Physiology of Pregnancy, Hormonal Changes and Impact of Maternal Nutrition on Fetus

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ABSTRACT

This research paper delves into the intricate physiology process of pregnancy focusing on hormonal changes and profound impact of maternal nutrition on fetal development. It multifaceted in the world of pregnancy physiology offering a comprehensive examination of the intricate mechanisms that orchestrate the miraculous journey from conception to childbirth.

To study physiology of pregnancy aims to deepen our understanding of complex physiological processes occurring during pregnancy. (i) To understand hormonal dynamics: Including the role of human chorionic gonadotropin, estrogen and progesterone to comprehend their impact on maintaining pregnancy. (ii) Explore cardiovascular adaptations: Examine cardiovascular changes that occur to meet fetal development demands during pregnancy, which includes increase in blood volume and increase cardiac output. (iii) Study placental function: Understanding the development of placenta examining the role of gas exchange, providing nutrition and excretion of waste products. (iv) Address complications and risks: Identifying the factors that contribute to risks and complications of pregnancy such as gestational diabetes, preeclampsia, and intrauterine growth restriction, aiming to implement strategy for prevention, early detection and management.

Keywords: Pregnancy; Maternal Nutrition; Childbirth; Gonadotropin; Estrogen; Progesterone; Cardiovascular Changes.

1. Pregnancy

It is a medical term used to describe the developmental period of a fetus inside the uterus. It lasts up to 40 weeks or just over 9 months. Health care providers refer to three segments of pregnancy called 'Trimesters'. First Trimester: (0–13) weeks, Second Trimester: (14–26) weeks.

Third Trimester: (27–40) weeks. In order to get pregnant, sperm needs to meet up with an egg. And this transformative journey begins with fertilization, a process where a sperm cell meets up with an egg forming an identical structure called 'zygote'. This process takes place in fallopian tubes. Zygote divides into four cells, eight cells, and sixteen cells called Morula. It further divides to form Blastocyst. It implants in the lining of the uterus and makes the initiation of pregnancy. Blastocyst stays in the uterine wall up to three days. Approx. in 5–7 days the implantation starts within the endometrium. It is supplied by the uterine milk which provides a healthy nutrition to it. As the progression of pregnancy, a remarkable organ (placenta) covers center stage. Placenta develops from both fetal and maternal tissues. It serves as a lifeline between mother and baby. Inside placenta a mass cell called Trophoblast provides a nutritional supply in the form of liquid to early embryos. These trophoblast mass cells release a proteolytic substance that digests the adjacent cells of endometrium. Trophoblast cells facilitate the exchange of gasses, nutrients and elimination of waste products from the fetus.

2. Placenta functions

Placenta provides nutrients, oxygen and removes carbon dioxide, waste products from the fetus. The oxygen is supplied to the fetus by the sinus of the placenta through maternal artery. Oxygen is generally uptaken by villus by diffusion process and is further provided to fetus through umbilical artery.

Oxygen poor blood is carried back by umbilical vein, poured into sinus and uptaken by maternal vein.
Villi contain fetal blood.

3. Changes in the segments of pregnancy [1]–[4]

~ First Trimester: (0–13) weeks

Changes in Mother:

1: Increase in Human chorionic gonadotropin.
2: Morning sickness.
3: Fatigue.
4: Breast tenderness.
5: Darkening of areolas.
6: Mood swings.
7: Increase in blood flow.
8: Frequent urination.
9: Changes in Appetite and taste.

Changes in fetus:

1: Implantation and formation of placenta.
3: Formation of limb buds.
4: Tissue differentiation.
5: Fingers and toes begin to form.
6: Early development of major organs (lungs, heart, kidneys, liver).

~ Second Trimester: (14–26) weeks

Changes in Mother:

1: Decrease in fatigue.
2: Decrease in nausea.
3: Uterus grows.
4: Skin pigmentation.
5: Enlargement of breasts.
6: Pressure on lower back.

Changes in fetus:

1: Fetal movements.
2: Fetal brain undergoes rapid development.

