Fetal harmful environments and the related consequences: the answers to our queries

Abstract
The fetal origin of adult disease (FOAD) hypothesis makes the physician reflect on how fetuses that have not reached their genetic growth potential (intrauterine growth retardation, IUGR) due to different nutritional deprivation situations, may be at risk of later adult diseases. In this mini review, we try to characterize how these IUGR fetuses make roll a series of metabolic mechanisms with the aim of protecting themselves in low nutritional-oxygenation states, and how consequently these mechanisms may interact leading to the FOAD explanation. We have been working in the study of different maternal-fetal complications for more than 20 years, dealing with different pregnancy disorders and prenatal diagnosis, such as: fetal lung maturation, maternal infections, endometriosis, computerized cardiotocography, maternal platelets alterations, color flow velocimetry, etc. At a certain point, one of my team leaders asked: what is the future of these IUGR fetuses? He passed the way a few years ago. Nevertheless, that question remained fixed in my mind. The fetal origin of adult disease (FOAD) was an argument of one medical Congress a couple of years ago, and I have observed the gap of knowledge concerning this interesting theory in the international literature worldwide. Since that time, I went deep in this theory, and these pages represent a brief comment regarding the FOAD hypothesis.

Keywords: short term, long term consequences, nutritional, pregnancy disorders

The low weight fetal adaptation
David Barker, an epidemiologist, in more than one decade has evidenced throughout anthropological and epidemiological studies, that during fetal life, during rapid cell division stages, tissues and vital organs enter the so called “critical periods” of development. Regarding the FOAD theory, the nutritional derangement during fetal life may cause the reprogramming of the regulation of the circulatory system, the insulin resistance in the muscle tissues and in the liver, with the aim of directing fetal resources to brain and heart. Economists have also been active in demonstrating that various environmental factors can have negative impacts on the developing fetus, even at levels previously thought harmless. Later-life impacts extend to “bread and butter” economic outcomes, including educational attainment and wages. Recent studies suggested that the balance of maternal protein and carbohydrate intakes during pregnancy is related to blood pressure in the offspring.

Low birth weight and adult cardiovascular disease
By using 1911-1930 birth records for one English county (Hertfordshire), Barker showed that lower birth weight and weight at one year were associated with an increased risk of death from CHD and stroke.

Cardiovascular function
Different authors have considered the potential use of arterial intima media thickness and carotid stenosis in order to identify in IUGR babies the asymptomatic vascular disfunction. Obesity
People who were heavier at birth tend to become ‘fatter’ adults as measured by body mass index. However, this may reflect increased lean mass rather than adiposity. Further, gestational diabetes produces a U-shaped or J-shaped relationship between birth weight and adult type2 diabetes.

Neurodegenerative disease
Fetal growth restriction plays a fundamental role in the short term/long term outcomes, determining a high incidence of cerebral deficit and also of neurological development, other than the lower weight. These consequences may not be evident up to late infant development, and may lead to a low scholastic situation, memory deficit linguistic and visual defects and even in the motorial development. Infants with a low cranial circumference show a high risk of cognitive derangement and it has also been observed that a low birth weight may be related to a lower IQ in infants at 11 years.

Kidney glomerular disfunction
In IUGR babies, nephrons are reduced in number, mostly because of shorter kidneys. However, the kidneys glomerular flow is increased, and this in order to compensate a regular glomerular filtration velocity. This may lead to hypertension and glomerular hypertrophy, leading to a systematically hypertension and to an increased sodium resorption and finally to glomerular damage with consequent albuminuria and glomerulosclerosis.

Endothelial disfunction
An endothelial disfunction is an event that precedes atherosclerosis that precedes the structural changes in the vascular wall. Different groups hypothesize that the atherosclerosis process begins in the infant period, and it developed in a silent way, before events such as myocardial infarction or ictus verify.

May “fetal origin of adult disease” change our points of view?
Since the first description of “critical periods” of development,
David Barker opened a path leading to understand how fetuses in danger and with deranged growth, that develop the “brain sparing” effect in order to redirect the resources to brain and heart in a survival maneuver, may reprogram the whole system explaining further adult diseases. Recently, Zanetti et al, assessing the causal relationship of different associations using even Mendelian randomization, stated that that lower birthweight, used as a proxy for IUGR, is causally related with increased susceptibility to coronary artery disease and Type 2 Diabetes Mellitus. Chronic diseases are not the inevitable lot of humankind. They are the result of the changing pattern of human development. Prevention of chronic disease and an increase in healthy ageing require improvement in the nutrition of girls and young women.

FOAD hypothesis offers us a new view regarding the management of IUGR fetuses lives. If my friend and tutor were alive, we would continue to chase for the links that may lead to correlate prenatatal, natal and post natal life mechanisms by which metabolism, body composition and growth may permanently be affected in later life.

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Conflicts of interest

The author declares there are no conflicts of interest.

References


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