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PREGNANCY

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PREGNANCY

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SUMMARY

Beginning in the first trimester of pregnancy, physiological changes occur in a pregnant woman's body as she adapts to the demands of carrying a foetus. These changes appear to be amplified in women who exercise during pregnancy. For example, the blood volume increases and the heart pumps more blood around the body each minute. Early in the pregnancy, adaptations also appear in the mechanisms for heat loss and gain, which may be protective for the foetus and limit thermal stress in women who continue physical activity throughout their pregnancy. Beginning or continuing a regular program of recreational exercise during pregnancy is safe and beneficial for healthy women and their offspring.

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TAKE HOME MESSAGES:

- Maternal physiology changes during pregnancy.
- In physically active women, these physiological changes are amplified.
- Women show thermoregulatory (heat gain/loss) adaptations during pregnancy.
- Recreational exercise before and during pregnancy is safe and beneficial for healthy women and their offspring.
- Regular physical activity before pregnancy is associated with decreased risk of gestational diabetes.
- Regular physical activity during early pregnancy reduces the risk of preeclampsia.
- Aerobic exercise in pregnant women improves maternal physical fitness and wellbeing.
- Aerobically fit nulliparous women (no previous children) have shorter duration of labour.
- Moderate exercise during pregnancy does not increase the risk of intrauterine growth restriction.
- Exercise during pregnancy can improve the Apgar score.

PREGNANCY AND PHYSICAL ACTIVITY

As the health benefits of exercise have been increasingly recognised over the past decades, more women have become physically active in recreational and competitive sports. In 2005, 77% of Norwegian women older than 15 years were physically active once or more per week. When they become pregnant, many of them wish to continue light training, while other women such as competitive athletes want to perform vigorous exercise. Therefore, the effects of exercise during pregnancy—on both the mother and the foetus—are increasingly researched. These questions, amongst others, are being asked: Does physical activity during pregnancy influence the length of gestation, the incidence of abortion, the frequency of preeclampsia and gestational diabetes, and the course and length of the labour? Could physical activity during pregnancy have health benefits for women during, and after, pregnancy? Could physical activity during pregnancy cause foetal distress, overheating or growth restriction? How does maternal exercise affect the health of the foetus, complications during labour, and diseases in the short and long term?

Several physiological changes that occur during pregnancy affect the exercising pregnant woman. Blood volume begins to increase in the first trimester of pregnancy. Cardiac output also increases due to a rise in heart rate and stroke volume.[1] These changes are seen as early as 5 weeks of gestation, and by 12 weeks, the cardiac output is about 35% above pre-pregnancy levels. This rise accounts for 75% of the total increase in cardiac output during pregnancy. Regular exercise also increases cardiac output and blood volume. These physiological changes appear to be amplified in women who exercise during pregnancy. If women who exercise before pregnancy and continue to exercise during their pregnancy are compared with women who don't continue to exercise, the increase in cardiac output seen in the first group is 40% more than that of the second group. Similarly, the blood volume rises by an extra 20% in women who continue to exercise.

During exercise, some blood vessels dilate, which increases the blood flow to the heart, the working muscles and the skin, while other vessels supplying the internal organs constrict (narrow) and decrease the blood flow to these areas. The blood flow to the spleen can decrease by about 40–50% during exercise in non-pregnant women. Simultaneously, blood flow to the uterus decreases. In the exercising pregnant woman, this may decrease blood flow to the uterus, the placenta and the foetus. Animal studies show a decreased blood flow to the uterus during exhausting exercise. However, the blood flow to the uterus will not decrease as much if the animal has been physically trained. Studies in ewes confirm that compensatory mechanisms such as a preferential shift of blood flow to the placenta and an increased oxygen extraction from the blood ensure that the supply of nutrients and oxygen to the developing foetus is adequate. In addition, physical conditioning may minimise the exercise-induced fall in uterine blood flow.

