**Antibiotics and Their Role in Disrupting the Adolescent Human Microbiome**

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**By analyzing studies done on mice and imposing those results upon humans, researchers have inferred that early exposure to antibiotics may play a role in disrupting the natural state of the human microbiome, which may further lead to certain metabolic and immunological diseases. This study shows exactly how antibiotic use affects the human microbiome, specifically in Finnish children aged 2-7 years old, and attempts to correlate this disruption with obesity and asthma. With this newfound knowledge will come a more complete understanding of the effects caused by antibiotics on the human body. Additionally, it will allow others to more readily weigh the pros and cons behind their personal use of antibiotics.**

**Introduction**

It is no secret that antibiotic use has increased dramatically since the discovery of penicillin. In fact, antibiotics are the most commonly prescribed drugs in the western world, saving lives every day2. However, antibiotics carry a double-edged sword in terms of global health and safety. Antibiotic overuse and misuse has led to the new challenge of antibiotic resistance1. Even more recently, studies on mice have shown that early-life antibiotic use is associated with metabolic and immunological diseases such as obesity and asthma2. However, mice are entirely different from humans and, as of yet, no large studies have been done to determine the physiological effects of antibiotics on the microbiome of human children.

The purpose of this study is to gain a better understanding of the shifts caused by antibiotic use in the gut-flora of children. And secondly, what those shifts may mean for one's long-term health. This was done by utilizing the purchase history of each child's antibiotic prescriptions, provided by the Finnish Social Insurance Institute, and using DNA sequencing to report the microbiotic diversity of each child's fecal sample. From here, results were compared to each child's body mass index (BMI) and asthmatic symptoms in order to draw a positive, or negative, correlation between antibiotic use and the aforementioned health concerns.

**Recent Progress**

As expected, the microbiotic composition of each child's microbiome was indeed effected by recent antibiotic use. However, what is surprising is that different types of antibiotics have different effects on the microbiome as a whole. For example, penicillins had very little effect on the composition of one's gut-flora even at as little as 6 months after use2. Macrolides, a separate type of antibiotic, made distinct changes in microbiotic composition. At 6 months after use, Actinobacteria levels were essentially reduced to nothing and in their place came an increased amount of Bacteriodetes, Protobacteria, and to a smaller degree, Firmicutes2. This increased disturbance in microbiotic composition is most likely due to the fact that macrolides have a wider antibacterial spectrum than penicillins. Even more surprising was how long it took children with recent macrolide use to return to their normal composition levels, with some not fully recovering after two years of no antibiotic use2. It should also be noted that these results were consistent among all age groups covered in this study. Meaning that macrolide use affected 2 year olds in a similar way as 7 year olds.

In addition to differentiating amounts of microbiotic composition between active and non-active antibiotic users, there is also the negative relationship between the amount of time since a macrolide course and macrolide resistance. To summarize, there was a much higher amount of antibiotic resistant microbes found in the samples of children who had just had a course of antibiotics than in the children who had their last course a year ago2. These results only further strengthen the ideas behind antibiotic overuse.

More importantly, there proved to be a clear connection between frequent early-life macrolide use and health concerns such as obesity and asthma. With an odds ratio of 6.11, individuals who had frequent macrolide use within the first 2 years of life had a significantly greater chance of developing asthmatic symptoms2. The same trend applied to obese children as well2. In the case of asthmatic individuals, the bacterial genera *Blautia, Rothia,* and *Coprobacillus* stood out to be in a different abundance when compared to the healthy control group2. Obese children had the bacterial groups *Clostridium, Akkermansia,* and *Enterococcus* in different abundances2. Regardless, it is easy to see a difference in the composition and abundance of the microflora in these individuals, eight of which were asthmatic and nine had a high BMI.

**Discussion**

The results in this study show a relationship between early exposure to antibiotics and the properties of the intestinal microflora. There were night-and-day differences in the abundance and composition of the microflora in individuals who did not receive rounds of antibiotics and those who did. For some individuals, micriobiotic levels did not seem to level out until years after termination of antibiotics. It was the researchers thinking that these dramatic shifts in microbiotic levels could possibly be correlated to obesity and asthma. After some testing and comparing, this proved to be a valid hypothesis.

However, correlation is not necessarily causation. Yes, all children who had taken antibiotics proved to have differentiating amounts of bacteria. But, not all of these children proved to be asthmatic or obese. So, just the simple act of taking antibiotics does not mean one is doomed to a life of strenuous breathing or dieting.

Many different factors could have played a role in these children's metabolic and immunologic diseases, such as: genetics, eating habits, infection, or parental choice. The decision to formula feed, rather than breast feed, a child can serve as an example of a parental choice that may affect the child's health. Children that are breast fed from birth are shown to have higher amounts of *bifidobacteria*, a genus responsible for producing antibodies that combat against pathogenic bacteria and viruses, than children who are formula fed3. This decreased amount of *bifidobacteria* may help explain why formula fed children in third-world countries are six times more likely to die from waterborne diarrheal diseases3.

Nevertheless, correlations are a necessary starting point to begin solving new and pertinent issues like asthma and obesity. Currently, the amount of asthmatic cases diagnosed in the U.S. increases annually with 1 in 12 people (25 million) having the disease, costing the U.S. 56 billion dollars in medical bills, lost work days, and deaths4. Additionally, nearly 17% of American children are obese as well as 35% of adults5. These are both very concerning diseases that need to be treated sooner rather than later. It is the researchers hope that this study will serve as motivation when addressing these key issues, as well as any others issues related to microbial populations.

**References**

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