in urban areas may have access to healthcare facilities, but these are often overcrowded, under-resourced, and focused more on antenatal and intrapartum care rather than postpartum care [5, 9]. The disparities in postpartum care are further exacerbated by gender inequality, poverty, and the limited availability of skilled healthcare providers [10, 11]. This section explores these disparities, highlighting the need for targeted interventions to ensure that all women receive the postpartum care they need, regardless of their socioeconomic status or geographic location.

Uterine atony is the most common cause of postpartum hemorrhage, while hypertensive disorders also contribute significantly to maternal mortality [3, 12]. Women experiencing their first pregnancy are at a higher risk of developing preeclampsia—a condition characterized by hypertension and proteinuria—compared to those in subsequent pregnancies [12]. Preeclampsia can lead to severe complications, including seizures and strokes, and when seizures occur, it is called eclampsia [12, 13]. Infections also contribute to maternal deaths, although the full extent of their impact in low- and middle-income countries (LMICs) is often unclear.

In high-income countries, effective interventions have been well-researched and proven to prevent most maternal, fetal, and neonatal deaths [6, 14]. Theoretically, if these interventions were made accessible to pregnant women and their newborns in LMICs, maternal mortality rates could be reduced to levels comparable to those in high-income and some middle-income countries [4, 6]. Achieving significant reductions in mortality rates in these regions does not necessarily require the development of new interventions or technologies. In many low- and middle-income countries (LMICs), one of the major barriers to improving pregnancy outcomes is the lack of reliable data [15]. Information that is difficult to collect, such as causes of death and the coverage of various prevention or treatment interventions, is often unavailable. Without high-quality data, it becomes challenging for any treatment facility or geographic area to track outcomes over time or compare them with similar entities [2, 15]. Moreover, the evaluation of newly implemented programs or interventions cannot be accurately conducted without reliable data. Consistent and accurate data collection is essential for documenting and achieving improvements in care and pregnancy outcomes [4, 16].

Instead, the challenge lies in effectively introducing these existing interventions, ensuring their correct application, and sustaining their use [14, 17]. For instance, even when an intervention is available, it may be initiated at the wrong time, poorly implemented, or applied to the wrong patients [2, 5, 7]. Therefore, while coverage is crucial, maintaining high-quality care is equally important. In resource-constrained

settings, one potentially effective strategy for reducing mortality is the identification and follow-up of at-risk mother-baby dyads [2, 10]. This approach involves identifying both immediate and distant risk factors that increase the likelihood of maternal and neonatal deaths in the postnatal period and prioritizing care for at-risk mothers and babies [16–18].

Anemia during pregnancy is a significant issue, particularly in South Asia, and is partially responsible for many maternal deaths, although the exact number remains unknown [19, 20]. Infections are generally considered the second most common cause of maternal mortality, with the leading cause being bacterial infections of the uterus and resulting sepsis [2, 19]. Most maternal deaths can be prevented through the early diagnosis and treatment of these major conditions. While most complications leading to maternal death cannot be predicted or prevented, care must be readily available to all pregnant women. Since most maternal deaths occur during labor, delivery, and the immediate postpartum period, it is crucial that treatments for these conditions are accessible during these times [15, 18, 20]. Unfortunately, many of these interventions are not available in homes or even in many clinics in LMICs, highlighting the need for all births to take place in hospitals equipped with the necessary resources. This strategy is likely to have the most significant impact on reducing maternal mortality.

In sub-Saharan Africa, syphilis is a significant cause of stillbirth, making programs that diagnose and treat maternal syphilis crucial for reducing stillbirth rates in this region [21]. Malaria also contributes to an unknown number of stillbirths in endemic areas, particularly in sub-Saharan Africa, where its impact is believed to be substantial [3, 21]. Preventing maternal malaria through bed nets and intermittent prophylaxis are strategies that could reduce malaria-associated stillbirths [21]. Reducing the incidence of prolonged labor to prevent bacterial chorioamnionitis may also play a role in decreasing stillbirth rates, though the extent of this reduction is not well-established [21]. Additionally, appropriate maternal vaccination against conditions such as polio, rubella, and other childhood diseases that can cause stillbirths could help eliminate some stillbirths altogether [7, 16].

3. Addressing the dual burden: Too Little, Too Late and Too Much, Too Soon

The "Too Little, Too Late" (TLTL) and "Too Much, Too Soon" (TMTS) paradigms represent the dual burden faced by women in LMICs during childbirth and the postpartum period. TLTL refers to the insufficient, delayed, or inappropriate care provided to women, particularly in rural or underserved areas [11]. This includes the lack of timely interventions, inadequate monitoring, and insufficient follow-up care, leading to preventable maternal and neonatal complications [3, 11, 13].

On the other hand, TMTS refers to the over-medicalization of childbirth, where unnecessary interventions are performed, often leading to adverse outcomes [14, 16]. In LMICs, TMTS can occur in urban settings where private healthcare providers may prioritize profit over patient care [3]. Both TLTL and TMTS contribute to poor postpartum outcomes and highlight the need for balanced, evidence-based, and patient-centered care approaches [3, 9, 11, 14]. This section delves into the consequences of these paradigms and discusses strategies to strike a balance between under- and over-medicalization in postpartum care.

Despite progress in reproductive, maternal, newborn, and pediatric health, significant disparities persist in low- and middle-income countries (LMICs). Each year,

approximately 4.5 million infants are either stillborn or die within the first week of life, and nearly 300,000 women worldwide die during childbirth, with most of these deaths occurring in LMICs [5, 16]. Most of these maternal deaths are preventable with proper care. Reducing maternal mortality is a key focus of the Sustainable Development Goals (SDGs), which aim to lower the global average maternal mortality rate to 70 per 100,000 live births [6, 9, 18]. Additionally, the SDGs set a national target that by 2030, no country should have a Maternal Mortality Ratio (MMR) exceeding 140 per 100,000 live births. Targets were also established to reduce each nation's newborn mortality rate and stillbirth rate to 12 or fewer per 1000 live births and total births, respectively [6, 18]. However, despite an average annual reduction of 2.9% between 2000 and 2017, nearly 300,000 maternal and neonatal deaths occurred in LMICs in 2017 [3, 15].

