Green Grace Igbogi

18/mhs07/021

Pharmacology

Phs 212 Assignment

Physiological Adaptation

**Question**

Elucidate the Physiological adaptations of the female to pregnancy?

**Maternal physiological changes in pregnancy** are the adaptations during [pregnancy](https://en.m.wikipedia.org/wiki/Pregnancy) that a woman's body undergoes to accommodate the growing [embryo](https://en.m.wikipedia.org/wiki/Embryo) or [fetus](https://en.m.wikipedia.org/wiki/Fetus" \o "Fetus). These [physiologic](https://en.m.wikipedia.org/wiki/Physiological) changes are entirely normal, and include [behavioral](https://en.m.wikipedia.org/wiki/Parental_brain" \o "Parental brain) (brain), [cardiovascular](https://en.m.wikipedia.org/wiki/Cardiovascular) (heart and blood vessel), [hematologic](https://en.m.wikipedia.org/wiki/Hematology) (blood), [metabolic](https://en.m.wikipedia.org/wiki/Metabolism), [renal](https://en.m.wikipedia.org/wiki/Renal) (kidney), posture, and [respiratory](https://en.m.wikipedia.org/wiki/Respiration_(physiology)) (breathing) changes. Increases in blood sugar, breathing, and cardiac output are all expected changes that allow a pregnant woman's body to facilitate the proper growth and development of the embryo or fetus during the pregnancy. The pregnant woman and the placenta also produce many other hormones that have a broad range of effects during the pregnancy.

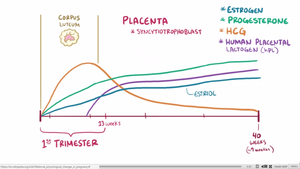
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HORMONAL

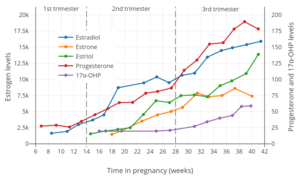
Pregnant women experience numerous adjustments in their [endocrine system](https://en.m.wikipedia.org/wiki/Endocrine_system) that help support the developing fetus. The fetal-placental unit secretes steroid hormones and proteins that alter the function of various maternal [endocrine glands](https://en.m.wikipedia.org/wiki/Endocrine_gland). Sometimes, the changes in certain hormone levels and their effects on their target organs can lead to [gestational diabetes](https://en.m.wikipedia.org/wiki/Gestational_diabetes) and [gestational hypertension](https://en.m.wikipedia.org/wiki/Gestational_hypertension).

* [v](https://en.m.wikipedia.org/wiki/Template:Hormone_levels_during_pregnancy_in_human_females)
* [t](https://en.m.wikipedia.org/wiki/Template_talk:Hormone_levels_during_pregnancy_in_human_females)
* [e](https://en.wikipedia.org/w/index.php?title=Template:Hormone_levels_during_pregnancy_in_human_females&action=edit)

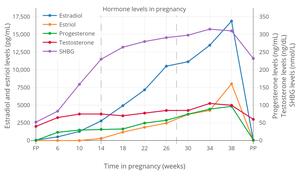
**Hormone levels during pregnancy in human females**

* [](https://en.m.wikipedia.org/wiki/File:Pregnancy_hormone_graph.png)

Estrogen, progesterone, and [human chorionic gonadotropin](https://en.m.wikipedia.org/wiki/Human_chorionic_gonadotropin) (hCG) levels throughout pregnancy.

* [](https://en.m.wikipedia.org/wiki/File:Estrogen_and_progesterone_levels_during_pregnancy_in_women.png)

Estrogen, progesterone, and [17α-hydroxyprogesterone](https://en.m.wikipedia.org/wiki/17%CE%B1-hydroxyprogesterone) (17α-OHP) levels during [pregnancy](https://en.m.wikipedia.org/wiki/Pregnancy) in women.[[1]](https://en.m.wikipedia.org/wiki/Maternal_physiological_changes_in_pregnancy#cite_note-pmid5025870-1) The dashed vertical lines separate the [trimesters](https://en.m.wikipedia.org/wiki/Pregnancy_trimester). Determinations were via [radioimmunoassay](https://en.m.wikipedia.org/wiki/Radioimmunoassay).