Thermal stress

Research has shown an association between an increased maternal core body temperature and neural tube defects[2] and other congenital anomalies. In these studies, the heat stress was produced by illness with fever or hot-tub immersion, not exercise. There are no reports that an increased body temperature due to exercise is teratogenic (causes foetal abnormalities). Changes in core temperature in exercising pregnant women depend on the intensity and

1 *Cardiac output* is the volume of blood pumped out of the heart per minute. Therefore, it depends on the heart rate (how many times the heart beats per minute) and how much blood is pumped out with each beat (the *stroke volume*).

2 *Neural tube defects* are abnormalities in the formation of the spinal cord and/or brain in the developing foetus and are present at birth (congenital). Spina bifida is a well-known example of these defects.

duration of the exercise. In one study, the core temperature did not increase more than 0.6 ºC during, or after, 60 minutes of exercise at 55% of maximal oxygen consumption.[3] The increased blood volume in pregnancy may create a mechanism that improves heat loss from the body.

The foetus also has mechanisms that protect it from thermal stress. In studies of pregnant ewes that were exercised for 30 minutes, the increase in body temperature was significantly less in the foetus than in the mother. Studies in humans show that the maternal temperature reached by exercising pregnant women is less than their pre-pregnancy values, even if the exercise is at the same relative load. This phenomenon is seen early in the first trimester and increases as the pregnancy progresses.

At 7 weeks of gestation, the maximum maternal temperature reached during exercise falls by 0.3 ºC and continues to fall at a rate of 0.1 ºC for each month of gestation. Near term, the maximum rise in temperature is reduced by more than 70% of pre-pregnancy values. In addition, the temperature at which sweating starts is also lowered from the seventh week and continues to fall throughout the pregnancy. The downward shift in the temperature 'set point' for sweating allows heat loss from the evaporation of sweat to occur at a lower body temperature. The increasing maternal weight also means that more heat must be produced to raise the body temperature by a given amount. These thermoregulatory adaptations appear in early pregnancy, and therefore probably exert a protective effect during foetal development. The adaptations may also limit thermal stress in women who continue physical activity throughout their pregnancy.

MATERNAL RESPONSES TO EXERCISE DURING PREGNANCY

Many studies show that physical activity is important in promoting health, improving quality of life, and preventing and controlling various diseases. Exercise is a critical component of strategies for the prevention and treatment of diabetes, hypertension, cardiovascular disease and obesity in non-pregnant women and in men. However, pregnancy is a special physiological condition in which such benefits may not always occur. Some decades ago, pregnant women were advised to reduce their level of physical activity, whatever their level of physical fitness or condition before they became pregnant. However, the American College of Obstetricians and Gynaecologists now recognises the positive effect of regular physical activity during pregnancy and encourages exercise for women with an uncomplicated pregnancy.

Limited data exists on the impact of exercise on maternal fitness, symptoms of pregnancy, maternal wellbeing, maternal weight gain, labour and delivery outcomes; the available data are also conflicting. However, a meta-analysis, which combines and analyses the results of a number of research studies, indicates that improved maternal physical fitness and wellbeing are associated with exercise during pregnancy.

Fitness

Women who exercise during pregnancy benefit from improved maternal fitness, aerobic capacity and overall exercise performance. Well-trained women who maintained a moderate-to-high exercise regimen during and after pregnancy were shown to have a small,

3 *Maximal oxygen consumption* is a measure correlated with maximum exercise capacity.

but significant, increase in maximal oxygen uptake following pregnancy. Other studies of women who were sedentary before conception found significant increases in their maximal aerobic power and their capacity for sustained sub-maximal exercise after they cycled on an ergometer between 17 weeks of gestation and the third trimester of pregnancy. These, and other, studies support the hypothesis that aerobic physical activity in pregnant women can increase maternal aerobic fitness and delay the start of blood lactate accumulation during graded exercise testing.

