

Physiological and Psychological Changes in Pregnancy

Pregnancy 101: Self-Study
Version 8.1.18



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Physiological and psychological changes in normal pregnancies

- Physiological changes

- Weight gain
- Sleep
- Endocrine system
- Cardiovascular system
- Hematologic system
- Respiratory system
- Urinary system
- Gastrointestinal system
- Central nervous system

- Psychological stages

- Preconception
- First stage
(known pregnancy to quickening)
- Second stage
(quickening to viability)
- Third stage
(viability to delivery)



Gestational Weight Gain

- Mean gestational weight gain (normal-weight women, full-term infants) is typically 22.0 to 36 lb.
- Recommendations have fluctuated over the past several decades. Current recommendations are body mass index (BMI) specific.
 - Underweight prepregnancy BMI ($<18.5 \text{ kg/m}^2$) -> 28-40 lbs
 - Obese pre-pregnancy BMI ($\geq 30 \text{ kg/m}^2$) -> 11-20 lbs



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Sleep

- Most pregnant women (66% to 94%) report alterations in sleep that lead to the subjective perception of poor sleep quality.
- Pregnancy causes such significant changes that the American Academy of Sleep Medicine has described a specific pregnancy-associated sleep disorder characterized by insomnia and/or daytime fatigue.
- Abnormal sleep patterns in pregnancy may contribute to certain complications, such as hypertensive disorders and fetal growth restriction.



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Sleep

- First trimester
 - Increased total sleep time: increase in naps
 - Increased daytime sleepiness
 - Increased nocturnal insomnia
- Second trimester
 - Normalization of total sleep time
 - Increased awakenings
- Third trimester
 - Decreased total sleep time
 - Increased insomnia
 - Increased nocturnal awakenings
 - Increased daytime sleepiness



Gabbe et al., *Obstetrics: Normal and Problem Pregnancies*, 2017

Modified from Santiago J, Nollo M, Kinzler W. Sleep and sleep disorders in pregnancy. *Ann Intern Med.* 2001;134:396.



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Endocrine System Changes

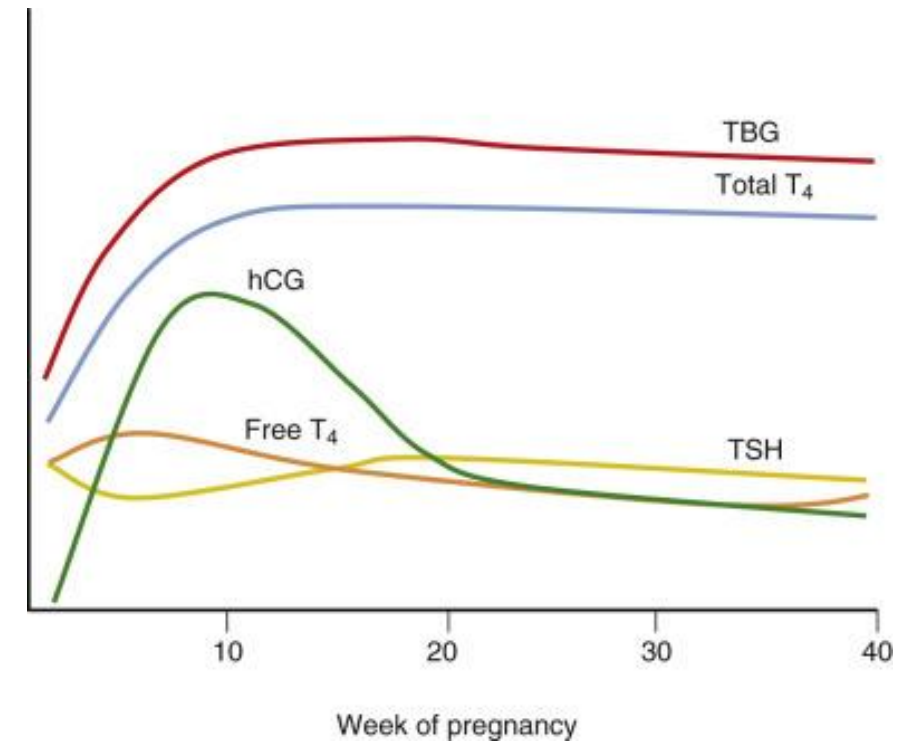
- Estrogen
 - Estradiol rises throughout pregnancy
 - Produced by the corpus luteum, then the placenta
 - Suppresses HPA axis and menstruation
- Progesterone
 - Numerous roles to promote pregnancy, including preparing endometrial lining, suppressing maternal immune system, decreasing contractility of smooth muscle, inhibiting lactation
 - Neuroactive metabolites (5 α -dihydroprogsterone and allopregnanolone) act centrally on GABA-A receptors



