The Human Microbiome Development and the First 1000 Days

Abstract:

It’s no secret that the United States has a high obesity rate. Much higher than other countries. How does prenatal care affect a child’s development? In this paper, The Human Microbiome Development and the First 1000 Days, we will look at how the development of a microbiome can affect a child’s weight later in life, whether it’s through overnutrition or undernutrition. A mother’s prenatal microbiome has a huge impact on the infant’s microbiome from the moment of contraception. While in the womb, fetuses are retaining everything the mother eats/drinks, therefore their microbiome of the mother also has an effect on the health of the fetus. From the time children are born they begin developing their own microbiome, and breast milk, along **with** other environmental factors is one of the things that helps their microbiome develop strong and health. Different regions have differing results in which bacteria need to be present to determine either stunting or obesity later in a child’s life. There are options to attempt to correct this issue, which involve introducing a healthy microbiome to an unhealthy one, or substituting foods for a more nutritional option.

Introduction:

The time from conception to two years is a crucial window for early childhood growth and development. It is well known that during this time infants are developing basic motor skills, the ability to talk and walk, and will begin learning cues from the environment around them. Something we don’t typically think about is the development of their microbiome during this time. Depending on what kind of environment a pregnant woman or child is living in will be the key determination on whether they develop a strong, healthy, and fully functional microbiome or not. Prenatally, one of the things a child is developing is a rapid maturation of metabolic, endocrine, neural, and immune pathways. When these pathways are challenged by something like an infection, it can alter the trajectory of a child’s growth, leading to the manifestation of obesity or undernutrition. Just like development of a fetus’ body, microbiome development begins at a young gestational age and any interruption in this development can have adverse effects for the child after birth.

Recent Progress:

 Exposure to antibiotics after birth has been introduced because, once born, children are exposed to an entire world of different microbiota, some of them harmless, and some of them not. These different microbiotas are different diseases an infant does not have innate immunity for, which is what makes vaccinations important. The early infant microbiota is defined by the maternal microbiota, antibiotic exposure, and feeding practices of the infant. The milk-microbiota interaction between an infant and their mother is a primary method of intervention through which faltering growth can be addressed. Breast feeding provides important nutrients for an infant to grow, along with important microbiome transmission for immunity. Undernourished infants have a gut microbiome similar to preterm infants. Infants benefit greatly from being breast fed because it helps stimulate healthy growth and development. It’s estimated that 25%-30% of infant bacterial microbiota originates from a mother’s breastmilk. However, one of the issues for the microbiome field is defining a ‘normal’ microbiome. This is because there are many different versions of a healthy microbiome and they vary from person to person. The role of the early-life microbiome is highly dependent on the composition and function of the acquired microbiome, depending especially on geographical location, gender, and age.

It has been discovered that mothers with a shorter stature are at a higher risk for having growth-impaired children, which is due to intergenerational genetic modifications. To correct these intergenerational growth impairments, the idea of introducing a dysbiotic microbiota to metabolic disorders has been proposed.

Discussion:

During pregnancy, fetal growth and development is influenced greatly by the in-utero environment. This environment is the only thing the fetus will know until birth. Any challenges to the developing composition of the microbiome put the fetus at risk for postpartum development issues, not only regarding motor skills but also regarding weight. Approximately 20% of stunting has in-utero origins due to preterm birth or small for gestational age (SGA). These in-utero origins have been traced back to maternal and placental infections and inflammations which suggest a prenatal role of microbes in fetal growth. Vaginal infections have shown to be an important route of transmission for pathogens to invade the in-utero environment. Based upon this, we can determine the microbiota composition is different from that of a nonpregnant woman and it continues to change throughout pregnancy. Another factor on the vaginal microbiota is geographical location. Pregnant women in different geographical regions have shown more diversity in the taxa of their microbiome. Some of the differences are positive and in favor of the fetus, but others are detrimental to the fetus. For example, a subtype of *Corynebacterium,* found in pregnant women in rural Malawi, results in a significantly reduced newborn length-for-age Z-score. Along with vaginal microbiota varying depending on the region a woman is living in; gut microbiota works the same way. Gut microbiota bacterium can positively affect women living in lower-income areas and can be detrimental for women living in high income areas. This is because women living in higher-income areas often have a lower gut microbiota diversity, meaning the types of bacteria present differ. Microbial invasion of the amniotic sac can result in preterm birth, along with other adverse birth outcomes.

 After breastfeeding, the introduction of solid food creates a rapid increase in the diversity and functionality of their microbiome. During this time period, a child is growing linearly. People living in low-income settings are at more of a risk for pathogen infections along with a heightened risk of undernutrition which will have more of an effect later in life. A group of infants from Bangladesh exhibited more of a specific type of bacteria that is associated with severe acute malnutrition (SAM) and indicated an immature microbiota compared to healthy children. In a small study in India is was discovered that a lack of *B. longum* and *Lactobacillus* along with an elevated abundance of *Desulfovibrio* was related to stunted growth in children. What has consistently been discovered with stunted growth is it shows in different ways. The prevalence of a bacterium in one region that resulted in stunting for those children does not result in stunted growth for children of other regions.

 The first 1000 days is the best time to intervene in a disturbed gut microbiota because this is the time when everything is still developing. Through the use of microbiota-targeted therapies, undernourished children presenting stunted growth can attempt to have the stunted growth corrected. Beneficial effects have been found through the use of antibiotics during pregnancy. The results have shown a reduction in stunting up to 5 years of age. Although the use of probiotics on birth outcomes remains unclear, there have been positive effects for children’s weight gain after birth for children who are at risk of undernutrition.

Sources

Robertson, Ruairi C., et al. “The Human Microbiome and Child Growth- The First 1000 Days and Beyond.” *Cell.com,* CellPress , www.cell.com/trends/microbiology/fulltext/S0966-842x(18)30204-X.