Symptoms of pregnancy and wellbeing

Improved aerobic fitness is not the only result of exercise during pregnancy. Women who are engaged in physical exercise during pregnancy report a higher level of psychological wellbeing and less physical complaints, insomnia and anxiety than do non-exercising pregnant women. Compared to women who decrease their exercise level or are sedentary during pregnancy, women who continue physical exercise throughout pregnancy for at least 20 minutes three times a week report fewer pregnancy-related symptoms such as nausea, heartburn, leg cramps, and ligament and low back pain during the first and third trimesters. Those who exercise before pregnancy, but stop when they become pregnant, maintain some benefit throughout the pregnancy. However, the benefit is not as great as that in women who continue physical exercise during pregnancy. Women who exercise in the beginning of their pregnancy, but decrease their exercise later in the pregnancy, report fewer negative symptoms than sedentary pregnant women report. Improvement in self-image has also been reported with exercise during pregnancy. Furthermore, compared to women who do not exercise, women who start to exercise during pregnancy have a significant improvement in perceived physical health, muscular strength, energy level and body composition.

Weight gain

There are conflicting data on weight gain in exercising versus sedentary pregnant women. Several observational studies and one meta-analysis found no difference in maternal weight gain between women performing different types of exercise, women exercising at varying intensities, or women exercising at different frequencies and durations. However, the meta-analysis did not differentiate between various exercise regimens with differing intensities, duration and frequencies. These factors may influence maternal weight gain. An observational study compared fit women who continued to exercise three times per week, for 30 minutes, until 37 week of gestation with women who stopped exercising when they became pregnant. The researchers found that the rate of weight gain was similar in the two groups in the first trimester, but was significantly less (3 kg) in the second and third trimesters in the exercising group. Others report a smaller weight gain (1.8 kg less) in pregnant women after a non-endurance exercise program (emphasising strength and stretch training) for at least 2 hours per week for 12 weeks, compared to the weight gain of sedentary pregnant women. The amount, intensity and timing of the exercise during pregnancy probably determine the amount of weight gain. In all these studies, the women volunteered to participate and selected for themselves a given pattern of physical activity during pregnancy. Possibly, some of these women had different eating habits and healthier lifestyles than the sedentary women, which may have contributed to the reduced weight gain, regardless of the exercise program.

The effects of a lifestyle intervention program on weight gain during pregnancy in overweight and obese women have been studied. The intervention combined changes in nutrition

and exercise. The women entered the study between 16 and 20 weeks of gestation and exercised at 30% of their peak heart rate reserve two to three times per week. In addition, each woman had an individualised diet with a total energy intake of approximately 2000 kcal/day. The intervention program resulted in a mean weight gain of 6.6 kg. The mean total weight gain (for the entire pregnancy) was 12.0 kg. According to recommended guidelines, the women gained more weight than recommended before the program, but while on the program their weight gain was within the guidelines of 0.3–0.4 kg/week.

Gestational diabetes

Exercise, dietary adjustments and weight loss (plus insulin when needed) are components of the treatment of type 2 diabetes. Evidence suggests that type 2 diabetes can be prevented by changes in lifestyle (exercise and nutrition) in both women and men at high risk for the disease. This implies that exercise during pregnancy could also reduce the risk of complications related to high blood glucose. Abnormalities of insulin secretion and signs of type 2 diabetes have been identified in gestational diabetes (GDM). GDM is a form of diabetes that is first diagnosed during pregnancy, usually between 24 and 28 weeks. There are modifiable and un-modifiable risk factors for developing GDM. The un-modifiable risk factors are a family history of diabetes, pre-pregnancy weight, parity, ethnicity, maternal age, GDM in a previous pregnancy, and a history of large babies weighing more than 4000 g. The modifiable factors are sedentary lifestyle, persistent obesity (BMI equal to or above 30 kg/m^2), and future weight gain. In fact, regular physical activity before pregnancy is associated with a decrease in GDM risk. Unfortunately, few studies have investigated whether exercise can reduce the incidence of GDM in at-risk groups of women. A self-reported questionnaire on physical activity was used in one study of pregnant women who participated in a leisure exercise program. The study found that regular participation in any recreational physical activity during the year before and/or during the first 20 weeks of pregnancy was associated with nearly a 50% reduction in the incidence of GDM. Another study investigated low-risk pregnant women in late gestation and found that mild exercise (30% of peak oxygen uptake) on a stationary bicycle was better at promoting glucose utilisation after exercise than was moderate-intensity exercise (70% of peak oxygen uptake). Nevertheless, investigators have not been able to suggest a cost-effective, easily available, evidence-based program with guidelines for frequency, intensity, duration, and type of physical activity in order to reduce the incidence of GDM in sedentary, at-risk populations.

