

The Transformative Journey of Pregnancy: Insights into Maternal Adaptations

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Abstract

During pregnancy, a woman's body changes in many ways because of hormones. These changes can sometimes be uncomfortable, but most of the time they are normal and enable her to nourish and protect the fetus, prepare her body for labor, and develop her breasts to produce milk. During pregnancy, changes in hormone levels drive a wide range of physical transformations in a woman's body, all of which play an essential role in supporting and protecting the growing baby. Although these changes can sometimes cause discomfort, their main purpose is to create the best environment for the baby's development and to prepare the mother for both childbirth and breastfeeding. A noticeable transformation takes place in the reproductive system as the uterus enlarges to make room for the developing baby, while the cervix softens and dilates in preparation for labor. At the same time, hormonal changes affect ligaments and joints, making them more flexible to allow the pelvis to widen, which is vital for childbirth. Moreover, hormonal spikes during pregnancy lead to changes in the cardiovascular and respiratory systems. Blood volume rises substantially to deliver essential nutrients and oxygen to the growing fetus, causing adaptations like a higher heart rate and increased circulation. Likewise, lung function adjusts to meet the increased oxygen needs of both the mother and the baby. In addition, hormonal changes promote the development of mammary glands, getting the breasts ready for breastfeeding after birth. This process includes the expansion of milk ducts and the increase of glandular tissue, ensuring the mother can feed her newborn. Overall, despite the challenges posed by pregnancy hormones, they are essential in guiding the extraordinary process of fetal growth and childbirth, ultimately fostering the nurturing connection between mother and child.

Keywords: Pregnancy, hormones, fetus, breast, labor

INTRODUCTION

In the modern nuclear family setup, it is uncommon for pregnant women or new mothers to have immediate access to proper guidance and support.

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This article will explore the various changes that take place during pregnancy in the uterus, cervix, vagina, cardiovascular system, gastrointestinal system, and urinary system, as well as changes in the breasts and skin.

Understanding these normal pregnancy changes can help reassure women who may be worried and allow for quicker detection and intervention if any abnormalities arise. Having a basic understanding of these adaptations is also essential for interpreting the results of laboratory tests conducted during pregnancy at healthcare facilities.

AIMS AND OBJECTIVES

To review basic Physiological changes of the maternal body during pregnancy.

CONCEPTUAL STUDY

Changes in Estrogen and Progesterone

In females, the main reproductive hormones are estrogen and progesterone, both of which play key roles in preparing the uterus for pregnancy and are crucial throughout the pregnancy. During a single pregnancy, a woman produces more estrogen than during her entire life outside of pregnancy. Estrogen helps increase maternal blood flow to the uterus and placenta during pregnancy. Meanwhile, progesterone levels are also significantly elevated, contributing to the enlargement of internal structures like the uterus to accommodate the growing baby. Progesterone also affects blood vessels and joints, which will be explored further in this study session [1].

Changes in the Uterus, Cervix, and Vagina

The Uterus

Following conception, the uterus establishes a supportive and protective environment for the developing fetus. Its size increases considerably, beginning as small as a pear when not pregnant and expanding to accommodate a full-term baby by 40 weeks. During the first 20 weeks, the uterus expands and increases in weight from about 50 g to approximately 1000 g, due to tissue growth. After this point, the uterus does not gain more weight but stretches to make room for the growing baby, placenta, and amniotic fluid. By full term, the uterus expands about five times its normal size: its height grows from 7.5 cm to 30 cm, its width from 5 cm to 23 cm, and its depth from 2.5 cm to 20 cm [2].

The muscles of the uterus undergo hypertrophy and hyperplasia, meaning the muscle fibers increase in size and length, with a limited addition of new fibers. These changes occur under the influence of estrogen and progesterone during the first half of pregnancy. However, in the second half, the enlargement becomes inconsistent as stretching takes over, with the fundus (the upper part of the uterus) enlarging more than the lower portion.

At 12 weeks of pregnancy, near the end of the first trimester, the fundus can be felt above the pubic bone. By 36 weeks, the uterus reaches its largest size. The vascular system also changes, with the blood supply to the uterus coming equally from the uterine and ovarian arteries, unlike in the non-pregnant state where the uterine artery is the main supplier.

As delivery approaches, the uterus may lower slightly as the baby's head moves into the pelvis, a process called "lightening." This is more noticeable in women experiencing their first pregnancy (primigravida) than in those who have been pregnant before (multigravida) [3].

