# Editorial

## How much do pregnant women need to eat – should we intervene?

The calculated additional energy requirement for pregnancy is 70 000 kcal (293 MJ) (Hytten & Leitch 1971). This is needed for the accumulation of protein and fat, along with additional energy required for the maintenance of the fetus and extra added maternal tissue. Up to about 30 weeks of pregnancy, the increased energy requirement is dominated by the accumulation of maternal fat. During the last 10 weeks, this fat deposition virtually stops and most of the energy is used for fetal tissue synthesis when fetal growth is maximal. Simultaneously, there is a considerable rise in oxygen consumption for the maintenance of the new tissues. The pattern of altered body composition of pregnancy during the first two-thirds of pregnancy provides an energy bank for fetal growth, labour and lactation in late pregnancy. The overall effect is to spread the energy accumulation evenly throughout pregnancy at about 400 kcal per day (1.6 MJ per day). The specific energy requirement of pregnancy is probably met by a reduction in energy expenditure and an increase in dietary intake. Reduced energy expenditure is achieved by voluntary reduction in exercise and the taking of more rest, as has been suggested some time ago by Hytten (1971) and more recently by Dufour *et al*. (1999). There is also a general reduction in muscle tone and a slight general fall in maternal tissue metabolism due to a reduction in free thyroid hormone (Ramsay 1998). This calculated energy requirement of pregnancy was disputed following studies of energy balance undertaken in five countries (Durnin 1987). However, in all five centres, the average weight and fat gain during pregnancy were less than the theoretical estimation. Fat is not deposited equally at all sites during pregnancy (Taggart *et al*. 1967); thus many methods of assessing total body fat are unreliable when used in pregnancy. Clearly, the amount of fat gained in pregnancy is vital in determining the energy cost of pregnancy, but the marked inter-centre variability evident in the five centres makes this difficult to assess. More recent studies (Kopp-Hoolihan *et al*. 1999; Butte *et al*. 2004) of body composition aimed at determining energy requirement in pregnancy are more consistent with the early estimates. However, these studies involved relatively small numbers of women of mixed parity, which is a significant confounding factor for body composition change in pregnancy (Campbell & MacGillivray 1972). It is remarkable how close the early calculated estimate of the energy requirement of pregnancy is to that published recently (FAO 2004) by a joint FAO/WHO/UNO expert consultative group after review of both theoretical and experimental evidence. This review recommends meeting the increased energy need of pregnancy by increasing food intake, but does not fully consider the implication of voluntary reduction in physical activity in pregnancy.

Not surprisingly, dietary intakes in pregnancy are affected by factors specific to the pregnancy itself. The increase in appetite towards the end of the first trimester cannot be possibly related to the demands of a fetus weighing less than 50 g, but is driven by the resetting of hypothalamic controlling centres by rising progesterone levels. Overall, most studies have shown no marked increase in the energy intake over the course of pregnancy. Only one small study (10 subjects) has considered energy intakes of women prior to pregnancy and longitudinally throughout the pregnancy as part of a longitudinal assessment of energy balance (Kopp-Hoolihan *et al*. 1999). Diet was assessed by 3-day weighed food intake records. This found a modest increase in energy intake of approximately 185 kcal per day, ranging from 61 to 518 kcal. Only two women failed to show an increase. Many cross-sectional studies of dietary intake in different stages of pregnancy from different parts of the world have shown ranges of intakes of approximately 1500–2500 kcal per day (6.3–10.5 MJ). The most recent recommendation for energy intake for the UK and from the World Health Organization suggests that an additional 200 kcal (0.84 MJ) per day over non-pregnant seems acceptable. The US RDA set at 300 kcal extra per day is likely to be unnecessary. Such a trivial increase is unlikely to be noticed by most pregnant women who both prior to and during pregnancy eat to appetite.