Endocrine Changes

- Thyroid

- Normal pregnancy symptoms mirror those of thyroid disease, which makes evaluation of thyroid disease difficult.
- Despite alterations in thyroid morphology, histology, and laboratory indices, pregnant women remain euthyroid.
- Adequate iodine intake is critical to maintain normal thyroid function; in pregnancy, more iodine is lost due to increased renal clearance. Iodine supplements are recommended by the American Academy of Pediatrics.



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Endocrine System

- Adrenal system
 - Pregnancy is associated with marked changes in adrenocortical function (characterized by increased serum levels of aldosterone, deoxycorticosterone, corticosteroid-binding globulin (CBG), adrenocorticotrophic hormone (ACTH), cortisol, and free cortisol) causing a state of physiologic hypercortisolism.
 - By the end of pregnancy, the levels of total cortisol are nearly three times higher than nonpregnant values and reach levels in the range seen in Cushing syndrome. Although most pregnant women do not experience the full clinical picture of hypercortisolism, increased cortisol levels are likely responsible for the weight gain, striae, hyperglycemia, and tiredness experienced in pregnancy.



Endocrine Changes

- Pituitary
 - Serum prolactin levels begin to rise at 5 to 8 weeks' gestation and by term are elevated 10-fold, preparing the body for lactation.
 - Maternal follicle-stimulating hormone (FSH) and luteinizing hormone (LH) are decreased to undetectable levels as a result of feedback inhibition from the elevated levels of estrogen, progesterone, and inhibin.
- Glucose metabolism
 - In all pregnancies, an increase in available glucose for mother and fetus is associated with at least a mild peripheral insulin resistance.



Cardiovascular System

- Heart

- As pregnancy advances, the heart is physically displaced upward/leftward.
- Eccentric cardiac hypertrophy is common in pregnancy. It is thought to result from expanded blood volume, and may be adaptive (as seen in athletes, enabling the pregnant woman's heart to work more efficiently).
- Return to normal size - up to 6 months post-pregnancy.
- Maternal BP decreases early in pregnancy, reaches a nadir mid-pregnancy and returns to pre-pregnancy levels by term.



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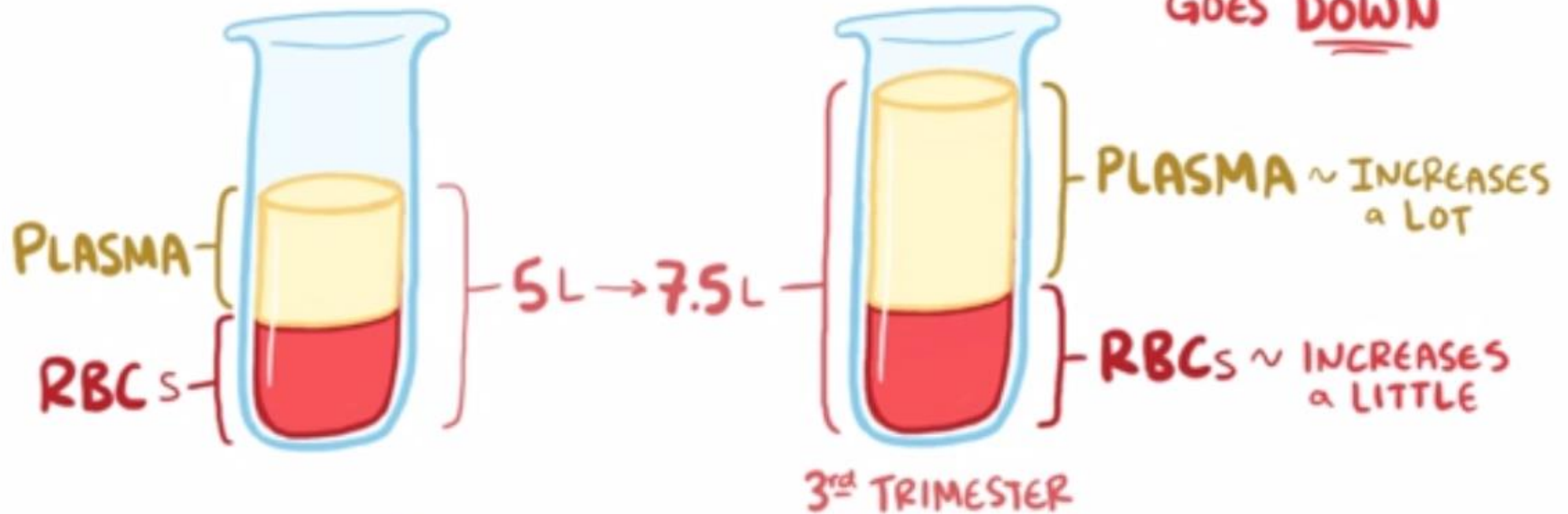
CARDIOVASCULAR SYSTEM EXPANDS