Preeclampsia

Preeclampsia is a condition associated with high blood pressure and protein in the urine in women after the 20th week of gestation. The physiological changes associated with regular exercise have been postulated to protect against preeclampsia. Suggested mechanisms for such an effect include increased placental growth and vascularity (the number of blood vessels), reduced oxidative stress, and exercise-induced reversal of maternal vascular problems. Compared with inactive women, women who engaged in any regular physical activity during early pregnancy experienced a 35% reduced risk of preeclampsia. The risk of preeclampsia decreased in proportion to the exercise intensity and the total energy expended during the activity. However, other studies concluded that the preventive effect of recreational physical activity during pregnancy may be less than that previously shown, and may apply only to women who are not obese. In addition, these studies were unable to document a protective effect of leisure-time physical activity against preeclampsia. Thus, the evidence is insufficient to draw firm conclusions on the ability of exercise to prevent preeclampsia and its related complications.

Early pregnancy loss (miscarriage), preterm labour and length of gestation

Two large observational studies did not find any difference in the miscarriage rate of fit women who either continued or stopped exercising during pregnancy. Two meta-analyses also support these findings.

However, there are conflicting results regarding exercise during pregnancy and the risk of preterm birth (less than 37 weeks) and the length of gestation. Some large studies, supported by smaller randomised trials and meta-analyses, reported a similar incidence of preterm labour and similar gestational age at delivery in women who exercised during pregnancy and a control group of non-exercising women. Another study also found no difference in the incidence of preterm labour in women who continued to exercise during pregnancy and women who discontinued their regular exercise regimen before the end of the first trimester. However, the women who continued to exercise began labour significantly earlier: the onset of labour at or near term occurred, on average, five days earlier.

Labour and delivery outcomes

An observational study of 750 military women on active duty compared women who did not exercise during pregnancy with those who did. The women who continued to exercise were more likely to need an induction of labour and had a longer first stage of labour. However, there were no differences in the mode of delivery, in the duration of the second (from 10 cm cervix dilation until the birth of the baby) or the third stages of labour (from the birth of the baby until the delivery of the placenta), or in the use of epidural anaesthesia. In contrast, another observational study compared healthy, low-risk, fit pregnant women who continued to exercise regularly at or above 50% of their pre-conception level throughout pregnancy with matched women who discontinued their regular exercise regimen before the end of first trimester. Results showed that the women who continued to exercise during pregnancy needed less epidural anaesthesia, had more vaginal deliveries, fewer forceps deliveries and fewer caesarean sections. In addition, these women had also a shorter first stage of labour and fewer cases of episiotomies (an incision made between the vagina and anus to assist in vaginal birth). There are also suggestions that nulliparous women (women with no previous pregnancies) with higher aerobic fitness have a shorter duration of labour than that of nulliparous women with lower aerobic fitness.

