

Investigating the impact of exercise during pregnancy

M.J. Morris, Medical Sciences, UNSW Australia, Kensington, NSW 2052, Australia.

Background: Independent of offspring diet, maternal obesity programs a range of detrimental effects including increased risk for metabolic diseases with greater body weight, adiposity, insulin and triglycerides in offspring. Promoting maternal exercise during pregnancy may be a useful strategy to reduce these effects, and animal studies provide a means to examine metabolic and molecular endpoints. The objective of the study was to investigate the impact of voluntary exercise during pregnancy on health outcomes in adult rat offspring of obese and lean mothers.

Study Design: Female Sprague-Dawley rats were fed chow (C n=28) or high fat (F n=32) diet for 6 weeks. At this time HFD dams were 15% heavier and consumed 60% more energy, with impaired glucose tolerance compared to chow fed dams (Raipuria *et al.*, 2015). From ten days before mating until parturition, half of each group were allowed access to a running wheel (CE/FE) in the home cage; the others remained sedentary (CS/FS). Pup body weight and energy intake were monitored. Effects were evident at weaning, including lower blood glucose in male FE offspring (Raipuria, Bahari & Morris, 2015). In the current study we tested long term outcomes. Glucose tolerance tests were performed at 10 weeks of age; male and female offspring were killed at 13 weeks for metabolic assessment and brains were dissected for hypothalamic gene expression of relevant appetite markers.

Results: Lean and obese mothers showed similar modest levels of exercise with no significant effect on maternal body weight. Male and female offspring from obese *versus* lean mothers consumed significantly higher amounts of energy (kJ/24 hours); only male offspring had significantly higher body weight at 13 weeks. Adult males from obese dams had higher plasma insulin and leptin concentrations; these were normalized by maternal exercise. In females only the insulin concentration was raised by maternal obesity. In male offspring maternal obesity was associated with decreased arcuate nucleus mRNA expression of the orexigenic peptides neuropeptide Y (NPY) and agouti-related protein (AgRp) and increased levels of the anorexigen Proopiomelanocortin (POMC); only the decreased NPY mRNA level was normalized by maternal exercise. Maternal obesity also downregulated mRNA expression of leptin receptors (ObRb) in arcuate nucleus of male offspring. No effects of maternal obesity or exercise were observed on hypothalamic appetite markers in female offspring.

Conclusion: Maternal obesity increased the risk of metabolic disease in adult offspring, with higher body weight, adiposity, hyperleptinemia, hyperinsulinemia and altered hypothalamic appetite markers. Modest levels of maternal exercise appeared to decrease the metabolic risk induced by maternal obesity. Exercise had sex-specific benefits that were more marked in male offspring. These data are in line with reports that lifestyle interventions in humans may have effects on offspring in the absence of marked changes in the mother.

Raipuria M, Hardy GO, Bahari H, Morris MJ. (2015) Maternal obesity regulates gene expression in the hearts of offspring. *Nutr Metab Cardiovasc Dis* **25**, 881-8.

Raipuria M, Bahari H, Morris MJ. (2015) Effects of maternal diet and exercise during pregnancy on glucose metabolism in skeletal muscle and fat of weanling rats. *PLoS One* 10:e0120980. doi: 10.1371/journal.pone.0120980