MATERNAL EXERCISE DURING PREGNANCY AFFECTS THE RAT MUSCULOSKELETAL SYSTEM AND INDICES OF ENERGY METABOLISM

A thesis presented in partial fulfilment
of the requirements for the degree of
Doctor of Philosophy
in
Veterinary Science

at Massey University, Manawatū,
New Zealand.

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2013

ABSTRACT

The developmental origins of health and disease hypothesis postulates that environmental cues perceived by the developing organism during early life program long-term health outcomes. A series of studies were undertaken to examine the developmental programming effects of maternal exercise during pregnancy on offspring musculoskeletal health and energy metabolism using a rat model. Firstly, an exercise that did not cause a potentially confounding stress response in the exercising animal was identified. Secondly, pregnant dams then performed this exercise and its effects on fetal growth and the maternal stress response were quantified. Finally, the offspring of dams that exercised throughout pregnancy were allowed to grow to maturity, and the effects of maternal exercise on their musculoskeletal health and energy metabolism were assessed. Throughout these experiments, body composition was assessed by dual-energy X-ray absorptiometry, and tibial parameters were measured using peripheral quantitative computed tomography. Maternal stress was quantified by measurement of faecal corticoid metabolites. Serum concentrations of the fully and undercarboxylated forms of the bone-derived hormone osteocalcin, and expression of genes related to osteocalcin carboxylation, were measured to explore their role in the response of offspring bone and energy metabolism to maternal exercise.

Two exercise types, rising to an erect bipedal stance and tower climbing, were initially tested in non-pregnant rats. Both rapidly caused changes in the tibias of exercised animals without inducing stress. In pregnant rats, both exercises increased fetal growth relative to controls, and neither caused a physiological stress response in the dams. Since rising to an erect bipedal stance had the greater effect on fetal growth, it was selected for use in the final study in which the offspring were grown to maturity. Maternal exercise throughout pregnancy was associated with sex-dependent changes in

the bone and body composition of the mature offspring. Male offspring of exercised dams had increased adiposity and serum undercarboxylated osteocalcin concentrations, while offspring of both genders had lower volumetric bone mineral density at the tibial diaphysis, relative to controls. These results suggest that maternal exercise has long-term effects on the musculoskeletal system and energy metabolism, and that undercarboxylated osteocalcin may play a role in these effects.

ACKNOWLEDGEMENTS

Many people assisted me in the course of this PhD research. First and foremost, I am grateful for the excellent supervision that I received from Professor Elwyn Firth, Professor Hugh Blair, and Dr. Mark Vickers. Their guidance, patience, encouragement, and insights were essential to keeping me on track and motivated. It has been a privilege to work with such excellent scientists and mentors. I am especially grateful to Elwyn for his continued confidence in me, and his flexibility in working around my family schedule when I (repeatedly) became distracted from my research by having babies.

The staff of the Massey University Small Animal Production Unit, and Drs. Juliet Cayzer and Kathy Parton, were all immensely helpful during my animal trials and I am grateful for all of their help and guidance. I also greatly appreciate the help and guidance that I received from Professor Marlena Kruger, Anne Broomfield, and Kim Wylie in the use of dual-energy X-ray absorptiometry during the experiments; Dr. Wei-Hang Chua for his help with the osteocalcin assays; Dr. Deborah Sloboda for her guidance on puberty checking rats (and for her help with my daughter in the airport on the way home from the DOHaD conference); Professor Patrick Morel for patiently teaching me statistics and answering my many, many questions; Dr. Christine Thomson for her guidance in stem cell research—even though this aspect of the PhD did not work out, I greatly enjoyed learning cell culture techniques; Dr. Laryssa Howe for her guidance in PCR techniques; and Dr. Keren Dittmer, especially, for her endless patience in teaching me to do PCR and for troubleshooting problems with me.

I would also like to thank the many friends and colleagues who assisted with animal care and sample collection and processing. Many of you are acknowledged in the specific chapters to which you contributed; without you this work would not have been possible. I would like to especially acknowledge Natalie Short (formerly

Thomson), who was a reliable and valuable assistant throughout this entire endeavour. Heartfelt thanks are also due to Kate Hill, who is a steadfast friend and was an incredible help throughout this combined PhD and motherhood adventure, and to Lily and Gary Davies for providing many hours of childcare while I worked on writing this thesis.

Finally, I wish to acknowledge my family for making this work possible. To my parents, sister, and extended family, I thank you for your support and encouragement during this endeavour. To my husband, Cameron, thank you for your patience, physical and emotional support, and understanding of the various stresses and distractions that I faced trying to learn to do a PhD and be a mother at the same time. And, to my wonderful children, Stella and Owen, you have never known me when I wasn't working on my PhD. I look forward to a new phase of our lives together now that it is done.

This PhD was funded primarily by GRAVIDA: National Centre for Growth and Development, New Zealand. Some funding was also provided by the Massey University Postgraduate Research Fund. All necessary approvals were obtained from the Massey University Animal Ethics Committee.

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