In contrast to work in animal models, virtually all studies have not demonstrated a clear link between energy intake and outcome of the pregnancy with respect to fetal growth. The use of crude birthweight, sometimes even just being below 2500 g, to assess fetal growth and pregnancy outcome is unacceptable. Birthweight should always be adjusted for gestation at delivery (the main determinant of birthweight), sex of the baby and parity. Consideration should also be given to adjustment for maternal body stature. Even in women with multiple pregnancy when the combined birthweight is clearly greater than a singleton pregnancy, dietary intake has been shown to be similar to those of singleton pregnancies, although weight gain is greater (Campbell *et al*. 1974; Rosello-Soberon *et al*. 2005).

In view of the above, it is perhaps hardly surprising that attempts to increase pregnant women's dietary energy/protein intake have failed to demonstrate any benefit from supplements. There is at best a modest increase in birthweight of approximate 50 g, which is clinically insignificant (Kramer 2000a). Even in women at high risk of impaired fetal growth, supplementation does not improve outcome (Say *et al*. 2003). Moreover high-protein supplementation is associated with adverse outcomes such as preterm delivery and increased neonatal deaths, and should not be advocated (Kramer 2000b). Studies aiming to increase energy intake by supplementation in pregnancy may not have achieved their goal, as it is difficult for women eating to appetite to maintain a further increase in total energy intake over a prolonged period of time. Most studies have shown that women do take the supplements, but it is total energy intake during the day that matters and they may decrease some other component of their diet (Campbell-Brown 1983).

Limiting energy intake during pregnancy seems to be detrimental to the mother and the fetus. Severe energy restriction such as in famine (Susser & Stein 1994) is extreme but fortunately rare. Energy protein restriction of pregnant women who had a high weight gain significantly reduced maternal weight and birthweight, but had no effect on pregnancy complications (Kramer & Kakuma 2003). Butte *et al*. (2004) suggest that, for women with a high body mass index prior to pregnancy, excess weight gain during pregnancy should be discouraged presumably by limiting energy intake, but intervention studies of energy restriction in obese pregnant women (Campbell 1983; Kramer & Kakuma 2003) show detriment to the fetus as it does not allow the developing baby to achieve its full growth potential. In pregnancy, fat deposited in relatively central sites around the abdomen and upper thighs (Taggart *et al*. 1967) is readily mobilizable to support a successful pregnancy. Long-term fat depots are not as mobilizable: thus if obese pregnant women are, by calorie restriction, denied the opportunity to establish mobilizable stores, they may not be able to meet the energy needs of fetal growth and pregnancy. There is also some evidence of harm from long-term follow-up studies of women who were given a high-meat, low-carbohydrate diet in late pregnancy and thus a relatively low energy intake. Such an unbalanced diet may programme lifelong disease such as hypertension-mediated by hypercortisolaemia (Herrick *et al*. 2003).

In conclusion, the consensus is that there is no simple relationship between maternal macronutrient (energy) intake and expenditure and fetal growth/birthweight. The hypothesis that increased intake leads to increased maternal weight gain, which leads to increased fetal growth, which leads to increased survival, is no longer acceptable (Rush 2001). While it is appealing to target pregnant women with nutritional advice as they are a captive population, the temptation to impose nutritional interventions (usually applicable to the non-pregnant state) should be resisted as they are likely to cause more harm than good. Moreover, there is danger that pharmaceutically prepared supplements may divert attention from the need to improve the circumstances which led to undernutrition in the first place. Nevertheless, the importance of good nutrition remains unquestioned. Well-grown, well-nourished and healthy mothers have the best reproductive performance, and general nutrition education without any other intervention seems likely to be the best approach to improve the nutrition of children who will be the parents of the future.

Doris Campbell
*Department of Obstetrics & Gynaecology*
*University of Aberdeen*
*Foresterhill*
*Aberdeen AB9 2ZD, UK*
*E-mail: d.m.campbell@abdn.ac.uk*

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