The Cervix

The cervix remains 2.5 cm long throughout pregnancy. In late pregnancy, softening of the cervix occurs in response to increasing painless contractions of its muscular walls [4].

The Vagina

The vaginal wall thickens, becomes swollen, and receives an increased blood supply, making it more vascular. This enhanced blood flow, particularly in the venous plexus around the wall, results in a bluish coloration of the mucous membrane, known as Jacquemier's sign. Vaginal secretions increase, becoming thin and curdy white due to the presence of exfoliated cells and bacteria. The pH of the vagina turns acidic, ranging from 3.5 to 6, because the higher estrogen levels promote the conversion of glycogen to lactic acid by *Lactobacillus acidophilus*. This acidic environment helps prevent the growth of harmful organisms. As pregnancy progresses, the vagina becomes more elastic, allowing it to stretch during the second stage of labor as the baby moves through the birth canal [5].

Pregnancy-Related Changes in Posture and Joints

As the baby grows, a pregnant woman's posture shifts. Her abdomen changes from flat or concave to very convex, making her back curve more. The weight of the fetus, along with the enlarged uterus, placenta, and amniotic fluid, adds pressure to her bones and muscles, often leading to back pain. Activities, such as standing for extended periods, leaning forward, or engaging in physical labor can lead to discomfort. Although back pain is frequently experienced during pregnancy, it can sometimes indicate a kidney infection. Moreover, progesterone causes the ligaments and joints to become more flexible throughout the body, which raises the likelihood of sprains and strains. This increased flexibility, along with changes in posture, makes pregnant women more susceptible to these problems [6].

Changes in Body Weight During Pregnancy

A continuous increase in weight during pregnancy is generally seen as a positive sign of both the mother's adaptation and the baby's growth. However, routine weighing throughout pregnancy is no longer considered essential, as it doesn't consistently reflect pregnancy outcomes. For instance, some women may lose a little weight in the early stages due to nausea and vomiting, commonly known as morning sickness. On average, a woman gains about 11 kg (24 lb) during a pregnancy with a single baby. This weight gain is typically distributed as 1 kg in the first trimester and 5 kg in the second trimester [7].

The expected weight increase for a healthy woman during a typical pregnancy is divided as follows:

Reproductive Weight Gain: 6 kg, Including

1. *Baby*: 3.3 kg.
2. *Placenta*: 0.6 kg.
3. *Amniotic Fluid*: 0.8 kg.
4. *Uterus*: 0.9 kg.
5. *Breasts*: 0.4 kg.

Net Maternal Weight Gain: 6 kg, Including

1. *Increased Blood Volume*: 1.3 kg.
2. *Extra Fluid*: 1.2 kg.
3. *Accumulated Fat and Protein*: 3.5 kg.

In total, weight gain is roughly 2 kg over the first 20 weeks, followed by an increase of about 0.5 kg per week, leading to a total gain of 9–12 kg by the end of pregnancy.

The Value of Weight Monitoring

A single weight check is of limited use, aside from identifying whether a woman is underweighting or overweight. Regular weight monitoring is important to detect any abnormalities. A rapid weight gain of more than 0.5 kg (1 lb) per week, or more than 2 kg (5 lb) in a month in the later stages of pregnancy, may be an early sign of preeclampsia and should be monitored carefully [8].

Factor Affecting the Weight Gain

Underweight or short patients or short patients or underfed patients are likely to gain less weight. All the components are affected with the result that the patient gains weight to the extent of only 6–7 kg. Nutritional supplements and encouraging the patient to eat more during pregnancy and likely to improve weight gain. Obese patients tend to gain more weight during pregnancy, and reducing carbohydrates and fats in their diet can help manage weight gain. Insufficient weight gain is frequently linked to a higher risk of pre-eclampsia, prematurity, dysmaturity, increased perinatal mortality, and difficulties with effective lactation.

A woman carrying more than one baby will experience greater weight gain compared to someone with a single fetus. Additionally, she will need a higher-calorie diet. While insufficient weight gain might not raise concerns for some women, it could suggest that the fetus is not developing properly. Healthcare providers may refer to this condition as intrauterine growth restriction (IUGR) in the fetus.

Changes in the Cardiovascular System

The cardiovascular system comprises the heart, blood vessels (including veins and arteries), and the blood that circulates throughout the body. It acts as a transport system, delivering oxygen and nutrients absorbed from the digestive tract to all the cells, tissues, and organs, allowing them to produce the energy required for their functions. The body's chemical processes create various waste products, which are transported by the blood to the kidneys and liver for elimination. Furthermore, the cardiovascular system is involved in regulating body temperature and transporting hormones and other substances that manage bodily functions. During pregnancy, there are several important changes in this system.