A study revealed that pregnant women from low-income groups receive poorer care compared to those from middle-income groups, with the most disadvantaged women being 60% less likely than their least disadvantaged counterparts to receive antenatal care [4, 5]. Poor maternal care quality hampers progress in improving maternal and perinatal outcomes. In many cases, inadequate care stems from an emphasis on facility births in settings that lack sufficient staff, training, infrastructure, equipment, and evidence-based clinical practices [3, 13]. This inadequate care is often referred to as "Too Little, Too Late" (TLTL). Conversely, the overmedicalization of childbirth has become widespread, particularly in middle-income countries, as facility use has rapidly increased [4, 17]. This excessive medicalization, termed "Too Much, Too Soon" (TMTS), can undermine the benefits gained from improvements in maternal and perinatal health [5, 14]. The TLTL and TMTS paradigms illustrate the growing diversity and divergence in maternal health care practices. Individual healthcare providers in facilities can mitigate the risks of TLTL and TMTS by adhering to evidence-based clinical guidelines such as Respectful Maternity Care (RMC).

4. Respectful Maternity Care (RMC) and its impact on postpartum outcomes

Respectful Maternity Care (RMC) is an approach that emphasizes the dignity, autonomy, and human rights of women during childbirth and the postpartum period [4, 9]. It involves providing compassionate care, ensuring informed consent, and protecting women from abuse and neglect, which are unfortunately common in many healthcare settings in low- and middle-income countries (LMICs) [7, 11]. RMC is increasingly recognized as a fundamental aspect of safe motherhood, as it goes beyond preventing mortality and morbidity to uphold women's fundamental rights, including their right to autonomy, dignity, and informed decision-making [1, 10]. The World Health Organization (WHO) has identified Respectful Maternity Care as a fundamental human right, essential for the health and well-being of both mothers and their children [18].

Despite advancements in reproductive, maternal, newborn, and pediatric health, significant disparities persist in LMICs. For example, only 14% of women in sub-Saharan Africa receive all essential medical care, including at least one antenatal care (ANC) visit, four or more ANC visits, childbirth with a skilled birth attendant, a postnatal check (PNC) within 24 hours, and family planning services within a year of giving birth [8, 11]. Women and their families often express dissatisfaction with facility-based services due to issues such as rude and uncaring attitudes from providers, inadequate privacy, discrimination against cultural practices, physical abuse,

unclean facilities, and delays in receiving care [17, 19]. These challenges frequently deter women from seeking facility-based care for childbirth or complications, exacerbating existing health disparities.

The World Health Organization (WHO) and other organizations advocate for the use of skilled attendants during childbirth [8, 18]. However, the training and capabilities of these caregivers vary significantly. Many lack the skills to perform cesarean sections, administer blood transfusions, or provide antibiotics—critical interventions that can save lives. Without access to these essential resources, even the most skilled attendants may have a limited impact on reducing maternal mortality. It is crucial to recognize that the availability of blood, uterotonics, antibiotics, and the necessary facilities and equipment for life-saving interventions, such as cesarean sections, are just as important as the presence of skilled attendants [2, 7].

In LMICs, the successful implementation of RMC requires a multifaceted approach. This includes a focus on education and professional development for healthcare providers, creating enabling environments that support respectful care, and integrating RMC principles into existing healthcare systems [8, 9]. Formal education, continuous professional development, and mentorship are essential for maintaining high standards of RMC [9, 21]. Health facilities can further foster respectful care by establishing quality improvement teams, monitoring instances of poor treatment, providing ongoing mentorship, and improving staff working conditions [1, 20]. Additionally, it is crucial for health systems to be structured in a way that supports healthcare practitioners and ensures adequate infrastructure in maternity wards to deliver respectful care to pregnant women [11, 12].

Several practices can enhance RMC, contributing to better outcomes for both mothers and babies:

- Continuous labor support: Continuous support during labor has been shown to improve maternal satisfaction, reduce the need for medical interventions, and contribute to a positive birthing experience [3, 13, 17].

- Effective pain management: Offering proper pain relief options, such as epidurals or other pharmacological methods, can make labor more comfortable and less stressful for women [10, 19].

- Personalized care and communication: Tailoring care to each woman's unique needs and preferences, while involving her in decision-making, fosters respect and autonomy. Effective communication between women and healthcare providers is crucial, ensuring clear and understandable explanations of options and procedures [11, 15].

- Evidence-based, non-invasive practices: Adopting evidence-based practices and minimizing unnecessary medical interventions can reduce the risk of unwanted procedures and potential harm [1, 3]. This includes promoting physiologically normal childbirth, decreasing the routine use of episiotomies, and respecting women's choices regarding labor and delivery positions [17, 18].

- Postpartum care and support: Comprehensive postpartum care is vital for achieving the best outcomes for both mothers and babies. This care should address physical and emotional needs, support breastfeeding, and provide guidance on newborn care [4, 15].

Respectful Maternity Care is essential for ensuring safe motherhood and enhancing postpartum outcomes, particularly in resource-limited settings. By focusing on the dignity, autonomy, and human rights of women, and by implementing evidence-based practices, health systems can make significant strides in improving maternal and newborn health [11, 17, 18]. Establishing supportive environments for healthcare providers and integrating RMC principles into existing healthcare systems are critical steps in achieving these goals in LMICs [6, 21].

5. Leveraging technology to improve postpartum care

Technology, particularly mobile health (mHealth), has the potential to revolutionize postpartum care in LMICs by providing women with access to information, support, and services. mHealth applications can offer health education, reminders for postnatal check-ups, and even remote consultations with healthcare providers, bridging the gap in postpartum care in resource-limited settings [9, 10, 12]. This section explores the potential of mHealth in postpartum care, the challenges in implementing digital health interventions, and lessons learned from successful case studies. It also highlights the importance of user-centered design, iterative testing, and community engagement in developing effective mHealth solutions.

The widespread use of mobile phones in low- and middle-income countries (LMICs) offers a valuable opportunity to explore how this communication channel can be leveraged to enhance maternal, newborn, and child health (MNCH). Numerous initiatives have attempted to capitalize on the extensive reach of mobile phones for health interventions [3, 8]. However, studies have shown that the successful implementation of mHealth interventions in LMICs is often hindered by several challenges, including a lack of government support and ownership, inadequate infrastructure and equipment, shortages in human resources and skills, insufficient legislation, unreliable or insufficient power supply, lack of sustainable funding, and weak evaluation mechanisms [4, 12].

