

GUT BACTERIA AND PEDIATRICS



What Do We Know

- Is it possible to improve the outcome for baby with interventions for mother and baby?
- It appears so – the research is starting to paint a picture
- The key is to improve the health of the mother during pregnancy and during breast feeding and providing the best start for baby – no matter the circumstances of the birth



In A Perfect World

- We would work with women for six months before conception
- We would correct the gut dysbiosis, improve their diet and lifestyle for diversity of strains, detox them, have them eat a healthy diet to prepare them for pregnancy
- We would then give them a healthy protocol with a focus on gut health and a follow-up protocol for after the baby is born for both mother and baby
- Unfortunately, this is just not the way we tend to get them.



What We Need To Know

- The newborn infant has been presumed sterile (from a microbe perspective)
 - The newborn is the perfect microbial habitat – food, warmth, moisture.
 - New research suggests maybe the mother gives some to baby in utero through the nervous system
- The majority of good bacteria that the baby needs is received from the environment both as and after the baby is born into the world



When Baby is Born

- Vaginal Birth: First exposure is skin, vaginal canal, and rectal micro flora from the mother
- Strains: Mainly Lactobacilli (mainly acidophilus types), streptococci non-haemolytic, Enterobacteria: various types including E coli.
- Minor Colonisers : Bifidobacteria, bacteroides, clostridia



When Baby is Born

- C-section: First exposure is from skin and hospital environment
- First Strains: Staphylococci (aureus) (MRSA) Enterococci, enterobacteria. Minor Colonisers : Lactobacilli
- Minor Colonisers : Bifidobacteria, bacteroides, clostridia.



Breast Milk

- Until recently, breast milk was thought to be contaminated from skin, nipple ducts –
- Now it is known that small number of good bacteria is collected by dendritic cells and macrophages from small intestines
- It is transferred to the breast tissue, via the lymph system