The Heart

The heart may enlarge during pregnancy because of the increased workload. The volume of blood ejected from the heart each minute is referred to as cardiac output. Variation in it during pregnancy is shown in Table 1.

Table 1. Changes in cardiac output during pregnancy.

Woman's Condition	Cardiac Output (Litre Per Minute)
Non-pregnant, resting	2.5
End of 1 st trimester	5
End of 2 nd trimester	6
Full-term	7

The rise in cardiac output during pregnancy is due to two key changes in heart function. First, the resting heart rate, or the number of beats per minute, increases by about 15 beats in pregnant women. Second, the stroke volume, or the amount of blood the heart pumps with each beat, becomes roughly 7 milliliters higher than usual.

Cardiac output is determined by multiplying the heart rate by the stroke volume. By the second trimester, the heart is working 40% harder than it does when the woman is not pregnant. This is largely because the heart becomes more efficient and pumps a greater amount of blood with each beat.

Blood Volume

During pregnancy, blood volume gradually rises by 30–50%, leading to an increase of approximately 1.5 liters of blood by the time of delivery. This heightened blood volume is essential for ensuring sufficient blood flow to the placenta, enabling the transfer of nutrients and oxygen to the fetus. The increase in blood volume is attributed to two primary factors:

1. An increase in the volume of blood plasma, the liquid portion of blood.
2. An increase in the number of circulating red blood cells.

Blood plasma volume begins to rise around the sixth week of pregnancy, reaching a peak of about 50% above non-pregnant levels by the second trimester, and then stabilizes until delivery.

The total red blood cell volume increases by approximately 18% during pregnancy to meet the higher oxygen demands of the mother, placenta, and fetus. Red blood cells contain hemoglobin, an iron-rich protein responsible for transporting oxygen. Taking iron supplements during pregnancy can lead to an increase in red blood cells by up to 30% compared to non-pregnant levels.

Iron is crucial for several bodily functions, including the transport and storage of oxygen. It is a key element of hemoglobin, which gives red blood cells their color. A diet deficient in iron can impair red blood cell production. Additionally, iron is important for the storage and release of oxygen in muscles.

Anemia is primarily characterized by a low hemoglobin concentration in the blood, and it is frequently linked to a decreased red blood cell count. The primary cause of anemia is inadequate iron intake. Hemoglobin levels are expressed in grams per deciliter (g/dL) of blood, with one deciliter equivalent to 10 milliliters (mL).

The World Health Organization advises that a pregnant woman's hemoglobin level should not drop below 11 grams per deciliter (Hb 11 g/dL).

Even though the number of red blood cells increases during pregnancy, the rise in blood plasma volume is much greater. As a result, pregnant women have more red blood cells than before, but they are diluted in the larger plasma volume. This condition is known as physiological anemia, highlighting the importance of adequate iron intake through diet or supplements during pregnancy [9].

Blood Pressure in Pregnancy

Earlier, we mentioned that progesterone contributes to the loosening of ligaments and joints during pregnancy. Additionally, it works alongside other natural substances in the body to promote slight relaxation of the muscular walls of blood vessels. This leads to reduced resistance against blood flow, as the same volume of blood moves through slightly wider vessels.

Blood pressure (BP) refers to the force exerted by blood against the walls of major blood vessels as it is pumped by the heart. Lower BP is particularly common in early pregnancy, and many women experience occasional dizziness during the first trimester due to reduced blood and oxygen reaching the brain. Progesterone can also cause a sudden relaxation of blood vessels, which may result in a sharp feeling of dizziness or even a brief loss of consciousness.

Exercise and Blood Flow in Pregnancy

Weight gain during pregnancy increases the physical demands on a woman's body. Engaging in steady, non-strenuous exercise is beneficial for the mother, as it helps prepare her body for labor. However, intense or sudden physical activity, as well as working long hours without breaks, can lead to dizziness. This dizziness may occur because lower BP and slight physiological anemia are insufficient to meet the body's increased oxygen needs.

Pregnant women should refrain from exercises that involve lying on their backs, as this can compress major blood vessels that return blood to the heart. Intense workouts may reduce blood flow to the uterus since blood is redirected to the muscles, though studies have not indicated any long-term negative effects on the baby. Additionally, pregnant women should avoid vigorous exercise in hot weather or if it causes breathlessness, especially if they have risk factors like a history of miscarriage.

