

Microbiome and Childhood Health

Hongmin Sun*

Division of Cardiovascular Medicine, Department of Internal Medicine, University of Missouri, Columbia, Missouri 65212, USA

*Corresponding author: Hongmin Sun, Division of Cardiovascular Medicine, Department of Internal Medicine, University of Missouri, Columbia, Missouri 65212, USA. E-mail: sunh@health.missouri.edu

Received Date: January 01, 2014 Accepted Date: February 28, 2014 Published Date: March 02, 2014

Citation: Hongmin Sun (2014) Microbiome and Childhood Health. J Pedia Cong Disord 1: 1-2.

In recent years, microbiome has gained attention for its contribution to infant and childhood development. There are trillions of microorganisms residing on human body whose community is referred as microbiota. These microorganisms are believed to play important roles in nutrition, protection from pathogens, and development of the immune response [1]. Microbiome is the collective genomes and gene products of the resident microorganisms living within and on human [2]. The microorganisms that live within and on humans are estimated to be of ten times the number of human cells [2]. The National Institutes of Health sponsored Human Microbiome Project to study the composition of the human microbiome [2]. It is believed that humans are a composite of microbial and human cells. As a result, microbial components could contribute to human physiology and predisposition to diseases [2]. This new concept suggests that development and evolution of microbiome could influence human metabolism and health.

The early days of human life are particularly important for development of microbiome and could have significant impact on human health. Taking intestinal microbiota as example, facultative bacteria start colonizing the sterile newborn guts first. The expansion of these bacteria creates a reduced environment gradually leading to establishment of an intestinal microbial community enriched with anaerobic genera. Eventually, the number of facultative species is outnumbered 100-1000:1 in adults. By age of 1 year, the infant intestinal microbiota will resemble adult gut pattern [3]. During that process, a number of environmental factors such as the ways babies are delivered and fed will greatly impact the formation of their gut microbiota. Usage of antibiotics will also drastically alter the composition of the intestinal and oral microbiota.

A number of pediatric diseases are linked with the altered states of the microbiome. The microbiotas of allergic and nonallergic infants are different. Earlier colonization with

certain bacteria such as *Bacteroides fragilis* and *Clostridium coccoides* has been associated with increased risk for asthma in children [4,5]. Changes in the microbiota are also linked to skin diseases including psoriasis, atopic dermatitis and acne [1,3,6]. The hygiene hypothesis proposes that improved hygiene leads to decreased exposure to infectious agents in early life that could cause increase in immune dysregulation and atopic diseases [1,3,7]. The establishment of a diversified balanced microflora is important for the normal development of the immune system [3]. Intestinal microbiota also plays important roles in host metabolism. It was observed that obese children had lower intestinal *Bifidobacterium* and higher *Staphylococcus aureus* counts compared with normal weight children [8]. However, further studies of the intestinal microbiota especially in the first 6 months of life are needed to improve our understanding of the roles of intestinal microbiota on obesity. Breast feeding was suggested to protect against obesity [9]. Studies on the effect of prebiotics and probiotics on preventing atopic diseases have been inconclusive [3].

In summary, there have been convincing observations that microbiome has major effect on human health. With the advance of sequencing and other molecular, bioinformatics technologies, we are gaining more knowledge on the intriguing roles of microbiome on human health. It should be noted that the composition of individual microbiota is in constantly dynamic state and there is also big variation among different individuals which pose daunting challenge to our effort to understand this important aspect of our genome. Continuing effort to study the relationship of dynamic of microbiome and human health will provide better understanding of the nutritional requirement of humans and guide the clinic practice. Giving that the foundation of microbiota is established in the early days of human life, studies on microbiome should be of particular interest to pediatric researchers and clinicians.

Acknowledgments

I would like to thank Dr. Michael Sherman for his insightful discussion.

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