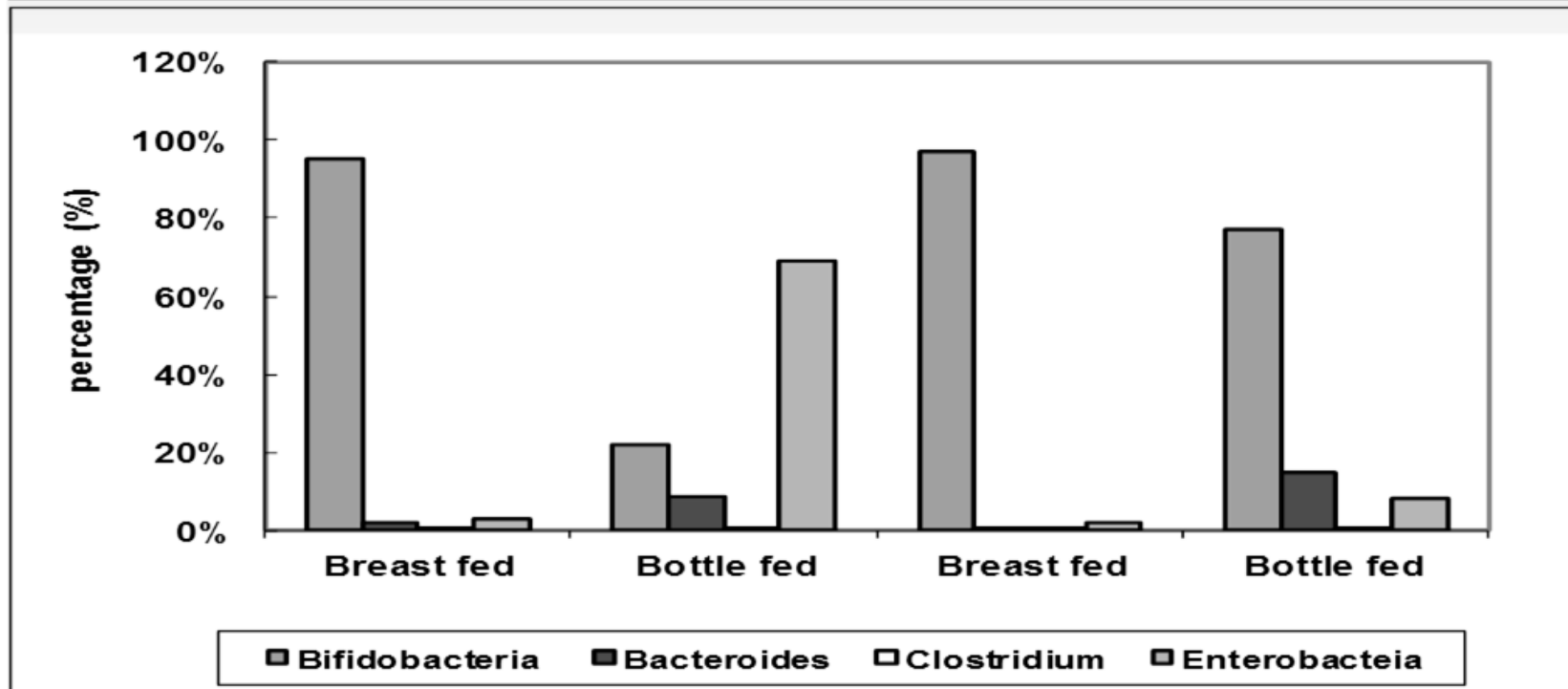
Breast Milk

- Numbers are low – 10,000 – 1 million CFU per 100 ml breast milk but this is significant given the timing and the condition of the baby
- This starts during the third trimester and stops when breast tissue returns to normal after breast-feeding stops. Proves baby get mothers intestinal flora through breast milk
- Gut microflora growth and diversity continues in infants until the age of two - this will represent the nature of the residential bacteria that a baby will have for life.
- Newborns need – need 570-900 ml breast milk per day(19- 30 oz)

Building Gut Bacteria

- At 1 Week
 - Bacteria in breast fed is 95% bifidobacteria and 3% enterobacteria
 - Bacteria in bottle fed only has 22% bifidobacteria and 69% enterobacteria
- At 19 weeks,
 - The breast fed baby is still at 95%
 - Bottle fed is 77% bifidobacteria with enterobacteria at 2% and 8 % respectively

	Microbiota at 1 week		Microbiota at 19 weeks	
	Breast fed	Formula fed	Breast fed	Formula fed
	(log cfu/g)		(log cfu/g)	
<i>Bifidobacteria</i>	9.0 (95%)	7.8 (22%)	9.8 (>95%)	9.7 (77%)
<i>Bacteroides</i>	7.3 (2%)	7.4 (8.7%)	7.5 (0.5%)	9.0 (15%)
<i>Clostridium</i>	3.5 (<1%)	5.1 (<1%)	4.9 (<1%)	6.6 (<1%)
<i>Enterobacteria</i>	7.5 (3%)	8.3 (69%)	8.1 (2%)	8.7 (8%)