* [](https://en.m.wikipedia.org/wiki/File:Estrogen,_progesterone,_testosterone,_and_SHBG_levels_during_pregnancy_in_women.png)

Levels of sex hormones and SHBG during pregnancy in women. The dashed vertical lines separate the [trimesters](https://en.m.wikipedia.org/wiki/Pregnancy_trimester). Determinations were via [radioimmunoassay](https://en.m.wikipedia.org/wiki/Radioimmunoassay).

### Fetal-placental unit

Levels of progesterone and estrogen rise continually throughout pregnancy, suppressing the hypothalamic axis and subsequently the menstrual cycle. The progesterone is first produced by the [corpus luteum](https://en.m.wikipedia.org/wiki/Corpus_luteum) and then by the placenta in the second trimester. Women also experience increased [human chorionic gonadotropin](https://en.m.wikipedia.org/wiki/Human_chorionic_gonadotropin) (β-hCG), which is produced by the placenta.

### Pancreatic Insulin

The placenta also produces [human placental lactogen](https://en.m.wikipedia.org/wiki/Human_placental_lactogen) (hPL), which stimulates maternal lipolysis and fatty acid metabolism. As a result, this conserves blood glucose for use by the fetus. It can also decrease maternal tissue sensitivity to insulin, resulting in [gestational diabetes](https://en.m.wikipedia.org/wiki/Gestational_diabetes).

### Pituitary gland

The [pituitary gland](https://en.m.wikipedia.org/wiki/Pituitary_gland) grows by about one-third as a result of hyperplasia of the lactrotrophs in response to the high plasma estrogen. [Prolactin](https://en.m.wikipedia.org/wiki/Prolactin), which is produced by the lactrotrophs increases progressively throughout pregnancy. Prolactin mediates a change in the structure of the breast [mammary glands](https://en.m.wikipedia.org/wiki/Mammary_gland) from ductal to lobular-alveolar and stimulates milk production.

### Parathyroid

Fetal skeletal formation and then later lactation challenges the maternal body to maintain their calcium levels. The fetal skeleton requires approximately 30 grams of calcium by the end of pregnancy. The mother's body adapts by increasing [parathyroid hormone](https://en.m.wikipedia.org/wiki/Parathyroid_hormone), leading to an increase in calcium uptake within the gut as well as increased calcium reabsorption by the kidneys. Maternal total serum calcium decreases due to maternal [hypoalbuminemia](https://en.m.wikipedia.org/wiki/Hypoalbuminemia" \o "Hypoalbuminemia), but the ionized calcium levels are maintained.

### Adrenal glands

Total [cortisol](https://en.m.wikipedia.org/wiki/Cortisol) increases to three times of non-pregnant levels by the third trimester. The increased estrogen in pregnancy leads to increase corticosteroid-binding globulin production and in response the [adrenal gland](https://en.m.wikipedia.org/wiki/Adrenal_gland) produces more cortisol. The net effect is an increase of free cortisol. This contributes to insulin resistance of pregnancy and possibly striae. Despite the increase in cortisol, the pregnant mom does not exhibit [Cushing syndrome](https://en.m.wikipedia.org/wiki/Cushing_syndrome) or symptoms of high cortisol. One theory is that high progesterone levels act as an antagonist to the cortisol.

The adrenal gland also produces more [aldosterone](https://en.m.wikipedia.org/wiki/Aldosterone), leading to an eight-fold increase in aldosterone. Women do not show signs of hyperaldosterone, such as hypokalemia, hypernatremia, or high blood pressure.

The adrenal gland also produces more [androgens](https://en.m.wikipedia.org/wiki/Androgens), such as testosterone, but this is buffered by estrogen's increase in sex-hormone binding globulin (SHBG). SHBG binds avidly to testosterone and to a lesser degree DHEA.

### Thyroid

The [thyroid](https://en.m.wikipedia.org/wiki/Thyroid) enlarges and may be more easily felt during the first trimester. The increase in kidney clearance during pregnancy causes more iodide to be excreted and causes relative iodine deficiency and as a result an increase in thyroid size. Estrogen-stimulated increase in thyroid-binding globulin (TBG) leads to an increase in total [thyroxine](https://en.m.wikipedia.org/wiki/Thyroxine) (T4), but free thyroxine (T4) and [triiodothyronine](https://en.m.wikipedia.org/wiki/Triiodothyronine) (T3) remain normal.