* **HIGH VOLUME STATE** *

BLOOD VOLUME INCREASES
by 30-50%

PHYSIOLOGIC
ANEMIA of
PREGNANCY

(% of RBCs)
HEMATOCRIT
GOES DOWN

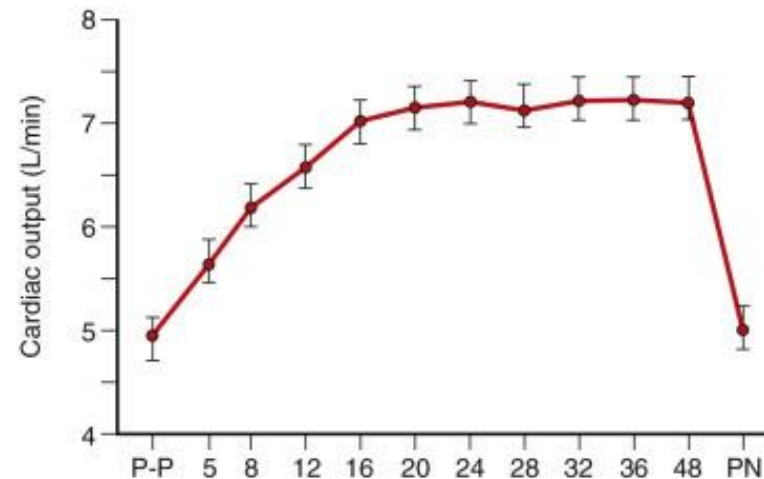
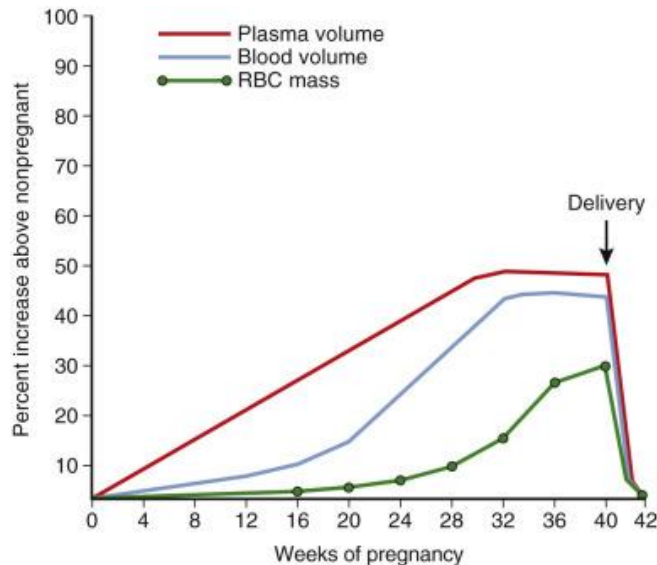


Cardiovascular System

- Cardiac Output

- Increase peaks at 30% to 50% above preconception values.
- The increase in cardiac output is disproportionately directed to the uterus, placenta, and breasts.

(From Hunter S, Robson S. Adaptation of the maternal heart in pregnancy. *Br Heart J.* 1992;68:540.)