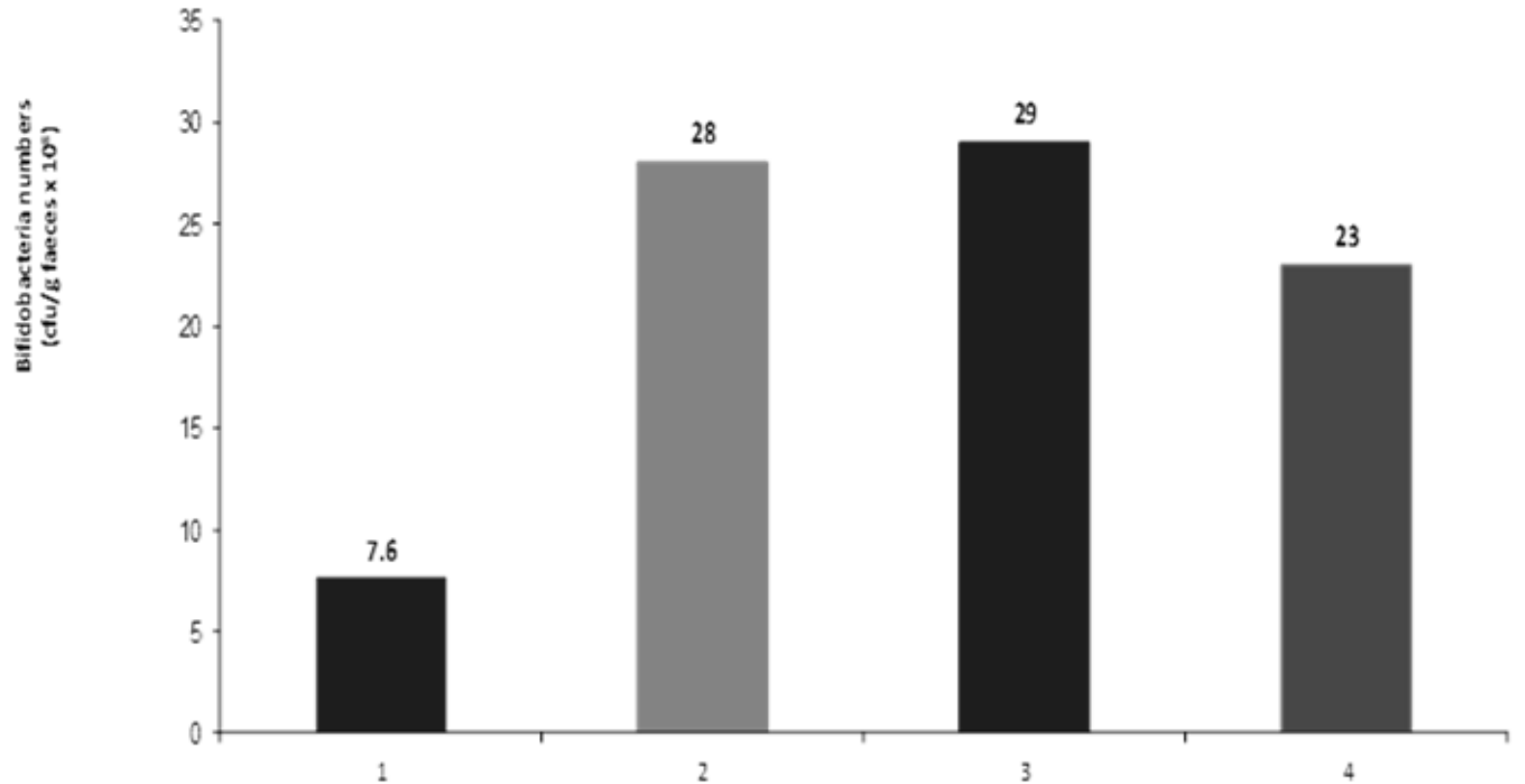
Prebiotics

- Breast milk contains prebiotics mainly galactose oligosaccharides (GOS) which causes the increase production of bifidobacteria at 1 week.
- Study: One group: Adding prebiotics to formula (900 mg GOS, 100 mg FOS)
- Another group fed bifidobacteria to mother 2 weeks before birth and feeding baby bifidobacteria for 2 months after birth
- Plus one bottle fed only group and one breast fed group



Study

- 1. Bottle Fed
 - 2. Breast Fed
 - 3. Formula Fed with GOS/FOS
 - 4. Formula Fed with B Lactis given to mother two weeks before delivery and for 2 months after
- (Rinne et al FEMS ImmunolMed Microbiol 2005)



Allergies in Children

- Delay in the compositional development of and in the amount of gut microflora was a general finding in allergic children
- Alterations in intestinal microflora have been detected both in infants suffering from allergies and in those later developing the disorder.
- Good bacteria can induce the production of IL-10 and transforming growth factor-beta, which possess an important regulative role in the development of allergic-type immune response
- Probiotics also strengthen gut defense barrier mechanisms and reduce antigen load in the gut