In resource-limited settings, where healthcare infrastructure is often inadequate, digital health solutions can offer timely and cost-effective support to both healthcare providers and patients. For postpartum care, mHealth applications can provide continuous support to new mothers through reminders for postnatal check-ups, health education, and mental health screening, which are crucial for preventing complications such as postpartum depression [19, 20]. Similarly, during intrapartum care, digital tools can facilitate real-time communication between remote health workers and specialists, ensuring that critical decisions are made quickly and based on the latest evidence [3, 14, 20]. By improving the coordination of care, offering remote monitoring, and enhancing the training of healthcare providers through e-learning platforms, digital health interventions can help reduce maternal and neonatal mortality rates in LMICs [3, 8, 14]. A study on a digital health program in Kenya offers crucial insights for ongoing digital health interventions aimed at antenatal and postnatal mothers in informal settlements [3]. The high rates of enrollment and user engagement observed in the study provide evidence of the potential effectiveness of digital health tools in improving antenatal and postnatal outcomes in these settings [3]. However, the findings also underscore the importance of tailoring technology solutions to the specific needs of the populations they serve to achieve optimal outcomes and maximize coverage and adoption [1, 5]. The high levels of user engagement among those enrolled, along with observed changes in care-seeking behavior

and knowledge, indicate a promising opportunity to use digital health interventions to address other MNCH outcomes [3].

6. Conclusion and future directions

The chapter has highlighted the significant challenges facing postpartum care in LMICs, including disparities in access to care, the dual burden of TLTL and TMTS, and the need for Respectful Maternity Care. It has also explored the potential of mHealth technology to bridge the gap in postpartum care.

Future efforts to improve postpartum care in LMICs should focus on strengthening healthcare systems, increasing access to skilled birth attendants, and ensuring the availability of essential medicines and equipment. Addressing the social determinants of health, such as poverty and gender inequality, is also crucial for improving maternal and neonatal health outcomes. Stakeholders, including governments, non-governmental organizations, and the international community, must prioritize postpartum care as a critical component of maternal and child health. By investing in healthcare infrastructure, supporting innovative interventions, and promoting policies that ensure equitable access to quality postpartum care, we can bridge the gap and improve health outcomes for women and newborns in LMICs.

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Chapter 5

Understanding the Genitourinary Syndrome of Lactation (GSL)

Sara Perelmuter

Abstract

Postpartum women often experience a range of genitourinary symptoms during lactation, collectively termed Genitourinary Syndrome of Lactation (GSL). GSL encompasses symptoms such as vaginal atrophy and dryness, dyspareunia, urinary issues, and sexual dysfunction that significantly impact the quality of life. These symptoms arise from hormonal changes and physiological alterations in the genitourinary tract during lactation. Although GSL is highly prevalent, it often goes unrecognized in clinical practice, resulting in underdiagnosis and insufficient treatment. This chapter provides a comprehensive overview of GSL, detailing its physiology and clinical manifestations, diagnostic methods, and wider health implications. It explores the hormonal dynamics of lactation, emphasizing the role of estrogen in maintaining genitourinary health. The chapter discusses the prevalence of vaginal atrophy and dryness, dyspareunia, and urinary health issues among lactating individuals. It highlights the need for effective assessment tools and standardized protocols to improve diagnosis and management. By enhancing clinical understanding of GSL, this chapter aims to promote better health outcomes and quality of life for postpartum women. Equipping healthcare providers with this essential knowledge fosters a more supportive and informed approach to managing the genitourinary health of lactating women.

Keywords: postpartum, lactation, breastfeeding, vaginal atrophy, urinary incontinence, dyspareunia, sexual health, genitourinary heath

1. Introduction

Postpartum women often experience a range of genitourinary symptoms during lactation, many of which go unrecognized. The term "genitourinary syndrome of lactation" (GSL) was recently introduced to highlight this complex state [1]. GSL encompasses various symptoms including vaginal atrophy and dryness, dyspareunia, urinary issues, and sexual dysfunction, all of which can significantly impact the quality of life for affected individuals.

GSL results from the complex interaction between hormonal shifts during lactation and physiological changes in the genitourinary tract. Despite its common occurrence and significant impact on maternal health, GSL remains largely

underrecognized in clinical practice, leading to frequent underdiagnosis and suboptimal treatment. A deeper understanding of GSL is crucial for both patients and healthcare providers, enabling improved recognition, management, and support throughout the postpartum period.

This chapter aims to offer an in-depth exploration of GSL, including its pathophysiology, clinical presentation, diagnostic approaches, and its broader effects on the health and quality of life of lactating women.

2. Physiology of lactation

2.1 Hormonal dynamics during lactation

Pregnancy progresses through multiple stages that are distinct from one another, each impacting breast development and lactation. In the first trimester, estrogen plays a crucial role in initiating breast changes, such as the enlargement of the areola and the maturation of type 3 lobules, which are precursors to milk-producing structures [2]. These changes are influenced by chorionic gonadotropin, which sustains the corpus luteum and promotes the production of estrogen and progesterone. Estrogen stimulates the proliferation of the ductal system, increasing the number and size of milk ducts, while progesterone supports the development of lobules and alveoli, the milk-producing units within the breast.

During the second trimester, progesterone levels rise significantly, driving further lobule proliferation and differentiation [3]. This stage is characterized by the development of lobuloalveolar structures that are essential for milk production. The alveolar cells begin to produce colostrum, a nutrient-rich, antibody-laden fluid crucial for newborn immunity [2]. Progesterone works alongside other hormones, such as prolactin, to prepare the breasts for lactation by increasing the number of alveolar cells and enhancing their secretory capacity.

By the third trimester, the breast tissue undergoes final maturation in preparation for lactation [2]. The alveolar cells become fully mature secretory cells, capable of producing and secreting milk. This process is aided by oxytocin, which promotes the contraction of myoepithelial cells around the alveoli, facilitating milk ejection. The breasts also become more vascularized, ensuring an adequate blood supply to support the milk production. Estrogen and progesterone levels remain high during this period to maintain the structural integrity of the breast tissue and prepare for the imminent lactation.

After delivery, Stage II lactation begins, defined by a reduction in progesterone and an increase in prolactin which triggers milk build-up in the alveoli and ducts [3]. High levels of prolactin lead to the decreased ovarian production of androgens and estrogens. The underlying mechanism involves hyperprolactinemia causing inhibition of hypothalamic Kiss1 neurons, whose role is to regulate the pulsatile release of Gonadotropin-releasing hormone (GnRH). Kiss1 codes for kisspeptin, a neuropeptide that is the most powerful stimulator of GnRH secretion and plays a pivotal role in the proper functioning of the hypothalamus-pituitary-ovarian (HPO) axis [4–6]. Prolactin inhibits GnRH and Kiss1 mRNA expression, in turn disrupting luteinizing hormone (LH) pulse amplitudes, thereby leading to the suppression of ovarian function and consequently, reduced levels of androgens and estrogen [6]. It is important to emphasize that while estrogen and progesterone are required for mammary gland development and during the final months

of pregnancy, their levels fall at delivery, enabling an increase in prolactin which initiates milk production [7]. After lactation is initiated, its continuation relies on prolactin, which, as mentioned, inhibits the release of estrogen and androgens [3].

