Low maternal weight: effects on maternal and infant health during pregnancy


Summary
A healthy body weight on conception and adequate weight gain during pregnancy are important to ensure that mother and baby remain well. A low maternal weight and poor pregnancy weight gain can have detrimental implications for the mother and baby. Women need to be provided with clear, consistent information about how much weight they should gain during pregnancy and the adverse effects of a low pre-pregnancy body weight and insufficient weight gain during pregnancy.

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Pre-pregnancy body weight
Research suggests that a low pre-pregnancy weight can have adverse effects on birth outcomes (Sekiya et al 2007) (Box 1). Low pre-pregnancy weight and maternal weight gain have been associated with a higher incidence of miscarriage (Helgstrand and Andersen 2005) and the delivery of smaller infants (Sekiya et al 2007). Ehrenberg et al (2003) studied data from a perinatal database in Cleveland, Ohio. It was reported that women with a low maternal weight before pregnancy had an increased risk of intrauterine growth restriction (IUGR) – inadequate growth of the fetus during the later phases of pregnancy – and delivering a low birth weight infant. The incidence of perineal tears was also higher in women weighing less than 45kg (Ehrenberg et al 2003).

Throughout pregnancy women have to adapt to extreme physical body changes (Johnson et al 2004). These include weight gain, endocrinological changes and physical symptoms such as nausea and/or vomiting, water retention, bowel habit changes and heartburn (Hytten and Chamberlain 1991). Scientists have calculated that throughout pregnancy the average woman should gain around 12.5kg, constituting approximately 0.9kg protein, 3.8kg fat and 7.8kg water (Hytten and Chamberlain 1991). However, additional weight gain and changes in body composition can leave many women feeling insecure about their body size and shape (Davies and Wardle 1994, Fox and Yamaguchi 1997).

Research indicates that as many as 40% of first-time mothers in the UK fear weight gain in pregnancy and up to 72% are afraid that they will fail to return to their pre-pregnancy body weight (Fairburn and Welch 1990). Cogswell et al (1996) reported that as many as 80% of pregnant women may attempt to limit their calorie intake. Kendler et al (1991) suggested that women born after 1960, and currently likely to be in their childbearing years, are at greater risk of experiencing dietary restraints. Such study findings may be attributed to increased social pressures to obtain an unrealistically low body weight (Warren and Perlroth 2001). However, dietary restraint, both at the time of conception and throughout pregnancy, can have devastating health implications for the child in the short and long-term (Ehrenberg et al 2003). Research indicates that an inadequate dietary intake during pregnancy may result in low birth weight deliveries (Lumey 1992). In the long-term, low birth weight infants have an increased risk of developing obesity (McMillen et al 2005), glucose intolerance (Rich-Edwards et al 1999) and cardiovascular disease (Lumey 1992) later in life.
In a study undertaken in Denmark—the Danish National Birth Cohort (DNBC)—2,000 mothers were interviewed about their pre-pregnancy body size and birth outcomes. The study found that women with a body mass index (BMI) below 18.5 before pregnancy had a significantly higher risk of spontaneous abortion when compared with women who had a healthy BMI of 18.5-24.9 before pregnancy (Helgstrand and Andersen 2005). A British study analysing birth outcomes in women with a history of eating disorders found that participants with a history of bulimia nervosa had higher rates of miscarriages, and women with a history of anorexia nervosa delivered lower birth weight babies when results were compared with the general population (Micali et al 2007). Edwards et al (1994) found that a lack of social and psychological support and low intake of micronutrients throughout gestation resulted in low birth weight deliveries and unsuccessful pregnancy outcomes, including miscarriages.