3: Fingerprints and footprints develop.

4: Sexual organs are differentiated.

5: Fetuses can open and close their eyes.

6: The lungs start producing surfactant.

~ Third Trimester: (27–40) weeks

**Changes in Mother:**

1: Weight gain.

2: Shortness of breath.

3: Heartburn.

4: Indigestion.

5: Backaches and joint pain.

6: Pelvic discomfort.

7: Swelling in ankles and feet.

8: Enlargement of breasts in preparation for breastfeeding.

**Changes in Fetus:**

1: Baby may settle into a head down position.

2: Development of the nervous system.

3: Maturation of organs.

4: Antibody transfer (mother to fetus).

5: Formation of meconium.

6: Weight gain.

**Hormonal changes**

During pregnancy we must discuss the main three hormones.

**HCG (human chorionic gonadotropin).**

**Estrogen.**

**Progesterone.**

**HCG: (Human chorionic gonadotropin):**

It is secreted by placenta. Its concentration increases up to 10–12 weeks of pregnancy then gradually decreases. After this it takes a constant value. The elevated levels of HCG signal pregnancy. It acts as a luteinizing hormone and mostly prevents the menstruation and involution of corpus luteum.
Estrogen/Progesterone:

These are basically released from corpus luteum. Between 13–17 weeks of pregnancy it is uptaken by placenta. Placenta continuously releases Oestrogen and progesterone until parturition.

During pregnancy estrogen helps in enlargement of breast and uterus. It enlarges the female external genitalia.

And progesterone provides nutrition to early embryos. It decreases the contraction of the uterus, thus preventing spontaneous abortion.

Other changes:

(i) Cardiovascular changes during pregnancy

During pregnancy, blood volumes and cardiac output should be increased in order to meet the demands of the developing fetus. Changes in blood pressure may be felt in the first two trimesters.

(ii) Respiratory adaptations

* Elevated diaphragm due to the expansion in the uterus.
* Uterine expansion may alter respiratory mechanics.
* Increase in oxygen consumption.

(iii) Renal Adjustment

* During pregnancy a woman needs to urinate many times a day it aids in eliminating fetal waste products.
* Kidney adjustments are viral in order to maintain a fluid and electrolyte balance.
* The physiology of pregnancy is a multifaceted journey marked by various changes across various systems.

□ 4. Impact of maternal nutrition on fetus

It plays an important role in influencing the fetal development, structuring the foundation of the baby's growth, organ formation and long term health. Healthy nutrition provides essential growth blocks, such as amino acids for the synthesis of proteins which genuinely helps in cell growth and differentiation during fetal development.

* Vitamin B – helps in neural tube formation in the very early stage of pregnancy.
* Folic acid – deficiency can lead to the neural tube defects in the developing fetus.
* Adequate nutrition supports the well formation of organs during the first trimester of pregnancy.
* Maternal nutrition can affect the placental ability to transfer nutrients, oxygen and hormones to the fetus.
* Insufficient calorie intake can lead to the intrauterine growth restriction and low birth weight impact the health of the baby at birth.
* Fetal brain development needs omega–3 fatty acids which contribute to formation of neural membranes.
* Vitamin D – intake is essential for the development of fetal bones and teeth.
* Deficiencies in vitamin A can increase the risk of birth defects. Excess vitamin A intake can also be harmful.
* Gestational diabetes can affect the baby's metabolism and increase risk of metabolic disorders.
5. Importance to studying pregnancy education

Studying pregnancy in women is important for several reasons. It helps understand maternal health, fetal development, and potential complications. This knowledge informs healthcare practices, leading to better prenatal care, reduced maternal and infant mortality, and improved overall reproductive health.

Studying pregnancy contributes to advancements in medical research and ensures women receive the support and resources needed for a healthy pregnancy and childbirth experience.

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Consent for Publication

The authors declare that they consented to the publication of this study.

Author’s Contribution

Both the authors took part in data collection, literature review, analysis, and manuscript writing equally.

References