FOETAL RESPONSES TO EXERCISE DURING PREGNANCY

Foetal heart rate

The hypothetical issues of decreased blood flow to the uterus and increased maternal temperature have led to a concern about foetal wellbeing during exercise. The foetal heart rate often serves as an indicator of foetal wellbeing or foetal distress. Research has shown various effects on the foetal heart rate during maternal exercise, including foetal bradycardia (low heart rate), no change in the heart rate, and foetal tachycardia (high heart rate). These variations might be due to differences in how the trials were performed, differences in exercise regimens (e.g. type, duration and intensity of the exercise), and maternal variables (e.g. maternal position during exercise and fitness level). Some investigators recorded that bradycardia (in 15 of 79 maximal exertion tests) occurred within 2 minutes of stopping after maximal exercise and lasted for a median of 90 seconds. However, after sub-maximal exertion (70% of maximal aerobic capacity) with a maternal heart rate of 148 beats per minute, only three episodes of bradycardia were recorded. This finding indicates that

bradycardia occurring after exercise could be the result of an abrupt decrease in maternal cardiac output, rather than the result of prolonged hypoxia (lack of oxygen). Hence, sub-maximal exercise is rarely associated with foetal bradycardia and is not related to adverse foetal outcomes.

Other studies report mild transient increases in foetal heart rate during sub-maximal exercise. However, only 10% reached mild tachycardia (160–180 beats per minute) in one of the studies. Possible causes of the increased foetal heart rate are awakening of the foetus, placental transfer of maternal catecholamines ('stress hormones') and a rise in maternal temperature. However, all these studies indicated no significant risk of adverse changes in foetal heart rate when pregnant women exercised at sub-maximal levels.

Birth weight

The literature contains inconsistent data with regard to the effect of exercise during pregnancy on birth weight. There are studies reporting increases, no difference and decreases in the birth weight when comparing women who exercise during pregnancy to those who do not. Based on maternal exercise status, a meta-analysis reported no difference in birth weight.

One of the investigations that reported decreased birth weight studied mothers who continued moderate- to high-intensity exercise late into the third trimester. The results indicated that the newborns of the exercising mothers had reduced foetal fat mass, but no difference in head circumference, crown–heel length or lean body mass. They concluded that approximately 70% of the difference in birth weight could be explained by the difference in neonatal fat mass. Recently, another study showed that babies born to women in the highest quartile of physical activity weighed 608 g less than babies born to women in the lowest quartile. The inverse relationship between physical activity and foetal growth was modified by increased maternal height. Thus, physical inactivity may be a risk factor for excessive foetal growth in taller women.

Although there are conflicting results regarding the effects of exercise on birth weight, there is consistent evidence that moderate exercise during pregnancy is not associated with an increased risk of intrauterine growth restriction. On the other hand, physical inactivity before pregnancy can lead to the birth of macrosomic children (birth weight higher than 4.2 g). A low level of pre-gestational physical activity (less than 1 hour per week) can be a significant determinant of delivering a macrosomic infant. Hence, the main conclusion may be that 'beginning or continuing a regular program of recreational exercise during pregnancy is safe and beneficial for healthy women and their offspring'.

Apgar score

An Apgar score is defined as 'an objective score of the condition of a baby after birth. This score is determined by scoring the heart rate, respiratory effort, muscle tone, skin color, and response to a catheter in the nostril. Each of these objective signs receives 0, 1, or 2 points. An Apgar score of 10 means an infant is in the best possible condition. The Apgar score is done routinely 60 seconds after the birth of the infant.' (http://www.medterms.com/script/main/art.asp?articlekey=2303). Physical activity during pregnancy has no negative impact on 1-minute or 5-minute Apgar scores. In fact, some studies showed improved Apgar scores and a significant decrease in cord abnormalities in women who continued to exercise during pregnancy, compared to those who stopped exercising. Cord abnormalities were defined as true knots in the cord, velamentous insertion of the cord (the umbilical cord inserts away from the centre of the placenta), abnormally short cords and cords wrapped completely

around the foetal neck. Data also show no apparent adverse outcomes in women who exercised at intensities and durations above the 1978 ACOG recommendations (i.e. at more than 90% of maximal heart rate and more than 60 minutes of continuous aerobic activity).

