You are what your father ate: Paternal inheritance of obesity and metabolic disorders

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Video Abstract

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Abstract

A fundamental law of genetics states that offspring do not inherit traits from their parents that were acquired in response to environmental conditions. Recent research in the field of epigenetics, however, is turning this principle on its head. Several recent studies have come to the remarkable conclusion that unhealthy diets in males can contribute to the development of metabolic diseases in their offspring. Even when those offspring are raised with healthy diets_._ Now, a study has identified small RNAs as the molecules responsible for the transmission of these disorders. For a long time scientists thought that inheritance of traits only occurred via DNA being passed from parent to offspring. It is now clear, however, that the experiences of one generation can have an effect on the next. When parents have a high-stress lifestyle or an unhealthy diet, for example, chemical modifications can occur on genes that are then passed to their children. This is termed ‘epigenetic inheritance.’ To pinpoint the epigenetic factors involved in the inheritance of metabolic diseases, a team of researchers in France conducted experiments using a mouse model. Young male mice were divided into two groups. One was fed a standard chow diet and the other, a western-like diet, highly enriched in sugar and fat. After 16 weeks, these mice were crossed with females that had been fed a standard diet. The resulting offspring were raised on a healthy diet. Despite this, the researchers found that those offspring with an obese father exhibited significantly increased body weight and fasting blood glucose levels. A third experimental group was then assembled. Male and female mice that had been fed a standard diet were bred. RNA from the sperm or testis of a healthy mouse or obese mouse was then transferred by microinjection to the resulting embryo. This time, the body weight of the offspring depended not on the diet of their parents, but on the type of mouse from which the RNA molecules were derived. If the modified embryo received RNA from an obese mouse, the offspring showed significantly higher body weight than those that received RNA from a healthy one. _ _ These results add to a growing body of literature indicating that diet-induced metabolic diseases can be passed from one generation to the next, and implicate RNA signaling as a likely cause.