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The effect of intestinal microbiota on pregnancy and baby's health

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Abstract

Introduction: The intestinal microflora (IM) is a heterogeneous complex of all microorganisms inhabiting the human body, both commensal, symbiotic and pathogenic. It consists mainly of bacteria, but also of viruses, archaea, fungi and protozoa. IM has an important metabolic and immunological role and participates in the course of pathological processes. The composition of a newborn and baby's IM changes dynamically in the first year of life. Just in the first days of birth, the newborn is exposed to many different strains of bacteria, including Staphylococcus sp. and Enterococcus sp.

Aim: To purpose of systematic review was to collect and analyze material of effect of the mother's gut microbiota on the pregnancy and of the health of baby.

Material and methods: Review of the literature published in 2008-2020.

Conclusion: The uterus environment was originally considered sterile and the newborn's intestines were to be colonized only during and after delivery. However, recent studies indicate that placenta and amniotic fluid are involved in microbiota colonization of fetal intestines during prenatal life. This means that the fetus has an initial stock of microorganisms before birth. In addition, a significant effect of maternal diet and probiotic supplementation during pregnancy on the composition of microorganisms found in the amniotic fluid has been demonstrated. There is also a relationship between microbiotic programming in the aspect of civilization diseases.

Summary: The education of women of reproductive age on the subject of proper nutrition and supplementation during pregnancy and the puerperium is extremely important. Undertaking pro-health activities will affect the child's future health and development.

Key words: intestinal microbiota (IM), microbiotic programming, probiotic supplementation

Introduction

The intestinal microbiota (IM) is defined as a group of organisms, mainly bacteria, which is reside of the human digestive system and it’s inhabited by a significant number of species of microorganisms, modulate human health [1].

The adult human body hosts over 10^{13} bacteria, in what is generally a mutually beneficial symbiosis [2]. Most of these microbes reside in the gastrointestinal tract, where they are recognized as a vital part of the human metaorganism. The greatest activity of IM is displayed in the large intestine. It is estimated that it constitutes up to 80% of the feces mass. Microbiota microorganisms often live in symbiosis with humans and perform many crucial functions, like fermentation of certain nutrients, stimulation of the immune system to fight pathogens, regulation of intestinal development, production of vitamins (biotin and vitamin K) [3]. Animal studies have shown the importance of the intestinal microbiome for shaping local and peripheral immunity. Bacteria are essential for the efficient metabolisation of indigestible fibers. Metabolites produced by intestinal bacteria include short chain fatty acids (SCFA), of which butyrate and proprionate are a nutrient source for colonocytes and perform functions in gluconeogenesis, while acetate is a growth factor for other bacteria and plays a role in cholesterol metabolism [2]. With the recognition of the intestinal microbiota as important player in homeostasis, its potential role in metabolic disease is now also emerging.

The composition of IM depends on the food consumed, the hormonal balance, the host environment, antibiotics, medications and diseases. Proved that the IM of a pregnant woman, her diet and health status have a direct impact on subsequent profile of the baby's gut bacteria [4]. Recent studies using molecular techniques suggest bacterial communities in the placenta, amniotic fluid and meconium from healthy pregnancies. This would mean that the fetus, by ingesting amniotic fluid, colonizes the intestines with the microorganisms it contains. However, more research is needed to explain this phenomenon [5].

It have been demonstrated that the gestational age of birth also has an influence on proper colonization of the intestines. IM of the premature babies is different from that of term ones. The main differences include opportunistic and potentially pathogenic bacteria, such as Enterobacter, Enterococcus, Staphylococcus. It was noticed that irrespectively of the age of birth, the composition of the intestinal microbiota of infants tends to be dominated by Bifidobacterium, which is an indicator of healthy intestinal microbiota in children [6, 7].

It is noteworthy that infants with impaired IM development, increased occurrence of aerobic cocci and decreased amount of Bifidobacteria, show a higher risk of infections, including sepsis, compared to children with an adequately developed microbiota [7].

Aim of the work

To purpose of systematic review was to collect and analyze data of effects of the mother's gut microbiota on the pregnancy and the health of baby.

Discussion

The first 1,000 days of life beginning from conception offer an unique window of opportunity to improve lifelong health. Maternal disorders during pregnancy will determine *"early metabolic programing"* of their offspring, which adapts the fetus to the adverse intra-uterine environment. These complex interactions that exist between maternal nutrition and metabolic status, together with a wide range of factors influence the IM and its establishment, including maternal metabolic state, delivery and feeding mode, among others, which are particularly powerful during this period of rapid change [8].

