Proceedings of the Nutrition Society (2008), **67 (OCE8)**, E383 doi:10.1017/S0029665108000578

Summer Meeting 30 June–3 July 2008

The effect of cafeteria diet feeding on maternal body composition and plasma volume expansion during early gestation

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The prevalence of obesity is increasing dramatically worldwide. The high rates of overweight and obesity among women of child-bearing age is of major concern as obesity is associated with complications during pregnancy[1]. A large body of evidence shows the programming effect of the fetal environment encountered during critical stages of gestation on the developmental pathway of the fetus and risk of disease in later life[2]. In this context, the adverse effects of mother being overweight and obese remain unclear. It has been shown that feeding a cafeteria diet in rat pregnancy can induce altered food preferences and greater weight gain in the resulting offspring[3]. The aim of the present pilot study was to examine the effect of diet-induced obesity on maternal body composition, food intake and plasma volume expansion during pre- and early-gestation periods. As obesity is often associated with reduced fertility, an important aim of the study was to establish whether fetal programming studies could be performed in cafeteria-fed rats.

Wistar rats (4 weeks old) were fed either chow diet alone (n 4), as a control group (CO), or chow with cafeteria diet (n 4), as the experimental group (CF), for 6 weeks before mating and through to day 5 of gestation. The cafeteria diet consisted of highly-palatable human foods (cheese, chocolate, biscuits, pork pie, sausages, pate, peanuts, crisps, golden syrup cake and jam). The CF group was given four of these junk foods daily and the same food was not given for >2 d in order to maintain an attractive variety. Food intakes and body weights were measured in both groups daily. After 6 weeks all rats were mated and maintained on the same diets until day 5 of gestation. At this point the maternal plasma volume was determined through the intravenous infusion of Evans blue dye under terminal anaesthesia. Gonadal and perirenal fat pads were weighed after each animal was killed.

		BW (g)		PRF (g/100 g BW)		GF (g/100 g BW)		Plasma volume (ml)		WAT (g/100 g BW)		BAT (g/100 g BW)	
	n	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
CO	4	209	13.8	1.16	0.21	1.34	0.84	8.36	1.01	0.15	0.06	0.15	0.01
CF	4	186	4.95	2.23*	0.16	2.73*	0.20	9.09	0.48	0.29	0.04	0.28*	0.01

BW, body weight; PRF, perirenal fat; GF, gonadal fat; WAT, intrascapular white adipose tissue; BAT, intrascapular brown adipose tissue. Mean values were significantly different from control values: *$P<0.05$.

The energy intakes (kJ/d) of the CF group were significantly higher than those of the CO group throughout the study ($P=0.001$), especially for the first week (CO 239 (SE 16.6); CF 338 (SE 16.59)) and the second week (CO 252 (SE 16.6); CF 357 (SE 16.59)) of the study. Despite higher energy intake in the CF group, weekly weight gain (g) was not significantly different between the groups (CO 15.4 (SE 0.79); CF 16.0 (SE 0.79); $P=0.547$). Throughout the study the protein intake (g/d) of the CF group (2.24 (SE 0.78)) was significantly lower than that of the CO group (2.81 (SE 0.78); $P=0.039$). As expected, the fat intake (g/d) of the CF group (3.31 (SE 0.59)) was significantly higher than that of the CO group (0.45 (SE 0.59); $P<0.001$). All rats mated normally.

The present study indicates the adverse effect of feeding a cafeteria diet on body composition and food preferences of rats through pre- and early-gestation periods. The ability to become pregnant and cardiovascular adaptation to early pregnancy was not compromised by maternal obesity. Given current trends in weight gain and intake of foods high in fat and sugar, this area is one of considerable importance for the health of populations. Future studies will examine further aspects of the influence of maternal obesity on the physiological response to pregnancy and the development of the fetus.

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