### BOX 1

**Implications of low maternal weight gain**

<table>
<thead>
<tr>
<th>Maternal health:</th>
<th>Perineal tears</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maternal micronutrient deficiencies</td>
<td>Pre-term labour</td>
</tr>
<tr>
<td>Shortened gestation</td>
<td>Infant health:</td>
</tr>
<tr>
<td>Low birth weight</td>
<td>Poor adult health—increased risk of diabetes, obesity and cardiovascular disease</td>
</tr>
<tr>
<td>Prematurity</td>
<td>Spontaneous abortion</td>
</tr>
</tbody>
</table>

**TABLE 1**

<table>
<thead>
<tr>
<th>Pre-pregnancy body mass index (BMI)</th>
<th>BMI category</th>
<th>Recommended total weight gain in pounds for singleton pregnancies</th>
<th>Recommended total weight gain in kilograms for singleton pregnancies</th>
<th>Recommended total weight gain in stones for singleton pregnancies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 19.8</td>
<td>Underweight</td>
<td>28-40</td>
<td>13-18</td>
<td>20.29</td>
</tr>
<tr>
<td>19.8-26.0</td>
<td>Healthy</td>
<td>25-35</td>
<td>11-16</td>
<td>18-2.5</td>
</tr>
<tr>
<td>26.1-29.0</td>
<td>Overweight</td>
<td>15-25</td>
<td>7-11</td>
<td>11-18</td>
</tr>
<tr>
<td>More than 29.0</td>
<td>Obese</td>
<td>15</td>
<td>7</td>
<td>11</td>
</tr>
</tbody>
</table>

Adapted from the Institute of Medicine (1990) guidelines for total weight gain during pregnancy

**Appropriate weight gain during pregnancy**

### Restricted weight gain

It is well documented that women who are underweight before pregnancy and those with a low maternal weight gain have an increased risk of shortened gestation or preterm deliveries and giving birth to small-for-gestational-age (SGA) infants (Sekiya et al 2007). Research conducted by Tsukamoto et al (2007) studied the effects of restricting pregnancy weight gain in 3,071 mothers in Tokyo. Findings indicated that women with a total pregnancy weight gain of 8kg or less had an increased risk of delivering a low birth weight or SGA infant.

Helms et al (2006) studied patterns of pregnancy weight gain over the course of 16 years in North Carolina. More than one million pregnancies and their outcomes were studied and it was reported that 10% of mothers, with a mean age of 26 years, gained an inadequate amount of weight (below the Institute of Medicine (IOM) 1990 guidelines) (Table 1). This figure has risen since the 1980s when 7.3% of women failed to gain sufficient levels of weight throughout their pregnancies (Helms et al 2006).

Women with inadequate weight gain were also more likely to deliver low birth weight infants than women achieving the recommended weight gains (Table 1) (IOM 1990). Wells and Murray (2003) also undertook an analysis of birth certification data in Colorado and found that 23% of women gained weight below the recommended ranges (Table 1).

It has also been suggested that attempts to lose weight, fasting diets, or self-reported eating disorders and a low intake of dietary folate during pregnancy, particularly in the first three months, may be associated with an increased risk of delivering a child with neural tube defects (NTDs) (Carmichael et al 2003). The fact that dieting behaviours were most strongly associated with NTDs in the first three months of pregnancy rather than before pregnancy suggests that dieting during this time may impede fetal development (Carmichael et al 2003). This theory is further supported by research undertaken by Sekiya et al (2007), which studied...
the effects of weight gain in each of the three trimesters of pregnancy in relation to birth weight and length of pregnancy. The results of the investigation showed that weight gain in the second trimester was positively associated with both birth weight and length of pregnancy (Sekiya et al. 2000). Therefore, it seems that an inadequate weight gain during the second trimester may be a strong risk factor for low birth weights and premature infant deliveries.

**Long-term health implications of inadequate weight gain**

Much research has been undertaken to investigate the associations between maternal nutrition, infant birth weight and adult health status. The ‘fetal origins’ hypothesis proposes that inadequate maternal nutrition and a low infant birth weight can predispose the child to diseases such as diabetes, cardiovascular disease and in females, pre-eclampsia later in life (Barker and Martyn 1992, Langley-Evans 2006). It is thought that nutrient restriction during pregnancy can affect the metabolic programming of the developing fetus (Langley-Evans 2001). Such growth restriction is also associated with reduced cognitive development and a reduced intelligence quotient in childhood (Martinez-Cruz et al. 2006).

