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ELUDINATE THE PHYSIOLOGICAL ADAPTATION OF FEMALE TO PREGNANCY

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.

Breast size

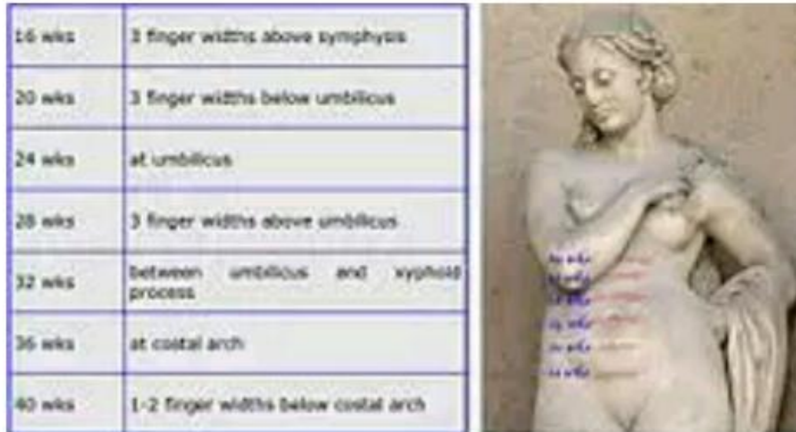
A woman's breasts grow during pregnancy, usually 1 to 2 cup sizes [citation needed] and potentially several cup sizes. A woman who wore a C cup bra prior to her pregnancy may need to buy an F cup or larger bra while nursing. A woman's torso also grows and her bra band size may increase one or two sizes. 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 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.

Edema

Edema , or swelling, of the feet is common during pregnancy, partly because the enlarging uterus compresses veins and lymphatic drainage from the legs.

Body weight

Illustration of fundal height at various points during pregnancy



16 wks	3 finger widths above symphysis
20 wks	3 finger widths below umbilicus
24 wks	at umbilicus
28 wks	3 finger widths above umbilicus
32 wks	between umbilicus and xyphoid process
36 wks	at costal arch
40 wks	1-2 finger widths below costal arch

Illustration of fundal height at various points during pregnancy

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.

Lumbar lordosis

To positionally compensate the additional load due to the pregnancy, pregnant mothers often extend their lower backs. As the fetal load increases, women tend to arch their lower backs, specifically in the lumbar region of their vertebral column to maintain postural stability and balance. The arching of the lumbar region is known as lumbar lordosis , which recovers the centre of mass into a stable position by reducing hip torque . According to a study conducted by Whitcome, et al., lumbar lordosis can increase from an angle of 32 degrees at 0% fetal mass (i.e. non- pregnant women or very early in pregnancy) to 50 degrees at 100% fetal mass (very late in pregnancy). Postpartum, the angle of the lordosis declines and can reach the angle prior to pregnancy. Unfortunately, while lumbar lordosis reduces hip torque, it also exacerbates spinal shearing load, which may be the cause for the common lower back pain experienced by pregnant women.

Gait

Gait in pregnant women often appear as a “waddle” – a forward gait that includes a lateral component . However, research has shown that the forward gait alone remains unchanged during pregnancy. It has been found that gait parameters such as gait kinematics , (velocity , stride length, and cadence) remain unchanged during the third trimester of pregnancy and 1 year after delivery. These parameters suggest that there is no change in forward movement. There is, though, a significant increase in kinetic gait parameters, which may be used to explain how gait motion remains relatively unchanged despite increase in body mass, width and changes in mass distribution about the waist during pregnancy. These kinetic gait parameters suggest an increased use of hip abductor , hip extensor, and ankle plantar flexor muscle groups. To compensate for these gait deviations, pregnant women often make adaptations that can result in musculoskeletal injuries. While the idea of "waddling" cannot be dispensed, these results suggest that exercise and conditioning may help relieve these injuries.

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. Haemorrhoids and gingival disease are two common pregnancy associated physical findings involving the gastrointestinal system. Haemorrhoids 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.

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.

Endocrine System

During pregnancy a woman experiences a change in her endocrine system. Throughout pregnancy the levels of progesterone and oestrogen increase; the oestrogen being produced by the placenta and the progesterone being produced by the corpus luteum and later by the placenta. Increase in oestrogen levels results in an increase in hepatic production of thyroid binding globulin (TBG). As a result, more free T3 and T4 bind to the TBG, this causes more thyroid stimulating hormone to be released from the anterior pituitary gland. Therefore, the free T3 and T4 levels remain unchanged – but the total T3 and T4 levels rise.

Thyroxin is essential for foetus's neural development, but the foetal thyroid gland is not functional until the second trimester of gestation. Hence, increasing T3 and T4 levels in the mother ensures that there is a constant supply of thryoxin to the foetus early in pregnancy.

During pregnancy, mainly during there second trimester, there is an increase of human placental lactogen, prolactin, cortisol levels along with the increase in progesterone and oestrogen levels. These are anti-insulin hormones therefore, they increase insulin resistance in the mother and reduce peripheral uptake of glucose. This ensures that there is a continuous supply of glucose for the

foetus. The mother switches to an alternative source of energy which is provided by lipids. The increase in lipolysis means that there is an increase in free fatty acids in the plasma which provide substrate for maternal metabolism. The breakdown of lipids can result in ketogenesis thus, pregnancy is associated with an increased risk of ketoacidosis .

Urinary System

Increased cardiac output during pregnancy causes an increase in renal plasma flow which increases the GFR by about 50-60%. This would mean that there is an increase in renal excretion. So in pregnancy the levels of urea and creatinine will be lower. Progesterone affects the urinary collecting system causing relaxation of the ureter (resulting in hydroureter). There is also relaxation of the muscles of the bladder. Both of these changes causes urinary stasis which predisposes a woman to UTIs, commonly pyelonephritis.

Respiratory System

Anatomically, the growth of the foetus during pregnancy causes upward displacement of the diaphragm. This however, does not decrease the total lung capacity significantly since there is also an increase in the transverse and anterior-posterior diameters of the thorax.

In pregnancy a woman faces an increase in their metabolic rate which leads to an increased demand for oxygen. The tidal volume and the minute ventilation rate increases to help the mother meet the oxygen

demands. Many women experience hyperventilation during pregnancy. It is thought that the reason for this is the increased carbon dioxide production and the increased respiratory drive caused by progesterone. This hyperventilation results in a respiratory alkalosis with a compensated increase in renal bicarbonate excretion.