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**Maternal physiological changes in pregnancy** are the adaptations during [pregnancy](#) that a woman's body undergoes to accommodate the growing [embryo](#) or [fetus](#).

These [physiologic](#) changes are entirely normal, and include [behavioral](#) (brain), [cardiovascular](#) (heart and blood vessel), [hematologic](#) (blood), [metabolic](#), [renal](#) (kidney), posture, and [respiratory](#) (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.

### Metabolic

During pregnancy, both [protein metabolism](#) and [carbohydrate metabolism](#) are affected. One [kilogram](#) of extra [protein](#) is deposited, with half going to the [fetus](#) and [placenta](#), and another half going to [uterine](#) contractile proteins, [breast glandular](#) tissue, plasma protein, and [haemoglobin](#).

An increased requirement for nutrients is given by fetal growth and fat deposition. Changes are caused by steroid hormones, lactogen, and cortisol.

Maternal insulin resistance can lead to [gestational diabetes](#). Increased liver metabolism is also seen, with increased gluconeogenesis to increase maternal glucose levels.

### Breast size

A woman's breasts grow during pregnancy, usually 1 to 2 cup sizes and 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](#) 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](#) causes the breasts to sag (referred to as *ptosis*). As a result, some new parents are reluctant to nurse their infants. In February 2009, [Cheryl Cole](#) told British [Vogue](#) 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](#) (BMI), her [number of pregnancies](#), her [breast cup size](#) before pregnancy, and age.

## **Body weight**

Some degree of weight gain is expected during pregnancy. The enlarging uterus, growing fetus, [placenta](#), [amniotic fluid](#), normal increase in body fat, and increase in water retention all contribute weight gain during pregnancy. The amount of weight gain can vary from 5 pounds (2.3 kg) to over 100 pounds (45 kg). In the United States, the range of weight gain that doctors generally recommend is 25 pounds (11 kg) to 35 pounds (16 kg), less if the woman is overweight, more (up to 40 pounds (18 kg)) if the woman is underweight.

## **Nutrition**

Nutritionally, pregnant women require a caloric increase of 350 kcal/day and an increase in protein to 70 or 75 g/day. There is also an increased [folate](#) requirement from 0.4 to 0.8 mg/day (important in preventing [neural tube defects](#)). On average, a weight gain of 20 to 30 lb (9.1 to 13.6 kg) is experienced.

All patients are advised to take [prenatal vitamins](#) to compensate for the increased nutritional requirements. The use of Omega 3 fatty acids supports mental and visual development of infants. Choline supplementation of research mammals supports mental development that lasRenal and lower reproductive tract

## **Genitourinary Changes in Pregnancy**

Progesterone causes many changes to the genitourinary system. A pregnant woman may experience an increase in the size of the kidneys and ureter due to the increase blood volume and vasculature. Later in pregnancy, the woman might develop physiological hydronephrosis and hydroureter, which are normal. Progesterone causes vasodilatation and increased blood flow to the kidneys, and as a result glomerular filtration rate (GFR) commonly increases by 50%, returning to normal around 20 weeks postpartum. The increased GFR increases the excretion of protein, albumin, and glucose. The increased GFR leads to increased urinary output, which the

woman may experience as increased urinary frequency. Progesterone also causes decreased motility of the ureters, which can lead to stasis of the urine and hence an increased risk of urinary tract infection.

Pregnancy alters the vaginal microbiota with a reduction in species/genus diversity.

Physiological hydronephrosis may appear from six weeks through throughout life.

## **Gastrointestinal**

Changes in the gastrointestinal (GI) system during pregnancy are caused by the enlarging uterus and hormonal changes of pregnancy. Anatomically, the intestine and stomach are pushed up from their original positions by the enlarging uterus. While there aren't any intrinsic changes in the sizes of the GI organs, the portal vein increases in size due to the hyperdynamic state of pregnancy. Elevated levels of [progesterone](#) and [estrogen](#) mediate most of the functional changes of the GI system during pregnancy. Progesterone causes smooth muscle relaxation which slows down GI motility and decreases [lower esophageal sphincter](#) (LES) tone. The resulting increase in intragastric pressure combined with lower LES tone leads to the gastroesophageal reflux commonly experienced during pregnancy.