Although the precise mechanisms that govern changes in the hypothalamus-pituitary-ovarian (HPO) axis during lactation are not yet fully understood, a general overview of the events leading to the postpartum hypoestrogenic state can be outlined. Suckling is the primary stimulus responsible for maintaining the suppression of ovarian activity after pregnancy. Breastfeeding raises prolactin levels, which remain elevated until the frequency and duration of daily suckling decrease enough to reset the HPO axis. Hyperprolactinemia suppresses hypothalamic Kiss1 neurons, which directly regulates the pulsatile secretion of GnRH. This disruption in the pulsatile release of GnRH leads to a notable reduction in the frequency of LH pulses. As a result, insufficient secretion of LH and follicle-stimulating hormone (FSH) causes a decrease in estrogen and androgen levels (**Figures 1**).

Consequently, lactating women experience a hypoestrogenic and hypoandrogenic state that can persist as long as lactation continues. Lactation reduces the likelihood of subsequent pregnancy, which, from an evolutionary perspective, could interfere with the care of the infant. Prolactin's suppression of GnRH and gonadotropins inhibits folliculogenesis and aromatase activity, further reinforcing the hypoestrogenic state, similar to what occurs during menopause. This demonstrates both the significant impact and the commonality of the postpartum hypoestrogenic condition.

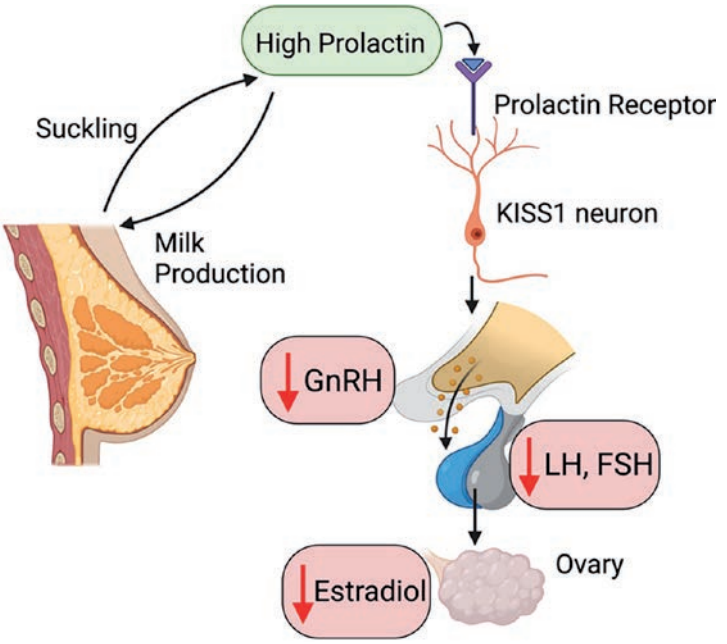

Figure 1.
Lactation-induced hormonal shifts elevate prolactin, resulting in decreased ovarian production of androgens and estrogen. As a consequence, the lactating woman experiences a hypoestrogenic and hypoandrogenic state, which may persist as long as lactation is continued. Prolactin suppresses gonadotropin-releasing hormone and gonadotropin, which in turn blocks folliculogenesis and aromatase enzymes. This further potentiates a hypoestrogenic state [2].

2.2 Impact of hormonal changes on genitourinary health

2.2.1 Tissue health

Estrogen plays a critical role in maintaining the health of the genitourinary tract. Estrogen receptors (ERs) are widespread throughout the female genitourinary system, located in the clitoris, bladder trigone, urethra, and vulvovaginal epithelium [8]. These receptors facilitate the effects of estrogen, promoting the proliferation and maintenance of epithelial and connective tissues. Indeed, estrogen is essential for preserving vaginal wall thickness, lubrication, and the structural integrity of the urethra and vulva [9]. Additionally, estrogen significantly contributes to the integrity of collagen and other connective tissues within the vulva and vagina. Collagen provides the necessary tensile strength and elasticity to the vaginal and vulvar tissues, ensuring their resilience and ability to stretch and recover, especially during sexual activity and childbirth.

Decreased levels of estrogen, such as those observed during lactation, can lead to atrophy of these tissues. Without adequate estrogen, the collagen fibers become less dense and organized, resulting in thinner, less elastic tissues [10]. This atrophy can cause vaginal dryness, decreased elasticity, and increased fragility, making the tissues more susceptible to tears and injuries. The reduction in tissue integrity and resilience can contribute to dyspareunia and other forms of discomfort during intercourse.

2.2.2 Maintenance of pH

Estrogen supports the growth of *Lactobacillus* species in the vagina by maintaining glycogen levels [11, 12]. Mechanistically, estrogen stimulates the maturation, proliferation, and glycogen accumulation in vaginal epithelial cells [13, 14]. Glycogen from exfoliated and lysed epithelial cells is catabolized by α-amylase in the vaginal lumen into smaller polymers, which are then metabolized to lactic acid by *Lactobacillus* [15]. In turn, lactic acid, along with cytolysin produced by *Lactobacilli*, promotes the lysis of epithelial cells, enhancing glycogen availability. Additionally, the lactic acid acidifies the vaginal environment, such that lactobacillus colonization is crucial for maintaining an acidic vaginal pH [15].

The pH of the vagina is a crucial health equilibrium factor influenced by hormonal changes. Estrogen helps maintain an acidic environment in the vagina, which is essential for protecting against pathogenic bacteria and infections. High levels of *Lactobacillus* species, sustained by estrogen, produce lactic acid, contributing to a healthy vaginal pH [16]. A decrease in estrogen can disrupt this balance, leading to a higher pH and increased susceptibility to infections.

2.2.3 Vascularity

Androgens work synergistically with estrogen to sustain the vascularity and function of vaginal tissues. Androgen receptors are abundant in the dermis of the labia minora and vestibule and are present throughout the genitourinary tract, as confirmed by various methods such as Western blot, immunohistochemistry, ligand binding, and gene expression studies [17, 18]. These receptors play a role in promoting vascular congestion, which allows transudate to flow through the epithelium, thereby lubricating the vaginal walls [19]. In contrast, progestins suppress the growth of smooth muscle cells, leading to reduced vasodilation and decreased lubrication.