GUIDELINES FOR PHYSICAL ACTIVITY DURING PREGNANCY

Training for aerobic fitness

As a general rule, all pregnant women should be moderately physically active (no less than 12–13 on the Borg scale; Table 1) for at least 30 minutes a day—even if they were relatively inactive before pregnancy. Conditioning training (Borg scale 14–15) can also be started during pregnancy. The exercise intensity must be high enough to cause the woman to sweat and feel out of breath. This kind of physical activity can be performed as close to term as the woman feels comfortable.

The pregnant woman should find an activity she likes to make it easier to maintain the activity throughout the pregnancy. Generally, all types of physical activity can be performed during pregnancy, with the most important determinant being that the woman feels good while she is active. However, some types of physical activity are not recommended, for example, diving, because of the low oxygen pressure to which the mother and, thereby, the foetus are exposed. Horseback riding and climbing are also not recommended because of the danger of falls. In fact, any physical activity that includes falling, or potentially falling, is best avoided. Likewise, after 3–4 months gestation, playing contact sports such as martial arts, football or handball is not recommended. The pregnant woman should also avoid endurance training in hot weather with high humidity, or if she has a fever, because the foetus cannot easily regulate the increasing temperature under these circumstances.

Table 1. Borg's rating scale of perceived exertion (RPE)

Number	Descriptor
6	No exertion at all
7	Very, very light — resting
8	
9	Very light — gentle walking
10	
11	Fairly light
12	
13	Somewhat hard — steady pace
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	Exhaustion

Please insert permission or data source as appropriate

Strength training

As the foetus grows, the woman's muscles of the back, the stomach and the pelvic floor have to become stronger to support the foetus. After the birth of the baby, the woman needs to lift and carry the child. Therefore, pregnant women should perform strength training of these muscles groups. Training the muscles of the arms and legs is also advisable.

Training all the body muscles two to three times a week is recommended. The strength training can be performed at home, either with or without light weights, or using training machines in fitness centres. Every exercise performed should be held for 6–8 seconds and repeated 8–12 times. These sets should be repeated two to three times during every training session.

Special physical activity for athletes

Women who have been very physically active (e.g. weight-bearing or non-weight-bearing fitness training) before becoming pregnant may continue their activity during the pregnancy, with these provisos: that the pregnancy is uncomplicated; that they make a small reduction in the amount and intensity of the exercise; and that they continue to feel good while exercising. Women who have been doing significant strength training before becoming pregnant can continue their routine as long as they feel comfortable.

Preventive physical activity

Women with a predisposition for gestational diabetes or preeclampsia should be physically active beyond the general recommendations for amount and intensity of exercise. Strength training with light weights or workout machines can begin during pregnancy and provide benefits. For all women, good muscle strength in the back and stomach may protect against low back pain during the pregnancy and make it easier to regain body shape after pregnancy. Non-weight-bearing physical activities such as swimming, water gymnastics and bicycling are recommended for women with back or pelvic pain, and are also generally recommended for women in late pregnancy. Urinary incontinence can be prevented by training the pelvic floor muscles during and after pregnancy.

PREGNANCY AND NUTRITION

Pregnant women need to achieve good nutritional status before, during and after pregnancy to optimise maternal health and to reduce the risk of birth defects and chronic disease in their children into adulthood. The principal metabolic nutrients for the foetus are glucose and amino acids. Glucose is the most important energy-producing substrate for basal metabolism and protein synthesis, and contributes to energy storage in the form of glycogen and fat in the foetus. Amino acids are used as the building blocks for proteins.

Macronutrients

To meet energy and nutrient needs, pregnant women should eat a variety of foods, according to the Norwegian recommendations for nutrition and physical activity: 'Norske anbefalinger for ernæring og fysisk aktivitet' (2005). The average energy intake in 23 899 subjects in the Norwegian Mother and Child Cohort Study (MoBa) conducted from 2002 to 2006 was 9958 kJ (2371 kcal) per day, while the corresponding result from a Danish study was 9967 kJ (2373 kcal) per day.