The variety and composition of IM evolve individually and depends on many factors. The impact of the mother's diet on the IM of the newborn is an object of new research. Saturated fat diets have become popular in the world, but it changes a child's IM, increasing the risk of many diseases, including asthma, necrotizing enterocolitis, atopy and hypertension [9]. In healthy people, a diet rich in walnuts significantly influences IM by strengthening the probiotic and butyrate-producing microflora [10]. High consumption of fiber and moderate fats was associated with a large variety of intestinal microflora in pregnant women, and the increased amount of Bifidobacteria in the intestines of the mother and her infant was caused by an increase in prebiotic fiber consumption [11]. Increased consumption of vitamin E and protein during pregnancy may reduce intestinal colonization by Proteobacteria, which have pro-inflammatory properties [12].

During pregnancy, insulin sensitivity changes over time to adapt to the changes in energy requirements that accompany the different stages of pregnancy [13]. An important factor affecting the infant's IM is the metabolic state of the mother. Gestational Diabetes Mellitus (GDM) influenced the composition of child's meconium microbiota by increasing the number of Bacteroidetes and Parabacteroidetes [14]. It is also possible to transfer the microbiota that causes obesity from mother to child. Obesity in pregnant women has also been associated with specific microbial changes, and pregnancy weight gain correlates with increased levels of Bacteroides [15]. Children of obese women, in comparison to children of women with correct body mass index (BMI), were characterized by significant amounts of Parabacteroides spp., Oscillibacter spp. and unclassified genus Bacteroidales, as well as small amounts of Blautia spp. and Eubacterium spp. [16, 17].

Regarding functionality, the microbiome of infants born to normal weight mothers was characterized by a significant enrichment in the abundances of "pentose phosphate pathway", "lysine biosynthesis", "glycerolipid metabolism" and "C5-branched dibasic acid metabolism". The microbiome of infants born to obese mothers was significantly enriched in "streptomycin biosynthesis", "sulphur metabolism", "taurine and hypotaurine metabolism" and "lipopolysaccharide biosynthesis". In addition, it was found that maternal overweight/obesity and excessive gestational weight gain were associated with differences in the maternal gut microbiota at the time of delivery [8].

Transfer of fecal bacteria from the third trimester to germ-free mice resulted in increased weight gain, development of insulin resistance, and inflammatory responses in these mice [18].

Recent studies have shown that preeclampsia (PE), a disorder associated with hypertension occurring after week 20 of gestation in combination with proteinuria, is associated with severe intestinal dysbiosis. One possible mechanism by which this occurs could be the destruction of the gut barrier and the displacement of pathogenic bacteria from the gut to the placenta, causing abnormal immune responses as studies have identified higher levels of all bacteria and Fusobacterium in the placenta. Fusobacterium has been shown to be a key regulator of the gut-placenta axis during PE [19].

The use of antibiotics during pregnancy also affects the baby's IM. It has been observed that treatment with antibiotics during the second and third trimesters of pregnancy was associated with an increase in BMI in children [20]. Therefore, it is important that antibiotics are used rationally, not only to limit the reproduction of antibiotic-resistant organisms, but also to prevent potentially unfavorable long-term metabolic consequences [21].

In the last few years, IM has emerged as a new factor that influences fetal neurodevelopment through the *"gut–brain axis"*. Malnutrition as well as intestinal diseases may determine a dysbiosis of the gut microbiota community inducing immunological changes resulting in inflammation. This inflammation will promote the intestinal barrier loss, causing translocation of pathogenic bacteria to the systemic circulation from the intestinal mucosa.

These components activate the innate immune system, which produces proinflammatory cytokines, leading to an impairment of the central nervous system (CNS) development and function. Although the role of the gut microbiota on the infant's neurodevelopment is not well understood, increasing evidence suggests that the gut microbiota plays a key role in this axis [8].

An important element is probiotic supplementation, affecting the host's IM. Probiotics in combination with dietary counseling improved glycemic control and insulin sensitivity in healthy women during and after pregnancy. It happened due to changes in the gut microflora and so alteration of the gut immune environment. It has also been noticed that supplementation of probiotics during pregnancy improves metabolic parameters, in some cases reducing the risk of GDM [16, 22]. Intervention with probiotics as early as possible can provide greater benefits to the offspring, creating a stable gut microenvironment. Therefore, probiotics administered during pregnancy may play a crucial role in optimal health of the offspring [23].

Summary

The intestinal microbiota is considered as an important organ of the endocrine system. It has a significant impact on host's health, so following a proper diet, rich in fresh fruit, vegetables and whole grains is worth. Supplementation with Bifidobacteria or bifidogenic prebiotics reduces the number of Enterobacterial, Clostridia and reduces the signs of child anxiety [24]. Scientific research has shown a significant impact of mother's gut microbiota on health and development of the child by reducing the risk of metabolic diseases and allergies. Therefore, preventive behaviors including dietary counseling of pregnant women, rational use of antibiotics and other medications and probiotic supplementation are important. Necessary treatments and interventions in pregnancy, such as antibiotic therapy before delivery and caesarean section, appear to interfere with the development of a healthy infant's microbiome, while vaginal delivery and breastfeeding appear to be crucial for the infant's development and long-term metabolism and immunity [25].

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