Vascularity in the vulva and vagina is vital for proper physiological and sexual function. Estrogen plays a crucial role in maintaining the health of the vascular network by promoting the growth and maintenance of blood vessels in the vulvovaginal tissues. It enhances blood flow to these areas, ensuring that tissues are well-nourished and capable of responding appropriately during sexual arousal [20, 21]. Estrogen facilitates vasodilation, which increases blood supply, contributing to tissue lubrication and elasticity [22]. Androgens also contribute significantly to vascular health in the genitourinary tract. They maintain the vascular structures by promoting the proliferation of blood vessels and enhancing vascular congestion [23]. This vascular congestion is essential during sexual arousal, as it allows transudate to flow through the epithelium and lubricate the vaginal walls, thus facilitating comfortable and pleasurable sexual activity. Androgen receptors, which are abundant in the dermis of the labia minora and vestibule, play a key role in this process by mediating the effects of androgens on the vascular tissues [17].

A lack of these hormones, namely estrogen, can lead to significant dysfunction in the vascular network. Reduced levels of estrogen can result in decreased blood flow and diminished tissue lubrication, leading to vaginal dryness and atrophy [20]. This can cause discomfort and pain during intercourse, known as dyspareunia. Similarly, low androgen levels can impair vascular congestion, reducing the blood supply to the vulvovaginal tissues and compromising their ability to lubricate adequately. The absence of adequate vascular support due to hormonal deficiencies can also contribute to the development of vulvodynia and vestibulodynia [24]. In these conditions, the reduced vascular supply can lead to tissue hypoxia and nerve irritation, exacerbating pain and discomfort. Furthermore, progestins, which inhibit smooth muscle cell growth and vasodilation, can counteract the beneficial effects of estrogen and androgens, further inhibiting lubrication and contributing to sexual dysfunction [25, 26].

Overall, the intricate balance of hormones is essential for maintaining the vascular health of the vulvovaginal tissues. Disruptions in this balance can lead to significant physiological and sexual dysfunction, highlighting the importance of hormonal regulation in genitourinary health.

2.2.4 Lubrication

Vaginal dryness is a prevalent and often distressing condition experienced by many postpartum women, particularly those who are breastfeeding. The manifestation of this symptoms is closely linked to hormonal changes that occur during lactation [27–29].

The physiological process of vaginal lubrication is complex and relies heavily on adequate estrogen levels. Estrogen helps maintain the health and function of the vaginal epithelium, the tissue lining the vaginal walls. Under the influence of estrogen, the vaginal epithelium becomes thick and well-vascularized, which is essential for proper lubrication. Estrogen promotes blood flow to the vaginal tissues, ensuring that they are well-hydrated and capable of producing the mucus and transudate (fluid) that contribute to lubrication. During sexual arousal, increased blood flow to the vaginal and vulvar tissues leads to vascular congestion, which causes the capillaries in the vaginal walls to become engorged. This engorgement allows plasma, the fluid part of blood, to seep through the walls of the capillaries and into the vaginal lumen, providing a natural lubricant.

The reduction of estrogen levels disrupts these aforementioned processes, leading to decreased lubrication and consequently vaginal dryness, discomfort, and even pain

during sexual intercourse [30]. Understanding the impact of these hormonal shifts on vaginal health is essential for providing effective care and support to postpartum women.

3. Clinical manifestations of GSL

3.1 Vulvovaginal atrophy

Vulvovaginal atrophy is a common but often under-discussed condition that can significantly impact postpartum women, particularly those who are breastfeeding. The hormonal shift that occur during lactation, namely the hypoestrogenic and hypoandrogenic state, play a pivotal role in the development of vulvovaginal atrophy. Estrogen is crucial for maintaining the thickness, elasticity, and lubrication of the vaginal and vulvar tissues. When estrogen levels drop, as they do during lactating, these tissues can become thin, dry, and less elastic, leading to discomfort and other symptoms.

Few studies have investigated the hypoestrogenic and hypoandrogenic state associated with lactating in relation to vulvovaginal atrophy. However, existing literature highlights a significant prevalence of these conditions among breastfeeding women. Masters and Johnson, research pioneers of the human sexual response, observed and compared visual examinations of breastfeeding and non-breastfeeding mothers consecutively at 4, 8, and 12 weeks postpartum [31]. They reported noticeable changes in the vaginal mucosa of breastfeeding mothers, including flattened rugal patterns, a "senile"-appearing light pink color, and a "steroid starvation pattern." A study by Lev-Sagie et al. found that vulvovaginal atrophy was significantly more common in breastfeeding women as compared to non-breastfeeding women [32]. This finding remained significant across three different atrophic criteria: gynecological examination (57.6% vs. 16.7%), pH measurement (70% vs. 22%), and cytologic evaluation (Vaginal Maturation Index, VMI; 51.1% vs. 0%) [32]. Despite the different diagnostic methods, this study consistently found a high prevalence of vaginal atrophy in the lactating population.

A study by Wisniewski and Wilkinson identified lactation as a potential contributing factor to postpartum vaginal atrophy [33]. Their findings showed that 67.6% of breastfeeding mothers experienced vaginal atrophy, compared to 32.4% of non-breastfeeding mothers [33]. The authors concluded that lactation was significantly associated with vaginal atrophy ($p < 0.0001$) [33]. However, they also highlighted individual differences in estrogen receptor sensitivity and the peripheral conversion of androstenedione to estrone in adipose tissue as factors that may influence this relationship.

3.2 Vaginal dryness

Low estrogen levels, such as those experienced during lactation, can disrupt the physiological process of lubrication detailed above in several ways. Firstly, reduced estrogen leads to thinning and atrophy of the vaginal epithelium, making the tissue less capable of retaining moisture and producing adequate lubrication. The decreased blood flow to the vaginal tissues results in less vascular congestion and, consequently, reduced transudate production. Furthermore, the secretion from the Bartholin's and Skene's glands is diminished, exacerbating the dryness.

Lactation-induced hormonal changes have been consistently correlated with vaginal dryness. Both historical [27] and recent studies [28, 29] report that breastfeeding women are more likely to experience vaginal dryness compared to those who are not breastfeeding. For instance, a study found that breastfeeding women reported vaginal dryness more frequently at both 3 weeks (13.3 vs. 3.8%) and 6 weeks (17.5 vs. 2.3%) postpartum [9]. Other studies focusing on self-reported sexual behavior and dysfunction have also identified vaginal dryness as a common concern among breastfeeding women [30]. This condition can lead to discomfort, irritation, and pain during intercourse, significantly impacting the quality of life. Despite its prevalence, there has been limited attention, screening, or management of vaginal dryness in the postpartum lactating population.

