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Studies on energy metabolism and body composition of healthy women before, during and after pregnancy

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ABSTRACT

Current recommendations propose that an entire pregnancy requires an additional amount of energy from the diet equivalent to 335 000 kJ. This figure is mainly based on increases in the basal metabolic rate (BMR) and retention of total body fat (TBF). The BMR response to pregnancy varies considerably among women, but the factors responsible for this variability are unknown. TBF can be calculated from total body water (TBW) and the hydration factor (HF), using the so-called two-component model. However, the validity of this model during pregnancy has been questioned. Furthermore, current recommendations propose that energy needs during pregnancy may be partly offset by reductions in physical activity, but this statement is supported by little experimental evidence. The aims of this thesis were: to evaluate if the physical activity level (PAL) can be estimated by means of heart rate recording, accelerometry, and a questionnaire in women planning pregnancy; to assess the effect of pregnancy on energy expenditure due to physical activity, on activity pattern and on the biological variability of HF; to evaluate the use of bioimpedance spectroscopy (BIS) for assessing TBW during pregnancy; and to identify factors explaining the variability of the BMR response to pregnancy.

Healthy women were studied before pregnancy (n=38), and in gestational weeks 8, 14, 20, 32, 35 and 2 weeks post partum (n=23). Total energy expenditure (TEE), BMR, TEE/BMR, activity pattern, body composition, circulatory variables and serum levels of thyroid hormones and insulin growth factor-I (IGF-I) were measured. Foetal weight in gestational week 31 and infant birth weight were assessed.

All estimates of PAL were imprecise and too low in women planning pregnancy. There was little change in TEE/BMR in gestational week 14, but it was significantly reduced in gestational week 32. However, activity pattern was largely unaffected by pregnancy. The biological variability of HF was 2 %, 3 % and 1.7% or less of average HF before pregnancy and in gestational weeks 14 and 32, respectively. BIS underestimated TBW during pregnancy. In gestational week 14, the increase in BMR correlated significantly with the increase in body weight and with TBF (%) before pregnancy. Together these variables explained about 40 % of the variability in the BMR response. In gestational week 32, the increase in BMR correlated significantly with changes in body weight, TBF, fat-free mass, IGF-I, cardiac output and free triiodothyronine. At this stage of gestation the increase in body weight in combination with foetal weight or with the increased levels of IGF-I in serum explained about 60 % of the variability of the increased BMR.

In conclusion: 1) Heart rate recording, accelerometry and the questionnaire produced inappropriate PAL estimates. 2) In women maintaining their pre-pregnant activity pattern the increase in BMR represents the major component of the increased energy expenditure during pregnancy. 3) The two-component model for assessing TBF is appropriate in late gestation, while its precision may be impaired in early pregnancy. 4) BIS in its present form is not appropriate for assessing TBW during pregnancy. 5) Nutritional factors are important regarding the variability in the BMR response to pregnancy.