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**Physiological Adaptation Of Pregnancy**

SKIN CHANGES

A number of changes take place in the skin of pregnant women. Mechanical stretching of the skin over the abdomen and breasts can lead to striate. The increased levels of estrogen and progesterone have also been implicated. Usually striate remain permanently with some change in colour. Prevention may be achieved with moisturizing creams, especially those containing lanolin and other oily substances. It should be realized, however, that striate may develop despite any preventative measures.

CHANGES IN THE GASTROINTESTINAL SYSTEM

Nausea and vomiting are the most frequent complaints involving the gastrointestinal system and usually happen in early pregnancy while heartburn happen primarily in late pregnancy. The gums become hyperaemic and oedematous during pregnancy and tend to bleed. The muscular wall of the oesophagus is relaxed and this may cause reflux, which in turn can lead to esophagitis and heartburn. The stomach and the intestines have decreased motility presumably due to the effect of progesterone on smooth muscle contractility. This causes an increase in the time that it takes for the stomach to empty. Reduced gastric secretion has also been documented and it could account for the improvement of peptic ulcers sometimes observed in pregnancy. Decreased motility of the large intestine may lead to constipation. The liver is affected significantly by pregnancy. Cholesteric jaundice is considered to be the result of estrogen effect on elimination of bilirubin by the liver. The effect of estrogen also, is to increase protein synthesis in the liver, which leads to increased production of fibrinogen and binding proteins. The liver enzymes are usually unaffected with the exception of alkaline phosphatase, which is increased at approximately two fold to four fold that is a result of a placental production. Pregnancy increases the size and decreases the motility of the gall bladder. The decreasing motility and increase in volume, combined with changes in the bile's composition, explain the correlation between the incidence of cholelithiasis and pregnancy.

## Cardiovascular system changes[[2](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-2)]

* There is peripheral vasodilation.
* Cardiac output increases by 20% by week 8, and then further up to 40% increase, maximal at week 20-28. In labour there is further increase in cardiac output and then a huge increase immediately after delivery, followed by return to normal within around an hour.
* Contributing to the increased cardiac output are increased stroke volume and an increase in heart rate of 10-20 beats per minute.
* Blood pressure is lower than normal in the first two trimesters but returns to normal in the third.
* Venous return in the inferior vena cava can be compromised in late pregnancy if a woman lies flat on her back due to pressure from the uterus, resulting in reduced stroke volume and cardiac output. This is relieved by lying in the left lateral position. Reduced cardiac output can compromise fetal blood supply.
* There is an increased risk of pulmonary oedema if there is an increase in blood volume, or increased pulmonary capillary permeability secondary to pre-eclampsia. The highest risk time is the second stage of labour or immediate postpartum period when cardiac output is high.
* Changes on examination and ECG below are caused by the physiological changes described above.

## Respiratory system changes[[2](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-2),[6](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-6)]

* Tidal volume increases by about 200 ml, increasing vital capacity and decreasing residual volume. In later stages of pregnancy, splinting of the diaphragm may occur with some decrease in tidal volume. Respiratory rate does not alter significantly.
* Increased oxygen consumption (by approximately 20%) and increased metabolic rate cause increased oxygen demand.
* State of compensated respiratory alkalosis - arterial pCO2drops, arterial pO2rises and decrease in bicarbonate prevents pH change. Lower maternal pCO2facilitates oxygen/carbon dioxide transfer to/from the fetus.
* Many women complain of feeling short of breath in pregnancy without hypoxia or explanatory pathology. The mechanism of this is not fully understood

## Urinary tract changes[[6](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-6)]

* The increased blood volume and cardiac output during pregnancy cause a 50-60% increase in renal blood flow and glomerular filtration rate (GFR). This causes an increased excretion and reduced blood levels of urea, creatinine, urate and bicarbonate.
* Mild glycosuria and/or proteinuria may occur because the increase in GFR may exceed the ability of the renal tubules to reabsorb glucose and protein.
* Increased water retention causes a reduction of plasma osmolality.
* The smooth muscle of the renal pelvis and ureter become relaxed and dilated, kidneys increase in length and ureters become longer, more curved and with an increase in residual urine volume.
* Bladder smooth muscle also relaxes, increasing capacity and risk of [urinary tract infection](https://patient.info/search.asp?searchterm=URINARY+TRACT+INFECTION++UTI&collections=PPsearch).
* The enlarging uterus may put pressure on the ureters.
* 2-10% of women have asymptomatic bacteriuria in pregnancy and if untreated up to 30% may develop acute pyelonephritis.[[7](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-7)]

## Musculoskeletal changes

* Increased ligamental laxity caused by increased levels of relaxin contribute to back pain and pubic symphysis dysfunction.
* Shift in posture with exaggerated lumbar lordosis leading to the typical gait of late pregnancy.

## Metabolic changes

* The basal metabolic rate increases slowly over the course of pregnancy, by 15-20%.
* It is thought that energy requirement does not increase significantly during the first or second trimesters, increasing by around 200 kcal per day in the third.[[9](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-9)]
* Active energy expenditure tends to fall over pregnancy.
* Recommended normal weight gain in pregnancy is 11.4 to 15.9 kg for a woman of normal body mass index (BMI).[[10](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-10)]Around 5 kg is the fetus, placenta, membranes and amniotic fluid and the rest is maternal stores of fat and protein and increased intra- and extra-vascular volume. Weight is no longer monitored in pregnancy as it does not affect outcome and is affected by a number of factors.

## Haematological changes[[2](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-2),[6](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-6)]

* Plasma volume increases over the course of pregnancy by about 50%. Dilutional anaemia is caused by the rise in plasma volume. Elevated erythropoietin levels increase the total red cell mass by the end of the second trimester but haemoglobin concentrations never reach pre-pregnancy levels.
* Usually mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC) are unaffected.
* A modest leukocytosis is observed.
* A normal pregnancy creates a demand for about 1000 mg of additional iron. This equates to 60 mg elemental iron or 300 mg ferrous sulfate per day.
* Serum iron falls during pregnancy whilst transferrin and total iron binding capacity rise.
* Levels of some clotting factors (VII, VIII, IX and X) and fibrinogen increase whilst fibrinolytic activity decreases. These changes protect from haemorrhage at delivery but also make pregnancy a hypercoagulable state with increased risk of thromboembolism. See separate [Venous Thromboembolism in Pregnancy](https://patient.info/doctor/venous-thromboembolism-in-pregnancy) article.
* One study found that during early pregnancy: antithrombin activity remained unchanged, protein S activity decreased significantly and there was a potentially biologically significant increase in protein C activity.[[8](https://patient.info/doctor/physiological-changes-in-pregnancy#ref-8)]See separate [Thrombophilia](https://patient.info/doctor/thrombophilia-pro) article.
* Serum albumin decreases.