

## Physiological Changes In Pregnancy

Pregnancy brings about profound physiological changes across various organ systems of the mother to support fetal development and maintain maternal homeostasis. Initially, the physiological demands are minimal, but as the fetus grows, these demands increase significantly. These changes aim to ensure adequate oxygen and nutrient delivery to the fetus and help the mother adapt to the metabolic, cardiovascular, and hormonal challenges of pregnancy.

Failure to understand these changes may result in misinterpretation of clinical findings and inappropriate management of pregnant women.

### Major Physiological Adaptations in Pregnancy

The major maternal physiological adaptations to pregnancy involve:

1. Structural and functional changes in the reproductive organs and breasts.
2. Increased metabolic activity to meet fetal nutritional demands.
3. Placental hormone secretion influencing various body systems.
4. Systemic changes across multiple organ systems including hematologic, cardiovascular, respiratory, renal, gastrointestinal, and endocrine systems.

## 1. Reproductive System Changes

### Uterus

- The uterus undergoes significant hypertrophy and hyperplasia. A non-pregnant uterus weighs approximately 50 grams and measures about 7.5 centimeters in length. By term, it weighs around 900 to 1,000 grams and measures about 35 centimeters.
- The growth in early pregnancy results from both hypertrophy (increased cell size) and hyperplasia (increased cell number). Later, growth is primarily due to hypertrophy.
- Uterine muscle fibers are arranged in three layers: an outer longitudinal layer, an inner circular layer, and a middle crisscross layer where blood vessels traverse.
- The uterus is anatomically divided into an upper and lower segment as pregnancy advances. The lower uterine segment (including the upper cervix) becomes distended due to its collagen-rich composition.

### Cervix

- The cervix becomes soft and edematous due to hormonal effects.
- Estradiol stimulates the growth of columnar epithelium in the cervical canal, leading to a condition called cervical ectropion.
- Glandular activity increases, resulting in mucus secretion that forms a plug, which is later expelled during labor as the "show."
- Prostaglandins and collagenases soften the cervix toward term by remodeling collagen fibers.

## Vagina

- The vaginal mucosa becomes thicker, and vaginal discharge increases due to desquamation.
- Vaginal pH becomes more acidic (between 3.5 and 6.0) due to estrogen-induced glycogen deposition and its conversion into lactic acid by lactobacilli. This acidic environment protects against infections.

## 2. Breast Changes

- Breast changes are more pronounced in first-time pregnancies (primigravida).
- There is enlargement due to hypertrophy of ducts (stimulated by estrogen) and alveoli (stimulated by both estrogen and progesterone).
- The nipples and areola enlarge, become more pigmented, and more erect.
- Sebaceous glands around the areola (Montgomery's tubercles) become prominent.
- By the twelfth week of gestation, some women may begin to produce colostrum.
- Estrogen promotes ductal growth, while progesterone promotes lobular-alveolar development. Prolactin stimulates milk secretion after delivery.

## 3. Skin Changes

- **Chloasma gravidarum (pregnancy mask)** : Pigmentation over the face (forehead, cheeks, and eyes) due to increased melanocyte-stimulating hormone.
- **Linea nigra** : A hyperpigmented line from the xiphisternum to the symphysis pubis.
- **Striae gravidarum (stretch marks)** : Pink or purple lines on the abdomen due to dermal stretching.

## 4. Weight Gain

- Average total weight gain during a singleton pregnancy is between 10 to 12 kilograms.
- Weight gain typically progresses as:
  - First trimester: approximately 1 kilogram
  - Second trimester: approximately 5 kilograms
  - Third trimester: approximately 5 kilograms
- Weight gain is due to fetal growth, increased maternal blood volume, fluid retention, and fat deposition.
- Excessive weight gain (more than 0.5 kilograms per week) may indicate pre-eclampsia.
- Inadequate or falling weight may suggest intrauterine growth restriction or fetal demise.

## 5. Volume and Hematological Changes

### Blood Volume

- Maternal blood volume increases by approximately 40 to 50 percent by the 30th to 32nd week.
- Plasma volume increases more than red cell mass, resulting in physiological anemia.
- Cardiac output increases by about 30 percent to accommodate increased circulatory demands.

## **Electrolyte and Fluid Retention**

- Hormonal changes (e.g., estrogen and aldosterone) cause sodium and water retention.
- There is a shift in fluid compartments with increased extracellular and intracellular fluid.
- Total body water may increase by up to 6.5 liters.

## **Hematological Indices**

- Red cell mass increases by 20 to 30 percent.
- Reticulocyte count rises.
- Hemoglobin concentration and hematocrit decrease due to hemodilution.
- White blood cell count and erythrocyte sedimentation rate increase.
- Fibrinogen levels rise significantly, enhancing blood coagulability.

## **Hypercoagulability**

- Pregnancy is a hypercoagulable state. Fibrinogen concentration increases by up to 50 percent.
- This adaptation protects against postpartum hemorrhage but increases the risk of thromboembolism.

## **6. Cardiovascular System Changes**

- Peripheral vasodilation leads to a decrease in systemic vascular resistance.
- Cardiac output increases by 30 to 50 percent, peaking between the 22nd and 28th weeks.
- Heart rate increases by 10 to 20 beats per minute.
- Stroke volume increases by approximately 10 percent.
- Mean arterial pressure decreases by around 10 millimeters of mercury.
- Physiological heart sounds may include louder first and second heart sounds, systolic murmurs, and occasional continuous murmurs due to increased mammary blood flow.
- Supine hypotension syndrome can occur in late pregnancy due to compression of the inferior vena cava by the gravid uterus, leading to reduced venous return, hypotension, and syncope. This can be alleviated by turning the mother to a lateral position.

## **7. Respiratory System Changes**

- Respiratory rate and tidal volume increase, resulting in higher minute ventilation.
- The rib cage expands in both the anterior-posterior and transverse diameters by approximately 2 centimeters.
- Diaphragmatic elevation occurs due to uterine enlargement, but diaphragmatic movement remains efficient.
- Progesterone increases the respiratory center's sensitivity to carbon dioxide, promoting hyperventilation and facilitating oxygen delivery to the fetus.