Developmental Origins of Health and Disease

It is well known that pregnant individuals have to be concerned about their own health; after all, they are living for two, eating for two, and making decisions for two. As the fetus grows in the womb, it is exposed to a variety of conditions. Logically, for a fetus to develop properly, it needs a healthy environment. Research helps us understand how significant the pre-conception and pregnancy periods are for lifelong health.

In 1995, Dr. David Barker proposed the fetal origins hypothesis that states that during the second half of a pregnancy if a fetus does not receive proper nutrition the body's organs grow out of proportion. This is associated with an increased risk of coronary heart disease (CHD) later in life. The baby's birth weight and head circumference are used as proxy measures (approximate gauges) of conditions in the womb. These measurements predict some long-term health outcomes (Barker, 1995). Eriksson (2005) writes, in the ten years that followed Barker's original article, evidence accumulated to support the fetal origins hypothesis, and not just for CHD but for many different health problems.

Gluckman and Hanson (2004) suggest the broader term, "developmental origins of disease paradigm" when discussing the role of prenatal conditions for disease in adulthood. They explain that both the embryo (3 – 8 weeks prenatally) and the fetus (from the 9th prenatal week until delivery) are extremely sensitive to the environment of the womb. They describe that many factors can negatively affect the quality of this environment, for example: poor nutrition, reduced oxygen delivery, young maternal age, and whether it is the mother's first pregnancy. If the prenatal environment is not conducive to healthy growth, three responses are possible: 1. the fetus might mature too quickly because of an increase of certain hormones, 2. the fetus might grow too slowly as it conserves nutrients, or 3. spontaneous abortion or preterm delivery might occur (Gluckman and Hanson, 2004). Greater adversity in utero, resulting in lower birth weights of infants, and a subsequent period of "catch-up growth" where children then gained weight rapidly, has been shown to significantly increase the risk of heart disease and diabetes (Gluckman and Hanson, 2004). The term "programming" is now used to describe the relationship between the environments that influence fetal development and life-long health outcomes.

Evidence is emerging that what goes on prenatally can affect infant mental health and temperament as well as physical health. Lenroot and Giedd (2011) describe that following two instances of widespread famine (the Dutch Hunger Winter of 1944-45 and the Chinese Famine of 1959-60) when pregnant individuals were severely undernourished, their children had twice the

expected rate of schizophrenia. Researchers are studying how maternal stress, depression and anxiety might affect fetal, and subsequently, infant development. For example, pregnant women who are depressed or anxious may predispose their children to developing depression or anxiety disorders. As information emerges in this area of research we will expand our understanding of the biological and environmental roots to various mental health conditions (Kinsella & Monk, 2009; Werner et al., 2007).

Research is exploring flavour learning, which includes the relationship between how maternal nutrition changes the flavour of amniotic fluid and breast milk, and subsequent taste preferences in early childhood and later life. A study by Mennella et al., in 2001 showed that infants who were exposed to carrot juice prenatally had fewer negative responses to cereal prepared with carrot juice than a control group of infants who were not exposed to carrot juice prenatally. An interesting review of literature by De Cosmi et al. (2017) concluded that introducing a varied diet and new foods repeatedly throughout prenatal and early infancy periods increased willingness to try new foods in supportive social environments. The early establishment of food preferences through the prenatal, infant and childhood periods has been associated with a lower risk of childhood obesity in several studies (De Cosmi et al., 2017).

The preconception period is another important focus of recent research, as understanding grows that the parents' health at the time of conception can have an influence on the health of their children throughout their life course. For example, paternal obesity has been associated with increased risk of chronic disease for the fetus, and evidence suggests that obesity in offspring may be more likely if one or both parents are obese at the time of conception (Stephenson et al., 2018).

Eriksson (2005) explains that, "the development of most non-communicable diseases entails several interactions, including genetic ones. From a public health point of view we need to keep in mind that adult diseases are not programmed as such but the tendency towards a disease is programmed" (p. 1096). As with most developmental outcomes, innate and environmental factors combine to influence (but not determine) a person's overall health. Therefore, if we want to improve health outcomes we must pay attention to all of the potential influences. The developmental origins research highlights why we need to focus on the health of parents of childbearing age and not just child and adult lifestyle factors. Given recent evidence that indicates potential for transgenerational effects of fetal programming, it is essential that we strive towards optimal conditions for preconception and prenatal health to improve the health of future generations.

References

Barker, D. J. P. (1995). Fetal origins of coronary heart disease. *British Medical Journal, 311*(6998), 171-174. https://doi.org/10.1136/bmj.311.6998.171

De Cosmi, V., Scaglioni, S., & Agostoni, C. (2017). Early taste experiences and later food choices. *Nutrients, 9*(2), 107. http://dx.doi.org/10.3390/nu9020107

Eriksson, J. G. (2005). The fetal origins hypothesis: 10 years on. *British Medical Journal, 330*(7500), 1096. https://doi.org/10.1136/bmj.330.7500.1096

Gluckman, P. D., & Hanson, M. A. (2004). Developmental origins of disease paradigm: a mechanistic and evolutionary perspective. *Pediatric Research, 56*(3). https://www.nature.com/articles/pr2004210.pdf

Kinsella, M. T., & Monk, C. (2009). Impact of maternal stress, depression and anxiety on fetal neurobehavioral development. *Clinical Obstetrics and Gynecology, 52*(3), 425-440. https://10.1097/GRF.0b013e3181b52df1

Lenroot, R. K., & Giedd, J. N. (2011). Annual Research Review: Developmental considerations of gene by environment interactions. *Journal of Child Psychology and Psychiatry, 52*(4), 429-441. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3268527/

Mennella, J. A., Jagnow, C. P., & Beauchamp, G. K. (2001). Prenatal and postnatal flavor learning by human infants. *Pediatrics, 107*(6), 1-12. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC1351272/pdf/nihms-5608.pdf

Stephenson, J., Heslehurst, N., Hall, J., Schoenaker, Danielle A. J. M., Hutchinson, J., Cade, J. E., Poston, L., Barrett, G., Crozier, S. R., Barker, M., Kumaran, K., Yajnik, C. S., Baird, J., & Mishra, G. D. (2018). Before the beginning: Nutrition and lifestyle in the preconception period and its importance for future health. *The Lancet, 391*(10132), 1830-1841. https://doi.org/10.1016/S0140-6736(18)30311-8

Werner, E. A., Myers, M. M., Fifer, W. P., Cheng, B., Fang, Y., Allen, R., & Monk, C. (2007). Prenatal predictors of infant temperament. *Developmental Psychobiology, 49*(5), 474-484. https://doi.org/10.1002/dev.20232