**Maternal obesity**

Maternal obesity is a risk factor for congenital abnormalities (Shaw et al. 2000) and NTDs (Ray et al. 2005). Although the mechanisms of these are yet to be fully understood, it has been proposed that a low folate acid intake accompanying restricted food intake, a poor quality diet or ketosis may be causative factors of congenital abnormalities (Robert et al. 1995). It is thought that overweight women have increased folate requirements, even after universal folic acid flour fortification, which may be attributed to the high incidence of infants born with NTDs in this population (Ray et al. 2005).

**Pregnancy weight guidelines**

Guidelines on weight gain during pregnancy have not been devised in the UK. Therefore, most obstetricians and midwives use those compiled by the IOM (1990) (Table 1). The guidelines recommend that during pregnancy, the average expectant mother should gain between 11-16kg, 7-11kg if overweight when pregnancy starts, and 3-7kg if obese at conception. However, at present research indicates that for most pregnant women their weight gain is either below or above these recommended proportions (Abrams et al. 2000). Olson et al. (2003) reported that 38% of women gained weight within the IOM (1990) guidelines. For the remaining study population, 29% of women had weight gains below and 22% of women had weight gains above the recommended range for their pre-pregnancy BMI (Olson et al. 2003). Evidence indicates that women with a normal pre-pregnancy BMI and those who meet the IOM (1990) recommended weight gains are healthiest and have healthier children.

**Antenatal education**

Research indicates that interventions are needed to ensure that expectant mothers gain adequate amounts of weight during their pregnancies (Abrams et al. 2000). Healthcare practitioners should recommend that women who are

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**References**


underweight, overweight or not meeting weight gain guidelines during pregnancy, seek advice from a dietician or nutritionist. Information regarding recommended nutritional intake and appropriate physical activity for expectant mothers can be obtained from various institutes and foundations. In terms of physical activity, excessive exercise during pregnancy has been associated with reduced infant birth weight and shortened gestation (Sternfeld 1997). Thirty minutes of daily exercise appears to be safe, although a pregnant woman’s overall health and the individual sport should be evaluated before participation (American College of Obstetricians and Gynecologists 2003). Recommendations for maintaining a healthy body weight during pregnancy are provided in Box 2.

**Conclusion**

Inadequate body weight before conception and low maternal weight gain are associated with negative health implications, including miscarriage, shortened gestation and low birth weight deliveries. Pregnant women should be encouraged to gain weight within the IOM (1990) recommended ranges and weight loss and dietary restriction should be discouraged. Healthcare practitioners should provide pregnant women and those planning a pregnancy with appropriate information highlighting the importance of maintaining a healthy body weight on conception and during the gestation period.

**USEFUL RESOURCES**

- **American College of Obstetricians and Gynecologists**: www.acog.org
- **BBC parenting**: www.bbc.co.uk/parenting/having_a_baby
- **British Dietetic Association**: www.bda.uk.com
- **Food Standards Agency**: www.eatwell.gov.uk/healthydiet/eighttipssection/
- **Maternal and Infant Nutrition Information Leaflet** (British Nutrition Foundation): www.nutrition.org (search under maternal and infant nutrition)
- **Institute of Medicine**: www.iom.edu
- **National Childbirth Trust**: www.nct.org.uk
- **Last accessed: September 4, 2007**

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**BOX 2**

**Recommendations for practice**

- Women planning to conceive should aim to achieve a healthy body weight with a body mass index (BMI) between 19.8 and 26.0.
- Expectant mothers should be advised to gain 11-16 kg (1.8-2.5 stones) from conception to delivery.
- Pregnant teenagers should be closely monitored by midwives, nutritionists, or dieticians to ensure that they are eating a balanced diet and gaining adequate weight.
- Women should be advised not to fall below or above Institute of Medicine (1990) recommendations (Table 1).
- Moderate levels of physical activity – around 30 minutes each day – are recommended throughout pregnancy, excluding impact sports.
- Women should be encouraged to enjoy their pregnancies and to not worry about weight loss until after the birth.

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**References**