Influence of early-life nutrition on mortality and reproductive success during a subsequent famine in a preindustrial population

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Individuals with insufficient nutrition during development often experience poorer later-life health and evolutionary fitness. The Predictive Adaptive Response (PAR) hypothesis proposes that poor early-life nutrition induces physiological changes that maximize fitness in similar environments in adulthood and that metabolic diseases result when individuals experiencing poor nutrition during development subsequently encounter good nutrition in adulthood. However, although cohort studies have shown that famine exposure in utero reduces health in favorable later-life conditions, no study on humans has demonstrated the predicted fitness benefit under low later-life nutrition, leaving the evolutionary origins of such plasticity unexplored. Taking advantage of a well-documented famine and unique datasets of individual life histories and crop yields from two preindustrial Finnish populations, we provide a test of key predictions of the PAR hypothesis. Known individuals from fifty cohorts were followed from birth

carrying them leave more descendants than individuals not carrying them.

The PAR hypothesis has frequently been invoked to explain associations between intrauterine growth restriction and health outcomes such as type II diabetes and cardiovascular disease (5, 11–14). It is argued that poor growth during early development signals adverse environmental conditions, causing individuals to develop a "thrifty" metabolism, characterized by insulin resistance, slow glucose metabolism, and increased fat deposition, which are adaptations to thriving in nutrient-poor conditions (5, 8, 9, 11). According to this view, only when individuals with thrifty metabolisms experience a nutritionally rich environment does the phenotype lead to disease, i.e., when developmental and later conditions are "mismatched" (9, 15). Metabolic diseases are increasing in prevalence worldwide (16), and the PAR hypoth-