The role of lifestyle factors *vs* early origins of cardiovascular disease

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Introduction: Lifestyle throughout the life course makes an important contribution to development of metabolic and cardiovascular disease. Diet, physical activity and smoking are amongst the well established lifestyle determinants of cardiometabolic health and disease. In particular, there is compelling epidemiological evidence that exercise reduces all-cause and cardiovascular mortality, while intervention studies suggest that the mechanisms responsible include cardiac, vascular, metabolic and autonomic adaptations.

Being born pre-term and/or small for gestational age is a well established risk factor for metabolic and cardiovascular disease. Physical activity has relevance to this relationship from multiple perspectives. Firstly, with regard to physical activity during pregnancy and its effects on birth weight and pre-term delivery and secondly, whether physical activity during childhood or adulthood for those born small or prematurely can prevent or reduce the detrimental effects of low birth weight is an important clinical and public health question. This is particularly since the prevalence of pre-term birth is rising in many developed countries as a result of increasing maternal age, use of assisted-reproductive technology as well as advances in neonatal intensive care over the past 40 years which have reduced the limit of fetal viability to around 24 weeks gestation.

Maternal exercise: The importance of maternal lifestyle on fetal health is well recognised. Evidence from epidemiological birth cohort studies suggests that the effects of moderate physical activity on birth weight are small, but reduce the risk of either high or low birth weight infants (Juhl *et al.*, 2010). In contrast, intense exercise in the context of either sport (Gollenberg *et al.*, 2011) or agricultural work (Launer *et al.*, 1990) has been associated with reduced birth weight. Randomised intervention studies are required to substantiate the epidemiology, but are challenging to conduct in humans. Insights from animal studies regarding the effects of maternal exercise on subsequent development of metabolic and cardiovascular disease in offspring will be discussed.

Exercise in later life in individuals born small or preterm: Whether being born small reduces the propensity or ability to exercise as well as the physiological response to exercise and subsequent disease risk has been the subject of increasing investigation in recent decades. While exercise ability in childhood and adulthood is compromised in extremely low birth weight individuals, regular physical activity attenuates many developmental problems. At an epidemiological level, a study using random population sampling in Finnish men indicates that the association between birth weight and metabolic disease is lost in fit individuals and consistently, that the association between low birth weight and metabolic syndrome is accentuated in unfit individuals (Laaksonen *et al.*, 2003). Interestingly, genetics and early habit formation are more likely to influence physical activity patterns at age 10-12 years than birth weight (Hallal *et al.*, 2006). Intervention studies suggest that most cardiometabolic risk factors respond to lifestyle interventions including exercise in a manner which is independent of being small for gestational age, although HOMA-IR response had a small component (4%) related to birth weight (Reinehr *et al.*, 2010). Physiological mechanisms by which exercise may protect early birth weight individuals include restoration of muscle mass, beta-cell mass and function as well as effects on both aerobic and anaerobic muscle metabolism, including substrate utilisation and mitochondrial function. Vascular and cardiac adaptations are also likely important, but are less well studied.

Gollenberg AL, Pekow P, Bertone-Johnson ER, Freedson PS, Markenson G & Chasan-Taber L. (2011). Physical activity and risk of small-for-gestational-age birth among predominantly Puerto Rican women. *Maternal and Child Health Journal* **15,** 49-59.

Hallal PC, Wells JC, Reichert FF, Anselmi L & Victora CG. (2006). Early determinants of physical activity in adolescence: prospective birth cohort study. *British Medical Journal* **332,** 1002-1007.

Juhl M, Olsen J, Andersen PK, Nohr EA & Andersen AM. (2010). Physical exercise during pregnancy and fetal growth measures: a study within the Danish National Birth Cohort. *American Journal of Obstetrics and Gynecology* **202,** 63.e1-63.e8.

Laaksonen DE, Lakka HM, Lynch J, Lakka TA, Niskanen L, Rauramaa R, Salonen JT & Kauhanen J. (2003). Cardiorespiratory fitness and vigorous leisure-time physical activity modify the association of small size at birth with the metabolic syndrome. *Diabetes Care* **26,** 2156-2164.

Launer LJ, Villar J, Kestler E & de Onis M. (1990). The effect of maternal work on fetal growth and duration of pregnancy: a prospective study. *British Journal of Obstetrics and Gynaecology* **97,** 62-70.

Reinehr T, Kleber M & Toschke AM. (2010). Former small for gestational age (SGA) status is associated to changes of insulin resistance in obese children during weight loss. *Pediatric Diabetes* **11,** 431-437.