3.3 Vulvovaginal tears and wound healing

The role of estrogen in wound healing is also crucial, particularly post-birth when women are likely to experience vaginal tears or other tissue injuries. Estrogen enhances the proliferation of epithelial cells and the formation of granulation tissue, both of which are vital for effective wound healing [34]. It also promotes angiogenesis, the formation of new blood vessels, which is essential for delivering nutrients and oxygen to the healing tissues [35].

In the postpartum period, the demand for effective healing processes is paramount as the body repairs injuries sustained during childbirth. However, if estrogen levels are low due to lactation, the healing process may be impaired. Reduced estrogen can lead to slower epithelialization, weaker collagen formation, and diminished angiogenesis, thereby prolonging wound healing and delaying full recovery [34, 36]. This impaired healing can result in prolonged pain and discomfort for new mothers, affecting their overall quality of life and ability to care for their newborns.

Estrogen plays a crucial role in promoting the growth of keratinocytes and enhancing re-epithelialization [37, 38]. A decrease in estrogen levels leads to reduced wound collagen, resulting in impaired healing. Estrogen deficiency is linked to lower expression of growth factors, diminished keratinocyte proliferation, and increased production of wound proteases, all of which contribute to delayed re-epithelialization [37]. Studies have shown that administering exogenous estrogen can counteract the breakdown of the extracellular matrix by inhibiting wound protease production and promoting collagen formation during the repair phase [39]. Research on postmenopausal women treated with hormone therapy (HT) has demonstrated that their levels of matrix collagen deposition as well as wound re-epithelialization were comparable to those of premenopausal women, whereas women not on HT showed diminished collagen formation and slower re-epithelialization [40, 41]. These improvements with estrogen administration were credited to increased proliferation of epidermal keratinocytes [41].

Considering this, it is plausible that lactating women, who are in a hypoestrogenic state, may experience delayed or impeded recovery compared to postpartum women who are not breastfeeding. However, no studies have specifically explored this potential relationship. This gap in research highlights the need for further studies to explore the impact of low estrogen levels on postpartum recovery, particularly in lactating women. Therefore, understanding the role of estrogen in tissue integrity and wound healing is vital, especially in the context of the postpartum period. Addressing and managing low estrogen levels during lactation can be crucial for ensuring efficient and timely recovery from childbirth-related injuries, ultimately supporting better health outcomes for both mother and baby.

3.4 Urinary health

3.4.1 Postpartum urinary incontinence

Postpartum urinary incontinence (UI) is a significant but frequently underestimated aspect of maternal health that requires greater clinical attention due to its prevalence and impact on quality of life. UI affects approximately 31% of women at 1 year postpartum, with the reported rates ranging from 10 to 63% [42]. Stress urinary incontinence (SUI) is the most common type, affecting 54% of women at 1-year postpartum [42]. This condition can be emotionally distressing and shameful for women, leading to a decrease in their overall quality of life [43].

Numerous clinical studies have attempted to identify specific obstetric events that contribute to incontinence. Potential factors include delivering large infants and difficult labor, particularly when the second stage of labor is prolonged, with or without the use of operative tools such as forceps or vacuum. However, no single precipitating factor has been conclusively linked to postpartum urinary incontinence, suggesting that it likely arises from a complex interaction of physiological factors. These underlying physiological changes can lead to not only urinary leakage but also pelvic organ prolapse (such as cystocele, rectocele, and uterine prolapse) and anal incontinence, all of which can cause significant distress. Despite their common occurrence, these pelvic floor issues often receive little attention.

Notably, there is a well-established link between stress urinary incontinence (SUI) and collagen. Studies show that patients with SUI have significantly lower levels of Type I and Type III collagen compared to controls ($p < 0.01$) [44]. Additionally, recent research has demonstrated that topical estriol therapy can alleviate SUI symptoms. A prospective study evaluating SUI symptoms before and after 6 weeks of topical estriol treatment reported improvements in the Urogenital Distress Inventory (UDI) stress domain [45]. Another study found significant improvements in SUI outcomes after 12 weeks of vaginal estriol cream use in postmenopausal women with stress incontinence [46]. It is important to note that estriol, the form of estrogen used in these studies, is not currently available in the United States. These findings suggest that estrogen supplementation can improve UI symptoms, implying that low estrogen levels may contribute to the development of UI. Therefore, individuals with reduced estrogen, such as postpartum lactating women, may be more prone to experiencing UI symptoms.

However, there is a notable gap in the literature and data regarding the impact of the hypoestrogenic state associated with postpartum breastfeeding on urinary incontinence (UI). Specifically, do breastfeeding women experience prolonged UI compared to those who do not breastfeed? We hypothesize that breastfeeding women may experience UI and other urinary symptoms similar to those observed in Genitourinary Syndrome of Menopause (GSM). Future research is needed to explore the relationship between postpartum UI and lactation, to better understand and address this condition in new mothers.

3.4.2 Urinary tract infections and other urinary health issues

In addition to urinary incontinence, low levels of estrogen during lactation can contribute to other urinary health issues such as urinary tract infections (UTIs), as well as increased urinary frequency, and urgency.

Estrogen is essential for maintaining the health of the urinary tract by supporting the epithelial lining of the urethra and bladder, enhancing blood flow, and promoting an

acidic environment that inhibits the growth of harmful bacteria. During lactation, the hypoestrogenic state can lead to thinning of the urethral and bladder epithelium, reducing its protective barrier and making it more susceptible to infections. The decrease in estrogen also affects the production of mucopolysaccharides, which play a crucial role in preventing bacterial adhesion to the urinary tract walls. Namely, estrogen plays a vital role in maintaining lactobacilli population in the vaginal canal by producing glycogen for lactobacilli consumption [13, 14]. In turn, lactobacilli provide protection from other pathological bacteria by producing hydrogen peroxide (H_2O_2), bacteriocins, and biosurfactants, and by preventing pathogen attachment to the epithelium through competitive exclusion [15]. They also promote the autophagy of infected epithelial cells. Additionally, the vaginal defense is strengthened by the production of mucins, immunoglobulins (secretory IgA and IgG), secretory leukocyte protease inhibitor (SLPI), neutrophil gelatinase-associated lipocalin (NGAL), β-defensins, and other antimicrobial proteins, providing a robust first line of defense against infections [15].

As a result of the decreased levels of estrogen in postpartum lactation, the population of lactobacilli is not supported due to the failure of glycogen support from estrogen. As such, the protective effects of lactobacilli are lost and consequently, breastfeeding women may experience a higher incidence of UTIs. Indeed, studies have shown that UTIs are more common in postpartum women, particularly those who are breastfeeding [47, 48]. Symptoms of UTIs include dysuria (painful urination), increased urinary frequency, and urgency. These symptoms can be particularly bothersome and impact the quality of life, adding to the challenges of postpartum recovery.