Study #1

- In one study, 215 infants aged 6-12 months were divided into two groups:
 - 1) Received *L. fermentum* plus GOS supplemented formula milk
 - 2) Received GOS only supplemented formula milk
 - Infants in group 1:
 - 46% reduction in the incidence rate of GI infections
 - 27% reduction in the incidence rate of URTI
 - 30% reduction in total number of infections at the end of study period compared to infants in the group 2

Study #2

- 1223 pregnant women received 4 probiotic strains or a placebo starting at the 36th week of pregnancy
- The baby receive probiotics and prebiotics for six months.
- The results showed no significant difference in allergies – however the symbiotic group had less eczema and less 1gE related conditions.
- However, there was a significance difference in the development of allergy in the placebo vs symbiotic group that were delivered by Cesarean

Study #3

- In an another study of infants 6-12 months all with eczema and a suspicion of cow milk allergy – three groups – one received L.Rhamnosus GG, one group received a 4 bacteria mixture and the third a placebo.
- Significant reduction in eczema with the greatest reduction in the L.Rhamnosis GG group especially in those infants who had not been on antibiotics during the study period

Allergies Studies

- Although 9 studies have been published on the potential of probiotics to prevent allergic diseases in childhood ([Table 2](#)), only one, Kalliomaki's study, was fully successful, while four studies reported no significant effect.
- The issue is that the studies generally have short term interventions
- The goal is to craft a protocol that serves long term goals

Issues For Optimal Gut Health for Baby

- Is baby breast fed or formula fed
- Is baby delivered vaginally or cesarean
- Condition of mother pre-conception, during pregnancy and while breast feeding
- Has the baby received an early course of antibiotic – before the age of 2
- Quality of mothers diet during her life, pregnancy and while breast feeding



IMPACT of INTRAPARTUM ANTIBIOTIC PROPHYLAXIS & OTHER PERINATAL INTERVENTIONS on the INFANT GUT MICROBIOME: findings from the CHILD Canadian birth cohort

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Quote for Researcher

- Although we are far from understanding what constitutes a “healthy infant gut microbiota,” normal colonization occurs when the infant is born full term by vaginal delivery, is not exposed to antibiotics and is exclusively breastfed during the first six months of life.

CHILD – a 6-year study of 3,300 children

In-utero - **recruitment:** Maternal, paternal studies; clinical, stress, nutrition and environment questionnaires

- Delivery - **delivery:** outcomes, cord blood, meconium
- 3 months - **home visit:** health questionnaires, home inspection, dust sampling, breast-milk, urine, nasal swab, stool, infant lung function, stress (sub-cohorts)
- 6 months - questionnaire follow-up
- 1 year - **clinic:** skin tests, blood, lung function, infections, urine, nasal swab, stool; maternal studies
- 1 ½ years - questionnaire follow-up
- 2 years - questionnaire follow-up 2 ½ years - questionnaire follow-up
- 3 years - **clinic:** questionnaires, clinical assessment, skin tests, lung function, urine
- 4 years - questionnaire follow-up
- 5 years - **clinic:** questionnaires, clinical assessment, skin tests, lung function, blood, physician assessment

IAP

- Intrapartum antibiotic prophylaxis – the period between onset of labour to the end of third stage of labour
- Bacteroidaceae abundance is lower and Clostridiaceae is higher with IAP (penicillin G) in vaginal delivery versus no IAP
- Bacteroidaceae abundance is substantially lower with IAP (cefazolin) in elective CS compared to no IAP (& IAP vaginal)
- After emergency CS, mothers and newborns were more likely to receive antibiotics

Is it due to IAP or cesarean section?