Edema in Pregnancy

If a pregnant woman experiences significant edema, particularly swelling of the face, it is a concerning sign that necessitates immediate referral to the nearest healthcare facility.

This condition can occur due to a combination of factors: a minor increase in the permeability of the smallest blood vessels, which permits more fluid to leak into the tissues; the additional weight of the uterus; and the downward force of gravity.

These factors can hinder the return of blood to the heart from the lower body, resulting in fluid accumulation in the legs and feet, especially after the first trimester. This swelling, known as edema, is common among pregnant women, particularly those who stand for extended periods.

Respiratory Changes

During pregnancy, the volume of air inhaled and exhaled by the lungs increases by nearly 50%, influenced by two key factors:

1. Each breath taken has a larger volume of air.
2. The breathing rate (number of breaths per minute) also experiences a slight increase.

Many women notice they feel short of breath during pregnancy, as the growing baby can restrict the space available for lung expansion. However, if a woman feels weak and fatigued or experiences constant shortness of breath, she needs to be evaluated for potential health issues, such as heart problems, anemia, or inadequate nutrition. Seeking medical advice is recommended if any of these concerns arise.

CHANGES IN THE GASTROINTESTINAL SYSTEM IN PREGNANCY

As we know, food and fluids enter the gastrointestinal system through the mouth, traveling down the esophagus, into the stomach, and through the intestines, with solid waste being expelled through the anus. This extensive pathway from mouth to anus is commonly referred to as the “gut.” In the gut, proteins, fats, and carbohydrates from our diet are digested into smaller units that can be absorbed into nearby blood vessels. This system also serves as the channel through which essential nutrients, such as vitamins and minerals, enter the body.

During pregnancy, the muscles in the walls of the gastrointestinal tract relax somewhat, leading to a slower rate of food passage from the stomach into the intestines. This slowed emptying can result in undesirable effects. As the fetus grows, it exerts pressure on the mother’s stomach, which can lead to indigestion and heartburn. The growing baby may also compress the mother’s lungs, causing shortness of breath. Additionally, many women experience nausea in the early months of pregnancy. Indigestion, often described as a burning sensation or pain in the stomach or chest, occurs as the expanding uterus pushes the stomach higher, causing stomach acids to reflux into the chest. While this discomfort is not harmful, it typically resolves after delivery.

For mothers struggling with nausea or indigestion, it is advisable to consume small, frequent meals. They should also avoid lying flat for one to two hours after eating, as this may exacerbate their symptoms.

Changes in the Urinary System during Pregnancy

The urinary system consists of the kidneys, two organs located on either side of the abdomen toward the back, as well as the tubes that connect the kidneys to the bladder, where urine is stored, and the urethra, which is the tube that expels urine from the body. The kidneys are essential for filtering waste from the blood and transforming it into urine. During pregnancy, they must work harder to remove not only the mother’s waste products but also those from the fetus, leading to an increase in urine production.

It is common for pregnant women to experience frequent urination, especially during the first and last months of pregnancy, as the growing uterus exerts pressure on the bladder. In the later stages of pregnancy, many women find themselves needing to get up at night to urinate. This is because the fluid that has accumulated in the legs and feet during the day (edema) is absorbed back into the bloodstream when the legs are elevated while sleeping. The kidneys then filter out this excess fluid and produce more urine, causing the bladder to fill more rapidly at night.

Skin Changes

Various changes occur in a woman’s skin during pregnancy due to hormonal fluctuations and the mechanical stretching of the growing abdomen and breasts.

This phenomenon is due to an increase in hormone-induced pigmentation in the skin cells in this area. After childbirth, the line typically starts to fade, although it may not completely vanish.

1. *Linea Nigra*: This dark line may appear between the belly button (umbilicus) and the pubic bone (symphysis pubis), and in some women, it can reach up to the sternum (the bone situated between the breasts).
2. *Mask of Pregnancy (Chloasma)*: Some women develop brownish pigmentation on their face and forehead, referred to as the “mask of pregnancy” or chloasma, giving a bronze-like appearance. This pigmentation usually begins to appear around the 16th week of pregnancy and gradually intensifies, but it typically fades after delivery.
3. *Stretch Marks*: As a woman’s weight increases, the skin stretches in areas where growth is most pronounced – primarily the abdomen, thighs, and breasts. Some women may develop pink or brownish stretch marks, which can be quite noticeable. Although they generally fade after delivery, they usually do not disappear completely.
4. *Sweat Glands*: The activity of sweat glands throughout the body tends to increase during pregnancy, leading to more profuse sweating, especially in hot weather or during physical exertion [10].