Moreover, the low estrogen levels associated with lactation can contribute to increased urinary frequency and urgency. The reduction in estrogen may lead to overactivity of the bladder muscles, causing a frequent need to urinate and a sense of urgency [49, 50]. This can be particularly inconvenient for new mothers who are already coping with the demands of caring for a newborn.

Taken together, the hypoestrogenic state during lactation can have several negative impacts on urinary health, including an increased risk of urinary incontinence, urinary tract infections, and symptoms of frequency and urgency. Understanding these risks and addressing them through appropriate management strategies are crucial for improving the overall health and well-being of postpartum women. Further research is needed to explore these issues in greater depth and develop effective interventions for lactating mothers.

3.5 Dyspareunia

Dyspareunia, or painful intercourse, is notably more prevalent in breastfeeding women compared to their non-breastfeeding counterparts. Studies have shown that approximately 80% of breastfeeding women experience dyspareunia, as opposed to 50% of non-breastfeeding women. Interviews conducted at 12 weeks postpartum have also revealed that 10.9% of lactating postpartum participants reported vaginal tightness and 46.5% reported vaginal irritation or dyspareunia [31]. Others have noted that dyspareunia at 6 months postpartum was significantly associated with current breastfeeding [30].

However, it is crucial to adopt a biopsychosocial approach when studying and diagnosing dyspareunia, as pain is complex and multifaceted. Postpartum sexuality can be influenced by a range of factors, including new psychological stressors, health complications from the peripartum period, and the physiological changes that

accompany breastfeeding and postpartum recovery. Furthermore, perineal trauma from vaginal delivery, delayed healing of episiotomies, or spontaneous perineal tears can also contribute to sexual difficulties during this time.

3.6 Sexual dysfunction

Sexual dysfunction is a common concern among postpartum women. The hypoestrogenic state induced by lactation significantly impacts sexual health, leading to various manifestations of sexual dysfunction, including changes in libido, arousal, desire, lubrication, and orgasm [9, 51, 52]. These issues can profoundly affect the quality of life and intimate relationships of new mothers.

The hypoestrogenic state during lactation leads to reduced vaginal lubrication as previously mentioned, contributing to discomfort and pain during sexual activity [53]. Estrogen is essential for maintaining the health and function of the vaginal epithelium, promoting blood flow, and supporting the production of natural lubricants. When estrogen levels drop, the vaginal tissues become thinner, drier, and less elastic. This reduction in lubrication can cause significant discomfort, irritation, and pain during intercourse, further exacerbating the problem of dyspareunia [53]. Physical discomfort can reduce sexual desire, creating a cycle of avoidance and decrease sexual activity. Additionally, sexual desire is significantly influenced by hormonal changes, particularly the levels of estrogen, which fluctuate considerably during the postpartum period [54]. Estrogen plays a crucial role in maintaining libido through influences neurotransmitters dopamine and serotonin, which are involved in regulating mood and desire, such that during a hypoestrogenic lactating state, mood and sexual desire can be diminished [54, 55]. Progesterone is also known to negatively affect sexual desire and the ability to lubricate [51]. Having a reduced libido makes it challenging for new mothers to feel sexually aroused or interested in sexual activity, further exacerbating their sexual dysfunction.

However, the decline in sexual desire during the postpartum period is not solely due to hormonal changes. The biopsychosocial model provides a comprehensive framework for understanding how various factors contribute to changes in sexual desire during this time [56]. Caring for a newborn is demanding and time-consuming, leaving little time or energy for sexual activity. The physical and emotional demands of breastfeeding, sleep deprivation, and constant caregiving can significantly reduce sexual desire. Postpartum fatigue is common and can be overwhelming. The lack of adequate sleep and the need to attend to the baby's needs around the clock can drain energy levels, making sexual activity less appealing. The transition to parenthood involves significant lifestyle adjustments. New responsibilities and changes in daily routines can create stress and reduce opportunities for intimacy, impacting sexual desire. The arrival of a baby can place stress on the couple's relationship. The focus shifts from the couple to the baby, and partners may struggle to find time for each other. This shift can lead to feelings of neglect or frustration, affecting sexual desire. Postpartum depression is a serious condition that affects many new mothers. Symptoms include sadness, anxiety, irritability, and loss of interest in activities, including sex. The hormonal fluctuations, along with the stress and exhaustion of new motherhood, can contribute to the onset of postpartum depression, further diminishing sexual desire.

Taken together, the impact of low estrogen levels on sexual desire during the postpartum period is profound, affecting both the physiological and psychological aspects of sexual function. The hypoestrogenic state leads to physical discomfort and

reduced libido, while the biopsychosocial factors compound these effects, making it difficult for new mothers to maintain a healthy sexual relationship. Understanding these multifaceted influences is crucial for healthcare providers to offer appropriate support and develop effective interventions and management strategies, helping new mothers navigate this challenging period and maintain their overall well-being and intimate relationships.

4. Tools to assess genitourinary health

4.1 Examination and patient interaction

Assessing vulvovaginal health in lactating individuals often involves a detailed visual examination of the vulva, vulvar vestibule including the urethral meatus, and the vaginal mucosa. A comprehensive examination is typically performed using a vulvoscope, which provides magnification and lighting to aid in the detailed visualization of these areas. During a speculum examination, saline microscopy and pH evaluation of vaginal discharge can be employed to assess the health of the vaginal mucosa. Pelvic organ prolapse can also be evaluated during this examination.

Clinicians can observe various indicators such as epithelial thinning, erythema, pallor, dryness, loss of rugation, petechiae, friability, and tenderness in the vulva, vestibule, and vagina. To assess the level of pain, the Visual Analogue Scale (VAS) is often used, where patients rate their pain with a handwritten mark placed at a point along the length of a 10-cm line, which represents a continuum between "no pain" to "worst pain." In addition, standardized questionnaires such as the Female Sexual Function Index (FSFI) are commonly used to evaluate sexual dysfunction. However, there is no universally accepted protocol for routinely evaluating genitourinary symptoms and/or changes in postpartum lactating women. This lack of standardized screening leads to the underdiagnosis of these symptoms, limiting the timely implementation of appropriate treatment strategies.

