

Cesarean versus Vaginal Delivery: Long term infant outcomes and the Hygiene Hypothesis

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KEY POINTS FROM THIS ARTICLE:

- 1) In the United States the rate of cesarean delivery has risen 48% since 1996, reaching a level of 31.8% in 2007.
- 2) The cesarean rate in China is about 50%.
- 3) In some private clinics in Brazil the cesarean rate is about 80%.
- 4) Some cesareans are "simply due to maternal request and may incur several risks for the child," including:
 - Neonatal depression due to exposure to general anesthesia
 - Fetal injury during delivery
 - Increased likelihood of respiratory distress
 - Breastfeeding complications
- 5) "Concurrent with the trend of increasing cesarean delivery, there has been an epidemic of both autoimmune diseases such as type-1 diabetes, Crohn's disease, and multiple sclerosis and allergic diseases, such as asthma, allergic rhinitis, and atopic dermatitis. Intestinal environmental interaction during early development of the immune system may relate to these diseases."
- 6) Cesarean versus vaginal delivery may influence the early development of the intestinal microbiota, altering the development of the child's immune system.
- 7) "The immune system undergoes major development during infancy and is highly related to the microbes that colonize the intestinal tract."
- 8) The microbes that 'seed' the intestine during either cesarean delivery or vaginal delivery may change long-term intestinal colonization, altering the immune system development.

9) The human intestinal tract:

- Has 10X more microorganisms than there are cells in the body.
- These gut flora have 100X times more genes than the human genome.
- The metabolic activities performed by gut bacteria resemble those of an organ, "leading some to liken gut bacteria to a 'forgotten' organ."

10) Gut microorganisms perform a number of useful functions:

- Fermenting unused energy substrates
- Training the immune system
- Preventing growth of harmful, pathogenic bacteria
- Regulating the development of the gut
- Producing vitamins for the host, like vitamin K

11) Gut microorganisms interact with other modern environmental changes that enhance inflammatory responses such as poor diet, obesity, psychological stress, vitamin D deficiency, pollution (dioxins), and cesarean delivery. These chronic inflammatory gut exposures can drive allergies, autoimmunity, inflammatory bowel disease, vascular disease, some cancers, depression/anxiety, perhaps neurodegenerative disorders, and type-2 diabetes.

12) Treatment with broad-spectrum antibiotics is a common practice for mothers who go into premature labor or who have a cesarean delivery. This treatment can reduce the biodiversity of the fecal microbiota and may be a factor in the cause of several diseases.

13) Intestinal commensal microbiota have an influence on early postnatal immune development.

14) "During vaginal delivery, the contact with the maternal vaginal and intestinal flora is an important source for the start of the infant's colonization." "During cesarean delivery, this direct contact is absent, and non-maternally derived environmental bacteria play an important role for infants' intestinal colonization."

15) The composition of the very first human microbiota could have long lasting effects. "The composition of enteric microbiota in early days of life seems to be a very important factor for achieving and maintaining good health in the years to come."

- 16) Intestinal bacteria play an important role in the postnatal immune system development.
- 17) Initial intestinal communities may serve as a direct source of protective or pathogenic bacteria very early in life.
- 18) Babies born vaginally are colonized predominantly by *Lactobacillus*, whereas cesarean delivery babies were colonized by a mixture of potentially pathogenic bacteria typically found on the skin and in hospitals, such as *Staphylococcus* and *Acinetobacter*.
- 19) The effect of mode of delivery on development of childhood disease has just recently begun to be explored.
- 20) Atopic diseases are more frequent in infants after cesarean delivery than after vaginal delivery.
- 21) Cesarean delivery has been associated with a significant increased rate of asthma and allergic rhinitis. The risk of asthma could be increased by up to 60%.
- 22) "Children born by cesarean delivery are also significantly more likely to suffer from celiac disease and to be hospitalized for gastroenteritis."
- 23) Cesarean delivery "appears to shift a baby's first bacterial community."
- 24) Standard of care dictates that antibiotics be administered prior to cesarean delivery and to mothers in preterm labor. Thus, the "exposure to antenatal antibiotics is significant." Antepartum and intrapartum antibiotics also alter the child's gut microbiota, altering the child's risk for disease.
- 25) Cesarean deliveries are on the rise and rates of vaginal births are declining.
- 26) "The 'hygiene hypothesis' suggests that an overly clean environment, especially in early childhood, may contribute to the development of several childhood diseases." "This new information about colonization differences with differing modes of delivery seems to be taking the hygiene hypothesis to an entirely new level."

COMMENTS FROM DAN MURPHY:

Gut flora and the symbiotic functions they provide their host, are critically important to host health, especially for immunity and brain function. Cesarean delivery colonizes a child's gut with pathogenic bacteria. Vaginal delivery colonizes a child's gut with beneficial bacteria. Maternal or pediatric antibiotics also alter gut flora in a negative way, promoting a variety of systemic diseases.