### Endocrine function tests in pregnancy

|  |  |  |
| --- | --- | --- |
| **Effect of pregnancy on endocrine function tests.** | | |
| **Hormone** | **Test** | **Result** |
| **FSH, LH** | GnRH stimulation | Unresponsive from third gestation until several weeks postpartum |
| **Growth Hormone** | Insulin tolerance test | Response increases during first half of pregnancy and then normalizes until several weeks postpartum |
| **TSH** | TRH stimulation | Response unchanged |
| **Pancreatic Insulin** | Glucose tolerance test | Peak glucose increases, and glucose concentration remains elevated for longer |
| **Adrenal Cortisol** | ACTH infusion | Exaggerated cortisol and aldosterone responses |
|  | Metyrapone | Diminished response |
| **Mineralocorticoids** | ACTH infusion | No deoxycorticosterone response |
|  | Dexamethasone | No deoxycorticosterone response |

BREAST SIZE

A woman's breasts grow during pregnancy, usually 1 to 2 cup sizesand potentially several cup sizes. A woman who wore a C cup bra prior to her pregnancy may need to buy an F cup or larger bra while nursing A woman's torso also grows and her bra band size may increase one or two sizes. An average of 80% of women wear the wrong bra size and mothers who are preparing to nurse can benefit from a professional bra fitting from a lactation consultant Once the baby is born up to about 50–73 hours after birth, the mother will experience her breasts filling with milk (sometimes referred to as “the milk coming in”). Once [lactation](https://en.m.wikipedia.org/wiki/Lactation) begins, the woman's breasts swell significantly and can feel achy, lumpy and heavy (which is referred to as engorgement). Her breasts may increase in size again by an additional 1 or 2 cup sizes, but individual breast size may vary depending on how much the infant nurses from each breast. A regular pattern of nursing is generally established after 8–12 weeks, and a woman's breasts will usually reduce in size, but may remain about 1 cup size larger than prior to her pregnancy. Changes in breast size during pregnancy may be related to the sex of the infant, as mothers of female infants have greater changes in breast size than mothers of male infants.

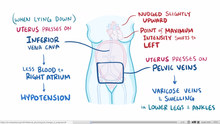
Many people and even medical professionals mistakenly think that [breastfeeding](https://en.m.wikipedia.org/wiki/Breastfeeding) causes the breasts to [sag](https://en.m.wikipedia.org/wiki/Ptosis_(breasts)) (referred to as *ptosis*). As a result, some new parents are reluctant to nurse their infants. In February 2009, [Cheryl Cole](https://en.m.wikipedia.org/wiki/Cheryl_Cole) told British [Vogue](https://en.m.wikipedia.org/wiki/Vogue_(magazine)) that she hesitated to breastfeed because of the effect it might have on her breasts. "I want to breastfeed," she said, "but I’ve seen what it can do, so I may have to reconsider." In actuality, breastfeeding is not considered to be a major contributor to ptosis of the breasts. In fact, the biggest factors affecting ptosis are cigarette smoking, a woman's [body mass index](https://en.m.wikipedia.org/wiki/Body_mass_index) (BMI), her [number of pregnancies](https://en.m.wikipedia.org/wiki/Gravidity), her [breast cup size](https://en.m.wikipedia.org/wiki/Cleavage_(breasts)) before pregnancy, and age.

CARDIOVASCULAR

The heart adapts to the increased cardiac demand that occurs during pregnancy in many ways.

* Cardiac output (Lit./Min.): 6.26
* Stoke Volume (Ml.): 75
* Heart Rate (Per min.): 85
* Blood Pressure: Unaffected

Cardiac output increases throughout early pregnancy, and peaks in the third trimester, usually to 30-50% above baseline Estrogen mediates this rise in cardiac output by increasing the pre-load and stroke volume, mainly via a higher overall blood volume (which increases by 40–50%).The heart rate increases, but generally not above 100 beats/ minute. Total systematic vascular resistance decreases by 20% secondary to the vasodilatory effect of progesterone. Overall, the systolic and diastolic blood pressure drops 10–15 mm Hg in the first trimester and then returns to baseline in the second half of pregnancy All of these cardiovascular adaptations can lead to common complaints, such as palpitations, decreased exercise tolerance, and dizziness.

[](https://en.m.wikipedia.org/wiki/File:Pregnancy_Uterus_Compression_of_Structures.png)

Uterine Compression of IVC and Pelvic Veins. Displacement of PMI by Uterus

Uterine enlargement beyond 20 weeks' size can compress the inferior vena cava, which can markedly decrease the return of blood into the heart or preload. As a result, healthy pregnancy patients in a supine position or prolonged standing can experience symptoms of hypotension.