4.2 Vaginal microbiome and pH

One established method for assessing vulvovaginal atrophy involves measuring vaginal pH. As such, measuring vaginal pH can serve as an indicator of vaginal health. Optimal vaginal pH is 4.5 or lower, while a pH of 5 or greater may indicate vulvovaginal atrophy, desquamative inflammatory vaginitis, or bacterial vaginosis [57]. Utilizing pH measurements as a diagnostic tool can improve sensitivity compared to clinical-based diagnosis alone [32].

4.3 Vaginal Maturation Index (VMI)

The Vaginal Maturation Index (VMI) evaluates vaginal health through cytological assessment. A vaginal sample, from the middle of the vagina, is obtained using a cotton swab and stained with hematoxylin and eosin on a glass slide for analysis. The cells are categorized into mature squamous epithelial cells, intermediate cells, and parabasal cells, each assigned a specific value. The VMI is calculated by multiplying the cell counts by their respective values and dividing by the total number of cells [58]. VMI values between 0 and 49 denote atrophy, 50–64 indicate mild atrophy, and 65–100 suggest a healthy vaginal environment with high estrogen levels. Decreased

levels of vaginal pH align with high VMI values, validating different diagnostic techniques. Furthermore, symptom presentation does not reliably correspond to VMI, highlighting the limitation of only using symptoms to obtain a diagnosis. Despite its potential usefulness, VMI is frequently performed in the research setting and is not often done clinically.

4.4 Vaginal Health Index (VHI)

The Vaginal Health Index (VHI) is a commonly used clinical tool for assessing vulvovaginal atrophy. It evaluates five key parameters: vaginal elasticity, discharge, pH levels, condition of the mucous membranes, and moisture. The total VHI score, ranging from 5 to 25, is obtained by summing the scores for each parameter. A score below 15 indicates the presence of vulvovaginal atrophy, helping to guide diagnosis and treatment based on these specific criteria [59].

4.5 Transabdominal/transvaginal sonography

Transabdominal sonography, traditionally used for visualizing pelvic organs, has been explored as a method for measuring vaginal wall and total vaginal mucosal thickness. A recent pilot study used this technique around the bladder trigone and found an association between vaginal wall thickness and menopausal status or vaginal atrophy [60]. Although this method has not yet been validated, it holds potential as a tool to associate thickness measurements to GSL symptoms and treatment responses for atrophy in the future.

4.6 Summary of tools

Each of these tools offers insights into the assessment of GSL-related symptoms. While visual examinations and patient interactions remain the cornerstone of diagnosis, tools like pH measurement, VMI, VHI, and emerging techniques such as transabdominal sonography provide valuable quantitative data that can aid in the diagnosis and management of vulvovaginal atrophy and related conditions. Standardizing these assessments could improve diagnosis and treatment, ultimately enhancing the quality of life for postpartum lactating women.

5. Conclusion

Lactation during the postpartum period brings about significant hormonal changes that can profoundly impact the genitourinary tract and sexual health of new mothers. The hypoestrogenic state induced by hyperprolactemia in breastfeeding affects vaginal and vulvar tissues, leading to conditions such as vulvovaginal atrophy, vaginal dryness, and dyspareunia, which are often underdiagnosed due to the lack of standardized screening. Estrogen is crucial for maintaining vaginal lubrication, supporting collagen integrity, and aiding in wound healing, and its reduction can impair these processes, making tissues more susceptible to atrophy, trauma, and slow recovery post-delivery. Additionally, urinary health issues such as incontinence, urinary tract infections, and increased frequency and urgency are linked to low estrogen levels. Sexual dysfunction, including decreased libido, arousal, and delayed orgasm, is exacerbated by both hormonal changes and biopsychosocial factors such as the demands of caring for a

newborn, fatigue, lifestyle adjustments, relationship stress, and postpartum depression. Effective assessment tools and standardized protocols are essential for diagnosing and managing these symptoms, highlighting the need for future research and clinical focus on the unique needs of the lactating postpartum population. Healthcare providers must be equipped with the knowledge and tools to support maternal health, ensuring the well-being and quality of life for new mothers during this critical period.

This chapter aims to bridge the knowledge gap in clinical understanding of GSL, promoting better health outcomes and quality of life for postpartum women. By equipping healthcare providers with this essential information, we can foster a more supportive and informed approach to managing the genitourinary health of lactating women.

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Conflict of interest

The author declares no conflict of interest.

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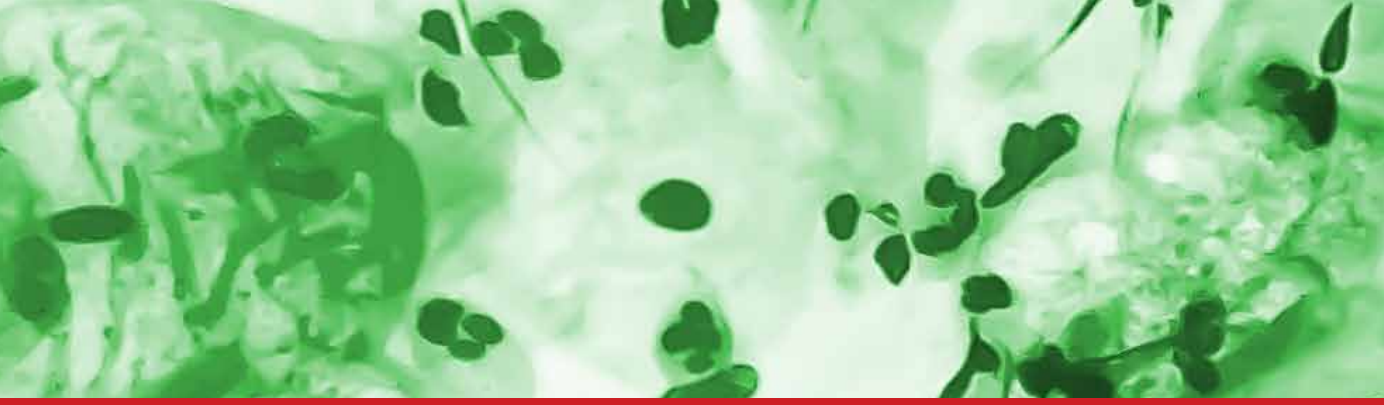

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This Edited Volume, *Postpartum Period for Mother and Newborn*, is a collection of reviewed and relevant research chapters, offering a comprehensive overview of recent developments in the field of obstetrics and gynecology. The book comprises single chapters authored by various researchers and edited by an expert active in the obstetrics and gynecology research area. All chapters are complete in themselves but united under a common research study topic. This publication aims to provide a thorough overview of the latest research efforts by international authors and open new possible research paths for further novel developments.

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