- Lower abundance of Bacteroidetes microbiota in the infant gut following cesarean section (CS)
- Changes to gut microbiota seen before infant weaning
- Elective and emergency CS are frequently grouped
- CS can interfere with breastfeeding, with the potential to affect infant gut microbiota

Summary of Findings

- Bacteroidaceae were reduced at 3 months in IAP
- Significant differences at the genus level with all CS types
- Genus level differences did not survive multiple correction in IAP vaginal delivery
- Clostridium & Enterococcus higher in emergency CS, consistent with resistance to beta-lactam antibiotics □ Trend for higher Clostridium in other IAP
- Exclusive breastfeeding at 3 months yields comparable levels of Bacteroidaceae & Clostridiales at 1 year in IAP exposed infants

Comparison of findings to the human literature

- IAP and infant gut microbiota composition Lower bifidobacteria counts 7 days after maternal IAP for GBS (Alosio et al. Appl Microbiol Biotechnol 2014;98)
- Lower Bacteroides in gut microbiota at 6 weeks of age with IAP/postnatal antibiotic treatment according to maternal report (Fallani et al. J Pediatr Gastroenterol Nutr 2010;51)
- No IAP-postnatal associated changes in infant gut microbiota post weaning (Fallani et al. Microbiology 2011;157)
- CS and infant gut microbiota composition: Reduced Bacteroides abundance following CS delivery (Jakobsson et al. Gut 2014;63, Azad et al. CMAJ 2013;185)
- Enterobacteriaceae and Veillonella more abundant at 2 months after acute/elective CS (Hesla et al. FEMS Microbiol Ecol 2014;90)

Diets

- High sugar, fat and protein diets are all associated with dysbiosis
- Mothers need a high complex carbohydrate diet, healthy fats and low refined sugars and poor quality fats
- Reasonable amounts of animal protein (if not vegetarian) – consider digestive enzymes if needed

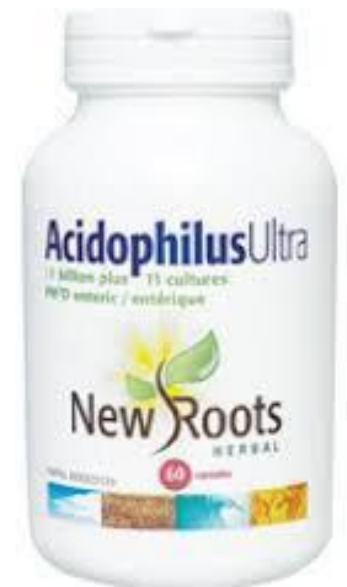


Building Mother's Residential Bacteria

- Mother should be on probiotics for entire duration of pregnancy and breast feeding
- The probiotic should contain GOS and if not then GOS should be added to the dietary protocol (dairy, legumes)
- FOS and other prebiotics can be obtained from diet and should be a priority in a protocol
- Mother should also consume fermented foods and glutamine-rich foods
- Once baby is born, the mother needs to continue this protocol – if breast feeding

Probiotic During Pregnancy

- Generally consider safe
- Meta-analysis study revealed no adverse reactions or issues with mother or baby
- Most companies will have a product they recommend for pregnant women
 - if not stated in their literature then ask
- Ideally, they would contain prebiotics or there can be a focus in diet with prebiotic foods



Study

- 256 women randomized into 3 groups during the first trimester – one received dietary counseling , one group received dietary counseling and probiotics and the third was a control group
- 13 % of the probiotic group developed gestational diabetes vs 36% of the counseling only group and 34% for the control group
- The counseling group had lower birth weight – (link to the later development of Diabetes II
- Similar study regarding weight gain in mothers given probiotics/counseling at 12 months after birth - 25% central fat vs 43% for counseling group and 40% for the control

Other Gut Health Nutrients

- Aloe vera is contra-indicated for pregnancy
- Chamomile and ginger tea are safe
- Glutamine – had shown benefits for baby in animal studies – little is known about it in humans
- Marshmallow has not been studied but traditional sources say it can be taken during pregnancy



Other Nutrients

- Slippery Elm is considered safe but has also not been studied and some herbalists think it could cause miscarriage
- Citrus pectin studies – Inconclusive
- Psyllium considered safe but discuss with MD
- MSM is considered safe during pregnancy but it can pass into breast milk (which contains it naturally) – discuss with MD
- As nutrition professionals, we should work with MDs or midwives before recommending supplements other than probiotics