Micronutrients

The MoBa study also showed that use of oral supplements improved the intake of folic acid, iron and vitamin D, but was not sufficient to reach the recommended levels. Folic acid supplements taken before and during pregnancy can reduce the risk of neural tube defects and other birth defects. Vegans and other strict vegetarians should also take a vitamin B_{12} supplement. Low vitamin B_{12} status may increase the risk of birth defects such as neural tube defects and may be a contributing factor in preterm delivery, although further research in needed on this topic. If a woman is iron deficient when she becomes pregnant, replenishing her iron stores during pregnancy can be difficult. Iron supplementation before pregnancy may improve maternal iron stores during pregnancy. Although vitamin and mineral supplementation may be beneficial for many women, care is needed to avoid excessive levels of intake. In particular, too much vitamin A early in pregnancy can cause birth defects. Furthermore, results from two major reviews did not find any evidence that routine antioxidant supplementation during pregnancy reduces the risk of preeclampsia or other serious complications. Nor is an increased garlic intake recommended. By contrast, calcium supplementation does appear beneficial for women at high risk of gestational hypertension and for women in communities with a low dietary intake of calcium.

BMI before pregnancy and weight gain during pregnancy

The US Institute of Medicine recommends a specific pattern of weight gain during pregnancy that is associated with the best pregnancy outcomes (Table 2). Nevertheless, many women do not gain weight within these ranges. Gestational weight gain above the guidelines is more common than gestational weight gain below. Recommendations for weight gain during pregnancy should be individualised according to pre-gestational BMI to improve pregnancy outcomes, avoid excessive weight retention by mothers postpartum, and diminish the risk of adult chronic disease in the child.

Table 2. Ranges for total weight gain recommended by the United States Institute of Medicine* for women with singleton pregnancies

Pre-pregnancy Body Mass Index category (kg/m^2)	Recommended total gain (kg)
Low (less than 18.5)	12.5–18.0
Normal (18.5–24.9)	11.5–16.0
High (25.0–29.9)	7.0–11.5
Obese (equal to or more than 30.0)	5.0–9.0

See IOM & NRC (2009)

Preeclampsia

A study showed that a dietary pattern characterised by a high intake of vegetables, fruits, rice, vegetable oils and poultry was associated with a reduced risk of preeclampsia, whereas a high intake of processed foods such as sausages, hamburgers, white bread, salty snacks and sugar-sweetened drinks increased the risk of preeclampsia. This result agrees with that of a previous study, which showed that a high caloric intake coupled with high intakes of sucrose and polyunsaturated fatty acids increased the risk of preeclampsia.

Gestational diabetes

With diabetes on the rise in the general population, more women are expected to enter pregnancy with pre-existing diabetes, or to develop diabetes during pregnancy. Gestational

diabetes (GDM) appears in the latter half (after 24 weeks) of about 2–5% of all pregnancies in the United States, and increases the risk of macrosomia (large babies) and, consequently, difficult labour, infant shoulder dystocia (impacted foetal shoulder with risk of nerve injuries) and caesarean section. The risk of these perinatal complications is elevated with even low levels of glucose intolerance. Therefore, dietary advice in pregnancy to prevent the development of glucose intolerance is very important. Studies have compared diets with a high and low glycaemic index (GI) to assess the effect of GI on clinical pregnancy outcomes. The infants of women who were instructed to consume low-GI carbohydrate foods during pregnancy were of normal size, but were smaller and had less body fat than did the babies of women whose dietary GI was high during pregnancy. Intake of low-GI carbohydrates was associated with normal maternal weights and birth weights between the 25th and 50th percentiles, while high-GI carbohydrate intake was associated with foeto-placental overgrowth and excessive maternal weight gain. However, these studies are not conclusive, and a major review of current data concluded that the results are promising, but are insufficient to change clinical practice without further research. The pre-pregnancy diet might also be associated with women's risk of gestational diabetes.

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