Breast Changes

In the early stages of pregnancy, women might feel fullness or tingling sensations in their breasts, and the breasts typically increase in size as the pregnancy progresses. Additionally, the areola, the pigmented area around the nipples, darkens and widens in diameter. Montgomery’s glands, which are small bumps in the areola, also enlarge and become more prominent. Increased blood circulation may make the surface blood vessels of the breasts more visible, sometimes giving them a bluish tint.

By the 16th week, during the second trimester, the breasts start producing colostrum, the precursor to breast milk. This yellowish secretion thickens as the pregnancy progresses and is extremely rich in protein and antibodies, which are special proteins from the mother’s immune system that help protect the newborn from infections. As pregnancy nears its end, nipples may release enough colostrum to cause wet spots on the mother’s clothing, which is perfectly normal and a positive sign. After delivery, colostrum is produced during the first three days before regular milk production starts. It is vital for the mother to breastfeed her baby with colostrum to provide the infant with important nutrients and antibodies.

1. In early pregnancy, lower BP is common due to progesterone causing slight relaxation of blood vessels, which may result in dizziness or temporary fainting.
2. Reduced blood flow returning to the heart can cause fluid buildup in the legs and feet, leading to swelling or edema.
3. Many women experience shortness of breath during pregnancy as the expanding baby limits space in the lungs. Additionally, indigestion may occur as the stomach is pushed upwards.
4. The gastrointestinal muscles relax somewhat during pregnancy, slowing digestion to optimize nutrient absorption for the mother and fetus. This can, however, cause nausea or constipation.
5. Frequent urination is typical, especially in early and late pregnancy, as the growing uterus presses on the bladder. At night, more fluid (edema) from the legs is reabsorbed, causing the bladder to fill quickly.
6. Hormonal shifts and abdominal and breast stretching during pregnancy may lead to stretch marks. Other skin changes can include increased pigmentation and sweating.
7. In the second trimester, the breasts begin producing colostrum, a thick, yellowish fluid rich in proteins and antibodies that are crucial for newborns’ health.

STAGES OF PREGNANCY

Pregnancy lasts for about 40 weeks, counting from the first day of your last normal period. The weeks are grouped into three trimesters.

1. *First trimester*: 1–12 weeks.

2. *Second trimester*: 13–28 weeks.
3. *Third trimester*: 29–40 weeks.

First Trimester Changes

1. Extreme tiredness.
2. Tenderness and swollen breast.
3. Morning sickness.
4. Mood swings.
5. Constipation.
6. Heartburn.
7. Weight gain.

Second Trimester Changes

1. Body aches, such as thigh, back, or abdomen.
2. Patches over the cheeks.
3. Numbness and tingling hands, called carpal tunnel syndrome.
4. Constipation.
5. Anorexia.
6. Gastritis.
7. Frequency of micturition or UTI.
8. Itching on the abdomen, palms, and sole.
9. Swelling of ankle, fingers, and face.

These common complaints can be worsened if associated with other complications.

Third Trimester Changes

1. Shortness of breath.
2. Heartburn.
3. Swelling on the ankle, face, and fingers become more common due to weight gain.
4. Hemorrhoids.
5. Tender breast.
6. Troubled sleep.
7. The baby dropping or moving lower in the abdomen.
8. Contractions in the lower abdomen.
9. Later, contraction increases and thinning of the cervix leads to further stages of labor.

DISCUSSION AND RESULTS

Women have been blessed by God with the invaluable gift of motherhood. The health and well-being of a developing baby rely heavily on the mother's health and nutrition, as she serves as both the seed and the soil nurturing the baby throughout the entire pregnancy. A woman plays a vital role in creating new life for future generations. God designed women not only to carry the new life in their wombs but also to nourish it with their blood until birth, a capability that men do not possess. Throughout the nine-month journey, mothers endure various physiological changes to accommodate the growing fetus.

CONCLUSIONS

The hormonal changes during pregnancy play a crucial role in facilitating the myriad adaptations a woman's body undergoes to support the developing fetus. While these transformations can sometimes lead to discomfort, their primary purpose is to create an optimal environment for fetal growth and prepare the mother for labor and breastfeeding. From the expansion of the uterus and softening of the cervix to the increased flexibility of ligaments and joints, each change is vital for childbirth. Additionally, the development of mammary glands ensures the mother can provide essential nutrition to her newborn, highlighting the profound connection between mother and child.

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