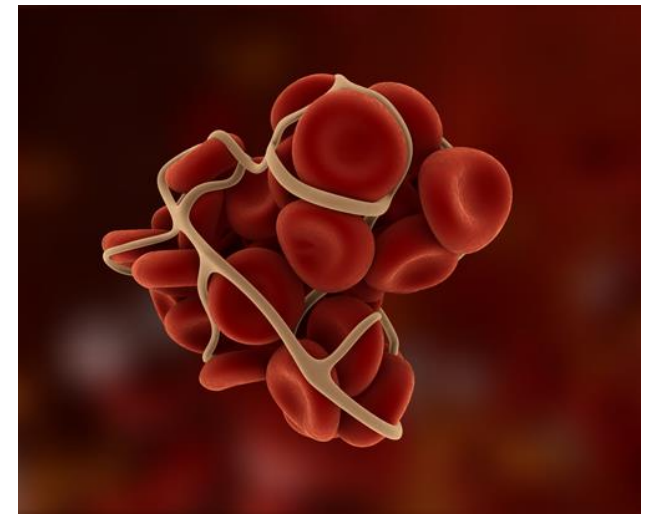
PN, postnatal
P-P, pre-pregnancy.



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Hematologic changes

- Pregnancy is a hypercoagulable state.
 - Increases in most pro-clotting factors
 - Decreases in the fibrinolytic system and inhibitors of coagulation.
- Risk of thromboembolic disease increases 5-fold to 6-fold.



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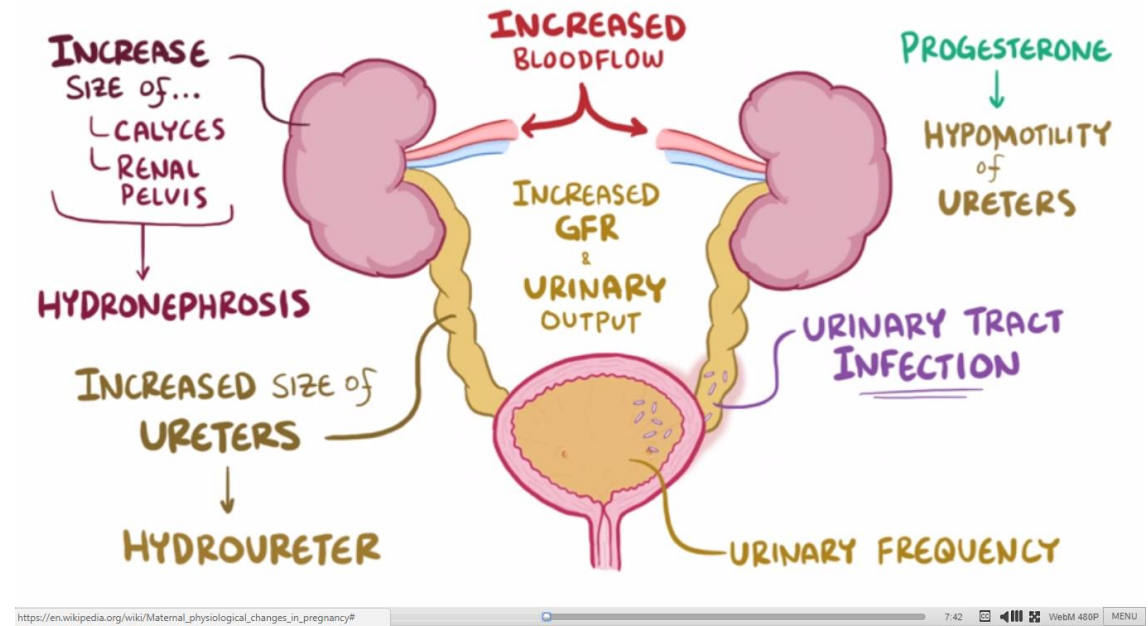
Respiratory System

- Upper Respiratory Tract
 - During pregnancy, the nasopharynx mucosa becomes edematous due to increased estrogen, leading to marked nasal stuffiness and decreased nasal patency.
- Lung Volume and Pulmonary Function
 - Alterations in chest wall configuration and diaphragm lead to reduced total lung capacity (TLC) and functional residual capacity (FRC).
- Gas Exchange
 - Increasing progesterone levels lead to chronic hyperventilation, low maternal PaCO₂, and chronic respiratory alkalosis.