The increased occurrence of gallstones during pregnancy is due to inhibition of gallbladder contraction (as result of increased smooth muscle relaxation mediated by progesterone) and reduced biliary transportation of bile (mediated by estrogen) which results in [cholestasis of pregnancy](#).

Nausea and vomiting of pregnancy, commonly known as “[morning sickness](#)”, is one of the most common GI symptoms of pregnancy. It begins between the 4 and 8 weeks of pregnancy and usually subsides by 14 to 16 weeks. The exact cause of nausea is not fully understood but it correlates with the rise in the levels of [human chorionic gonadotropin](#), [progesterone](#), and the resulting relaxation of smooth muscle of the stomach. [Hyperemesis gravidarum](#), which is a severe form of nausea and vomiting of pregnancy can lead to nutritional deficiencies, weight loss, electrolytes imbalance and is one of the leading causes of hospitalization in the first trimester of pregnancy.

[Constipation](#) is another GI symptom that is commonly encountered during pregnancy. It is associated with the narrowing of the colon as it gets pushed by the growing uterus found adjacent it leading to mechanical blockade. Reduced motility in the entire GI system as well as increased absorption of water during pregnancy are thought to be contributing factors.

Dietary cravings and dietary as well as olfactory avoidance of certain types of food are common in pregnancy. Although the exact mechanisms of these symptoms are not fully explained, it is

thought that dietary cravings may arise from the thought that certain foods might help relieve nausea. [Pica](#), which is the intense craving for unusual materials such as clay and ice has also been reported in pregnancy.

Hemorrhoids and gingival disease are two common pregnancy associated physical findings involving the gastrointestinal system. Hemorrhoids arise as a result of constipation and venous congestion that are common in pregnancy. Gingival disease is thought to be related to gum softening and edema (swelling from fluid collection) that is mostly observed in pregnancy. The mechanism and reason for the gingival changes are poorly understood.

## **Musculoskeletal**

Neuromechanical adaptations to pregnancy refers to the change in gait, postural parameters, as well as [sensory feedback](#), due to the numerous anatomical, physiological, and hormonal changes women experience during [pregnancy](#). Such changes increase their risk for [musculoskeletal](#) disorders and fall injuries. Musculoskeletal disorders include lower-back pain, leg cramps, and [hip pain](#). Pregnant women fall at a similar rate (27%) to women over age of 70 years (28%). Most of the falls (64%) occur during the second trimester. Additionally, two-thirds of falls are associated with walking on slippery floors, rushing, or carrying an object. The root causes for these falls are not well known. However, some factors that may contribute to these injuries include deviations from normal [posture](#), [balance](#), and [gait](#).

The body's posture changes as the pregnancy progresses. The pelvis tilts and the back arches to help keep balance. Poor posture occurs naturally from the stretching of the woman's abdominal muscles as the fetus grows. These muscles are less able to contract and keep the lower back in proper alignment. The pregnant woman has a different pattern of gait. The step lengthens as the pregnancy progresses, due to weight gain and changes in posture. On average, a woman's foot can grow by a half size or more during pregnancy. In addition, the increased body weight of pregnancy, fluid retention, and weight gain lowers the arches of the foot, further adding to the foot's length and width. The influences of increased hormones such as [estrogen](#) and [relaxin](#) initiate the remodeling of soft tissues, cartilage and ligaments. Certain skeletal joints such as the [pubic symphysis](#) and [sacroiliac](#) widen or have increased laxity.

The addition of mass, particularly around the [torso](#), naturally changes a pregnant mother's [center of mass](#) (COM). The change in COM requires pregnant mothers to adjust their bodies to maintain [balance](#).

