Foetal Health Stagnation: Have Health Conditions *in Utero* Improved in the US and Western and Northern Europe over the past 150 years?

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Between 1850 and the present many standard indicators of human health have improved dramatically around the world. Crude death, child mortality, infant mortality and stillbirth rates have fallen. Life expectancy and average adult height have increased. Western Europe and North America led these trends with the rest of the world following suit in the second half of the twentieth century. Given the tremendous improvement in human health over the past 150 years, one might assume that conditions for children *in utero* were also improving. However, there has not been a systematic study of multiple foetal health indicators to determine whether this was true.

This paper presents such an analysis. Examining several proxies for foetal health including birth weights, stillbirth rates and early neonatal mortality rates, it argues that there has been little change in foetal health conditions from the mid-nineteenth century to the present in North America and Western and Northern Europe. Birth weights have not improved dramatically (relative to other countries) over the past 150 years. This is true when looking at means of distributions, which have been compared extensively in the past, but also when comparing birth weight distributions in the mid and late nineteenth century with birth weight distributions in 1985. In addition to birth weights, stillbirth rates and early neonatal mortality rates were stagnant from the 1860s or 1870s to the late 1930s when they began to decline. However, this decline in rates was caused mainly by improvements in obstetric care rather than improving conditions *in utero*. After the discovery of antibiotics in the late 1930s, doctors began conducting more risky and invasive surgeries to save at-risk foetuses because they could protect mothers against puerperal fever with antibiotics (Løkke, 2012). And even before the decline in these rates, there is some evidence to suggest that selection effects of stillbirths and possibly early neonatal mortality were more important than scarring effects. Thus, a decline in the stillbirth rate might have a negative or at least ambiguous effect on the health of survivors.

This evidence could point toward two conclusions. It is possible that substantial improvements in living standards, nutrition, medical technology and health infrastructure have had a relatively small influence on foetal health. Perhaps improvements in postnatal health did not translate onto prenatal health. On the other hand, the evidence may suggest that the indicators used to measure foetal health, indicators that are still widely used today, are not as useful as researchers might hope. Perhaps foetal health has improved over the past 150 years, but we do not currently have proxies that can capture this improvement. This would suggest looking for new ways to measure foetal health in the past and future.

These findings have important implications for contemporary biomedical and social science research. Research that has found a relationship between birth weight and later life mortality and morbidity risk along with human capital formation may provide useful information about cross-sectional (within cohort) relationships between these variables, but these relationships should not be ascribed across cohorts without careful consideration. Arora (2013) shows that cohort mortality risk age

profiles from non-infectious diseases have improved since the mid-nineteenth century in Britain, but improving foetal health may not explain this cohort trend. Scarring from morbidity in infancy and early childhood might have been more important. In addition, these historical findings question the standards for birth weight by gestational age developed recently by the INTERGROWTH-21st group (Villar *et al*., 2014). If birth weights have remained remarkably stable over a period where health improved so dramatically, can the current pattern of foetal growth be considered as optimal?