For Baby

- Probiotics and prebiotics are provided through breast milk
- If baby is formula fed – then formula needs to have GOS and FOS
- Baby can start probiotics with prebiotics at 6 months
- Formula with GOS - Similac Go and Grow Omega 3 and 6 or Enfalac A+ Stage 1 - neither have FOS



Fermented Foods For Baby

- Traditionally, fermented foods have been introduced to babies
- However, a 2014 study of caregivers found that they were reluctant to feed fermented foods due to their lack of knowledge about the foods
- Lactobacillus GG may reduce respiratory infections in daycare (according to one study) and another found similar results with L. reuteri and B. lactis
- Fermented-milk formulas may help gut flora and immune tolerance
- Studies of traditional cultures compared to western cultures find greater diversity in children and higher consumption of fermented foods



Foods To Feed Children

- Milk kefir made with Russian kefir grains (32 good bacteria and yeast strains)
- If child already has a dairy allergy and does not tolerate the milk kefir, then try coconut kefir (must be made, details in Module 4) but see if dairy kefir is tolerated first
- To start baby – place some on the tip of finger and place on baby's tongue
- For feeding older children. Start with a small amount and work up (easy to hide in a smoothie – one tablespoon is good – if child likes it – more can be had)
- If child wants to eat more than they eat daily – let them – could be their natural intuition kicking in



Fermented Grains

- Starting baby with a fermented or “soured” porridge is also traditional
- Fermenting grains can be done simply by mixing oats, for example, with clean, non-chlorinated water and leave them to ferment for at least 24 hours
- This will make them more digestible by starting the digestion process
- Feeding children sourdough bread is another way to help prevent sensitivities and allergies to grain products
- More discussion of this in Module 4



Cultured Vegetable Juice

- The crunchiness of the a cultured vegetable is too much for a baby
- If the food can be purreed easily (like zucchini or tomato), then it may be acceptable
- The juice of cultured vegetables is another option – especially sauerkraut juice
- Put it on babies tongue – let them get used to the taste
- Helps develop a taste for sour and bitter so kids will not be so picky
- Cultured juice can also be added to regular baby food
- Water kefir (must make) also great for adding to existing foods or juice



Raising Healthy Children

- The key to preventing allergies is to feed the children good gut health foods and give extra thought and care as to how to get whole foods into their diet
- This is an education process for parents
- Help clients find and/or make fun foods for their kids that contain prebiotics and probiotics
- Teach parents why this is important
- If children already have allergies, then the goal is improve gut health to re-store immune tolerance
- There is not known protocol but supplementation may be required



Children With Allergies

- In a recent study of children with peanut allergies, 82% were unreactive as compared to the control group (3.6%)
- Both the experimental and control group participated in a de-sensitization program
- The experimental group received a probiotic - lactobacillus rhamnosus CGMCC1.3724 while the control received a placebo
- This means there is a pathway for restoring immune tolerance but there is still a lot of research to be done
- In the meantime – feeding children with allergies prebiotics and probiotic foods and trusting the power of the body to repair itself can help until more definitive answers are available.

In General

- We now know that we do not know the condition of a mother's gut prior to conception
- We can know if they probably have dysbiosis – but not how much lack of diversity there is
- Look at her diet, antibiotics use, alcohol use, birth control pills, corticosteroids etc throughout her life for clues
- Look for what she did right as well
- This will create a picture as to what you may be dealing with



In General

- Educating mothers about not being afraid of bacteria is important and help them create an environment for diversity
- Fathers contribute (as do pets) to gut diversity as families tend to evolve similar diversity from living together
- Probiotic and prebiotic strategies can be planned based on looking at the pre-existing circumstances
- You can get your gut microbes map [Ubiome](#)



As Practitioners

- Develop your protocol with an education element for the mother
- Women need to be educated about what a healthy gut can do to help them and how it can help their baby
- Increase your focus on gut health for children (especially those under two)
- Right now there is a lot of misinformation so everything we can do to help them would be appreciated

