

Perinatal Period and Obesity



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Abstract

Fetal programming concerns the fetal physiological or metabolic adaptations responding to an adverse environment during a critical developmental stage that become definitive later in life. The idea that tendency to develop chronic and degenerative disease as type 2 diabetes, obesity or hypertension could be programmed since the fetal stage is supported by scientific evidence. An excessive exposure to nutrients can be considered as an adverse environment. It is known that prevalence of overweight and obesity, impaired glucose tolerance, overeating, insulin secretion dysregulation and insulin resistance is higher in children born from mothers presenting gestational diabetes or obesity.

When the adverse environment consists on nutritional deficiency, thrifty mechanisms are switched-on in order to make the most of all the available nutrients. Nutritional restriction in the prenatal period hinders fetal development, causes low weight and prepares the fetus for an environment scarce in nutrients, programming a “thrifty phenotype” ready to preserve any nutrient excess. It is an effective adaptive mechanism when food is scarce, but in an abundant environment, it may cause obesity and metabolic disorders. When this programming becomes a definitive change, the “catch-up growth” occurs. It is considered as the most powerful marker in predicting obesity and metabolic syndrome later in life. Our aim is to highlight the importance of protecting the future being from obesity even before its conception and during the critical stages of development as pregnancy and the first years of life, mainly following a healthy diet.

Keywords: Fetal programming; Neonates; Pregnancy; Mediterranean diet; Obesity

Abbreviations: BMI: Body Mass Index; GDM: Gestational Diabetes; T2DM: Type 2 Diabetes Mellitus

Introduction

Fetal programming concerns the fetal physiological or metabolic adaptations that occur in response to adverse environmental conditions during a critical developmental stage and become permanent later in life. Scientific evidence shows that the tendency to develop chronic and degenerative disease as type 2 diabetes (T2DM), obesity or hypertension could be programmed since the fetal stage. There is different hypothesis explaining the fetal programming of obesity [1]. The most known is the one based in the “thrifty phenotype” [2] where there is a fetal undernutrition followed by an obesogenic childhood environment. Other theories are focused on fetal over nutrition, and some authors are working in postnatal nutrition and growth.

Fetal undernutrition and postnatal obesogenic environment

There are at least two ways leading to a nutritional deficiency in the fetus: the first one is maternal undernutrition and the other one placental dysfunction. In the first case, when the mother does not have an adequate diet, a lack of nutrients occurs, leading to

an intrauterine growth restriction. In the latter one, as placenta plays a key role in fetal metabolism (liver, lung, kidney) when a dysfunction happens, the fetus suffers a multi organic failure-like episode, leading to a nutrient deprivation. Responding to a nutritional deficiency, thrifty mechanisms are switched-on in order to make the most of all the available nutrients. Nutritional restriction in the prenatal period hinders fetal development, causes low birth weight and prepares the fetus for a postnatal environment scarce in nutrients, programming a “thrifty phenotype” ready to preserve any nutrient excess. It is an effective adaptive mechanism when food is scarce, but in an abundance environment, it may cause obesity and metabolic disorders [2]. When this programming becomes a permanent change, the “catch-up growth” occurs. It is considered as the most powerful marker in predicting obesity and metabolic syndrome later in life.

Fetal overnutrition

The adverse environment can also appear as an excessive exposure to nutrients. All the determinant factors in this field are related to gestation.

A. It is very important for the fetus that the mother has an adequate weight gain during pregnancy and it will depend on her weight before pregnancy. When she has a normal weight, she should gain between 11.3 and 15.8kg. If she is underweight before pregnancy, she should gain between 12.7 and 18kg, and if she is obese or suffer from overweight, she should gain between 6.8 and 11.3kg [3].

B. Maternal diet during pregnancy is also a critical factor. Diet during gestation must be enough, varied, adequate, balanced and simultaneous. The energy intake should be about 1800-2500kcal/day. The serving size and number of meals should be increased. Our group has studied this field and we concluded that the mediterranean diet is a good pattern to follow during pregnancy [4-6].

C. Maternal obesity is a risk condition for pregnancy itself. It is well known that obese women are more prone to subfertility (ovary dysfunction, endometrioses, polycystic ovary, etc). Once they are pregnant, they develop a higher tendency for preeclampsia, have a higher ratio of gestational diabetes (GDM) (6-12% more), when the body mass index (BMI) is over 25 kg/m² there are more miscarriages and if it is over 30 kg/m², macrosomia cases are 2-fold than in non-obese pregnant. During the perinatal period, obese mothers have 40% more cases of stillbirth; they have more cesarean section deliveries, pre-term infants, post-partum depression and have increased risk of post-partum venous thromboembolism [7]. Moreover, obese women have increased levels of serum glucose, insulin, leptin, lipids and inflammatory response factors that modify the nutrient supply by the placenta. These influences on the fetal plasticity and postnatal weight path in the way that girls born from obese mothers, will probably be obese women later in life, describing a vicious circle [1].

D. It is well-known that children born from mothers presenting GDM have more overweight prevalence, obesity, impaired glucose tolerance, overeating, and insulin secretion dysregulation and insulin resistance [8].

Posnatal nutrition and growth

When an undernourished fetus develops, as mentioned before, there is a reduced nutrient availability and serum glucocorticoids levels are increased. This leads to a diminished neogenesis and replication of the existing cells. They are born as small babies, with low birth weight, a small pancreas, few beta-cells and low insulinemia but high insulin sensitivity [3,5]. As they are small children, it is a tendency to overfeed them in order to facilitate them a quick growth until they reach their age-corresponding size. But what happens is that these babies are "programmed" for living in an environment scarce in nutrients, so if they are overfed, the "catch-up growth" will occur, and they will be at elevated risk for T2DM and obesity later in life.

Breastfeeding is the best nutrition for newborns. The WHO recommends it as exclusive food feeding source during the first

six months of life [9]. When it is not possible, the alternative is formula feeding. There are main differences in the protein content between human milk (9g/day at 3months, 10g/day at 6 months) and formula (14g/day at 3months, 18g/day at 6 months). Weber et al. [10] found that lower protein content in infant formula reduces BMI and obesity risk at school age, especially in those babies presenting a BMI>P90 at 3 months age. Breastfed babies presented less obesity rates than formula fed (2.9% vs 7.1%) and high protein formula fed children presented an odds ratio=2.87 than the low protein formula fed children for obesity development.

Conclusion

There are plenty of factors needed to take into account when our purpose is early prevention of obesity and metabolic syndrome. For women, it is a good way to be in normal weight and well-nourished before pregnancy. During pregnancy it is necessary to follow a healthy dietary pattern with a low glycemic amount index, like Mediterranean Diet, being rich in cereals, legumes, fruits and vegetables and scarce in meat and saturated fats, as well as an adequate weight gain according to the pre-pregnancy status. For children, it is beneficial to promote breastfeeding at least during the first 6 months. In case of low birth weights, it is better to assure a slow but continuous growth than overfeed them looking for a quick weight gain in the frame of a "catch-up growth". We think it is mandatory to establish educational strategies about nutrition and pregnancy, especially in topics like good dietary habits, good quality diet and mother's health and long-term metabolic benefits for the neonates.

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