Urinary System

- The kidneys enlarge during pregnancy, with **dilation of the ureters and renal pelvis**
- **Renal plasma flow rises 75% over nonpregnant levels by 16 weeks' gestation.** The increase is maintained until 34 weeks' gestation and returns to normal levels by 3 months postpartum.



Gastrointestinal system

- Appetite
 - The recommended dietary allowance calls for an additional 300 kcal/day, although in reality, most women make up for this with decreased activity.
- Stomach
 - Decreased smooth muscle tone, as a result of increased progesterone levels, may lead to heartburn.
- Nausea/vomiting
 - Nausea and vomiting (so-called morning sickness) complicates up to 70% of pregnancies, typically between 4 and 16 weeks gestation.



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Gastrointestinal system

- Intestines
 - Perturbations in the motility of the small intestines and colon are common in pregnancy and result in an increased incidence of constipation in some and diarrhea in others.
- Gallbladder
 - Because of progesterone, the rate at which the gallbladder empties is slowed, increasing the risk of gallstones.
- Liver
 - Although total body protein increases, serum albumin and total protein levels fall progressively during gestation as a result of hemodilution.
 - Pregnancy leads to changes in P450 enzyme activity, with corresponding implications for medication metabolism (Dallmann et al., Clin Pharmakin 2017)



Central Nervous System

- Changes in CNS in pregnancy are not well understood, despite the high prevalence of CNS symptoms such as headaches and cognitive changes.
- Estrogen and progesterone likely play significant roles, with known interactions with the immune system, HPA axis, and serotonin system.



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Microbiome

- Physiologic changes in the vagina interact with the vaginal microbiome to protect against infection and promote pregnancy maintenance.



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Psychological States of Normal Pregnancy

- “Pregnancy, like puberty or menopause, is a period of crisis involving profound psychologic as well as somatic change,” (Stotland) “.... from which there is no return.” (Bibring)



Psychological Stages of Pregnancy

- Preconception: Early preparation for motherhood starting in childhood (through play)
- First stage of pregnancy: realization of pregnancy to quickening
 - Primary task: acceptance of pregnancy
 - Most common fear: miscarriage
 - Common psychological changes:
 - Impaired memory
 - Emotional lability
 - Preoccupation with bodily needs (especially food)
 - Focus on secrecy/privacy of the knowledge of pregnancy



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Psychological Stages of Pregnancy

- Second stage: post-quickening to viability
 - Primary tasks:
 - Emotional attachment to fetus
 - Recognizing fetus as separate individual
 - Common changes
 - Decrease in uncomfortable physical symptoms -> relative calm
 - Increase in signs of nurturing, such as talking to fetus
 - Increase in anxiety about mothering, and identifying with own mother
 - With increasing awareness of fetus as separate entity, new feelings of ambivalence, resentment
 - As pregnancy begins to show, loss of control over who knows



alphacord.com/blog/2013/5/29/pregnancy-facts-second-trimester



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(Stotland and Stewart, Psychological Aspects of Women's Health Care, 2001)

Psychological Stages of Pregnancy

- Third stage: viability to end of pregnancy
 - Maternal-fetal attachment peaks, and at the same time, mother prepares for separation (delivery)
 - Major themes:
 - preparation for baby: nesting behaviors
 - somatic concerns and physical discomfort
 - worries about delivery
 - Baby's health
 - Pain
 - Loss of control



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References

- Gabbe et al., *Maternal Physiology, From Obstetrics: Normal and Problem Pregnancies*, 2nd ed, Elsevier, 2017
- *From Psychological Aspects of Women's Health Care: The Interface Between Psychiatry and Obstetrics and Gynecology, Second edition*, Nada Stotland and Donna Stewart (2001)
- Dallmann et al., A Physiologically Based Pharmacokinetic Model for Pregnant Women to Predict the Pharmacokinetics of Drugs Metabolized Via Several Enzymatic Pathways. *Clin Pharmacokin* 2017 (Epub)
- <https://www.clinicalkey.com/#!/browse/book/3-s2.0-C20130004082>

