The transgenerational epigenetic transmission of traits allows future generations to be maximally competitive in their environment. Under this assumption, adaptive gene programs acquired during the parental life span persist in the subsequent generation.

Key insights
The effects of developmental programming may be transmitted not only from parent to offspring, but to generations beyond. Data from human and animal studies indicate that metabolic disorders and adverse environmental influences may be perpetuated to the F2 and F3 generations via both the maternal and paternal lineages.

Current knowledge
Environmental factors can modulate the activity of the genome through several mechanisms. The most widely studied mechanism is epigenetics, with the classic example being the influence of the maternal phenotype and intrauterine environment on the regulation of fetal energy metabolism via altered DNA methylation of specific genes. However, environmental influences during key periods in development can also alter the germline of the fetus, thereby affecting the F2 offspring and beyond.

Practical implications
Exposure to environmental stressors such as poor early-life nutrition can result in maladaptive epigenetic traits that are passed on to the offspring. Over several generations, these have the potential to manifest as a population-wide phenotype. The rapid perpetuation of conditions such as obesity is especially relevant to populations undergoing the transition between traditional and Western lifestyles. There is an urgent need to deline the mechanisms that underpin the transmission of developmental programming in order to modulate the phenotype of future generations.

Recommended reading