AIMS For a better birth...

Sowing the seeds

AIMS Journal, 2015, Vol 27 No 4

Jessie Johnson-Cash and Rachel Reed explore establishing a healthy microbiome for your baby

Imagine a freshly ploughed field, with rich soil, ready for new life. The first seeds to take root, the first colonisers, determine which ecosystem will thrive there. Will they be a variety of indigenous plants, local to the area, carried in by wind, animal or other means? Or will they be a mass monoculture of foreign crops, reliant on fertilisers, herbicides and the constant tending of a dedicated farmer in order to survive?

Just as the newly ploughed field lies ready to be 'seeded', so too does a newborn baby, and the first colonisers have longterm implications for the health of the baby. The complex human ecosystem includes bacteria, viruses, fungi and protozoa and is known collectively as the human microbiota. What is the human microbiome?

'Microbiome' and 'gut health' are buzzwords that have been making their way into mainstream vocabulary recently, spurred on by documentaries such as Microbirth (microbirth.com). The human microbiome refers to the collective microbial genes, gene products and genomes (the combined genetic material) of the microbiota.1 The microbiota is the community of microbes that live symbiotically with the human body, priming immunity and maintaining homeostasis (balance). The Human Microbiome Project (commonfund.nih.gov/hmp/overview), undertaken by the National Institutes of Health, is mapping the genome of all microbes that live on and within the human body. In addition, it is exploring the relationship between the microbiome and human health, and answering some previously unanswered questions. For example, we have known for some time about the negative impact caesarean births and formula feeding have on long-term health; however, until recently, the 'why' was still unclear. These developments add to our understanding of the importance of the human microbiome for health, and how we can improve health outcomes.

Our own cells are outnumbered 10:1. Every surface of our bodies, external and internal (digestive tract and other orifices) is alive with rich microbial ecosystems that are essential to human health and well-being. The largest of these communities lies within the human gut. These commensal (beneficial) bacteria are responsible for a multitude of health functions from protection against pathogens (disease-causing microorganisms), to helping maintain immunity, as well as processing nutrients and regulating fat storage within the body.2 We have reached a point in time in high-income countries where infectious (communicable) diseases are no longer our biggest threat and we have seen a rise in autoimmune and inflammatory type diseases such as obesity, asthma, diabetes, cancer, autism and mental health disorders. These diseases have been found to be associated with the human microbiome.

Many parents and maternity care providers are seeking information about how to best support a healthy microbiome for babies. The establishment of the infant gut microbiota occurs in a stepped process, commencing in the prenatal period and reaching maturity at approximately two years of age2 There are a multitude of external factors that influence this process. By understanding the process, parents and maternity care providers can facilitate an optimum environment for seeding and establishing a baby's microbiome.

Pre-conception and pregnancy

A common, previously held belief is that babies, when inside the uterus, are sterile and only come in contact with bacteria and other microorganisms during the birth process. However, maternal gut microbiota, which changes as the woman's pregnancy develops, can pass via the maternal blood stream/placenta to the baby in-utero.2 Therefore, a healthy maternal microbiome during pregnancy is key to establishing healthy infant microbiome in-utero.

Diet is fundamental to helping establish a good maternal microbiome. Traditionally most cultures included fermented foods in their daily diet. In modern cultures, the shift towards processed, refined and packaged foods has made diets more sterile and reduced exposure to probiotic food sources. To promote a healthy gut microbiota you need to consume both probiotics (live microorganisms which produce a positive health benefit when consumed in adequate amounts) and prebiotics (indigestible food products which stimulate the growth of beneficial gut bacteria). The most common food that contains probiotics is live-cultured yoghurt. However, there is currently a reemergence of home-made fermented food such as sauerkraut, kimchi, kefir and kombucha. Prebiotics are available in starchy foods such as sweet potato, pumpkin and rice. In addition to influencing the gut microbiome, a diet rich in probiotics may also assist with promoting healthy vaginal microbes.3

Environmental and lifestyle factors influence the microbiome. For example, smoking alters gut biota reducing microbial diversity.4 Pharmaceutical drugs, particularly antibiotics, and anti-bacterial cleaning products (such as Dettol) eliminate both good and bad microbes damaging the microbiome5’6’7 In addition, maternal stress during pregnancy has been found to negatively alter the infant gut microbiota8 Although it is not always possible to eliminate stress, focusing on ways to relax and reduce stress should

be a priority during pregnancy.

Birth

Although the maternal microbiome during pregnancy has an impact, babies are primarily colonised by the first microbe-rich environment they encounter as they are born. There are clear differences in the microbiota of infants born by caesarean when compared with infants born vaginally[9] Babies born by caesarean are colonised by the hospital environment and maternal skin, primarily by Staphylococci and C Difficile. They also have less microbial diversity and significantly lower levels of Bifidobacterium compared with babies born vaginally. Babies that are born vaginally are colonised by maternal vaginal and faecal bacteria, primarily by Lactobaccillus, Prevotella and Sneathia. Babies born vaginally in their mothers' own environment (home) have the most beneficial gut microbiota.[10] The physiological process of labour may influence the microbiome of breastmilk.[11] Women who have had caesareans without any labour have different microbes in their breastmilk compared with women who experience labour. This may indicate that physiological stress or hormonal signals influence microbial transmission into breastmilk after birth.

However, not all babies can be born vaginally at home and there are some simple ways of optimising early microbial colonisation. Promoting vaginal birth, limiting exposure to antibiotics during labour, and minimising physical contact between the mother-baby dyad and health care providers are all beneficial to establishing a good microbiome.

Research is currently underway to trial a method of optimising seeding for caesarean born babies. Vaginal swabs are taken prior to surgery, and applied to the baby immediately after birth in an attempt to introduce vaginal microbiota onto the baby (see www.commonhealth.wbur.org/ 2014/06/birth-canal-bacteria-c-section). Early results are promising, with the babies born by caesarean and seeded with vaginal swabs having microbiomes that more closely resemble those of vaginally born babies.

The two other factors that women often ask about in relation to their impact on the infant microbiome are water birth and en caul birth. Although there are many theoretical ideas about their impact, there is currently no research available to provide clear answers.

Postnatal period

In the first days following birth the baby is colonised by the microbiota he or she was exposed to during birth, and the microbiota they are exposed to in the postnatal environment. This process can be assisted by careful consideration of what, and who, comes into contact with the baby. Encouraging the mother to have as much skin-to-skin as possible allows the baby to become colonised by her skin microbiota. Unnecessary touching of the baby by care providers and other non-family members should be avoided. Clothes and wraps that have been colonised with microbes from the mother's home environment can be used rather than hospital linen.

After type of birth, infant feeding method is the second most influential factor in the development of the

baby's microbiome.9 There are significant differences in the microbiota of breastfed babies compared with formula-fed babies. Beneficial bacteria are directly transported to the baby's gut by breastmilk and the oligosaccarides in breastmilk support the growth of these bacteria. Breastmilk contains the perfect package of probiotics and prebiotics to support a healthy microbiome. The difference in the gut microbiome of a formula-fed baby may underpin the long-term health risks associated with formula feeding.

Exposure to antibiotics during the birth process is common, for example during caesareans and for 'prolonged' rupture of membranes. Probiotic therapy for mother and baby may help to mitigate some of the disruption to the microbiome caused by antibiotics. Probiotic supplements may also be helpful for babies born by caesarean.

Summary

Pregnancy, birth and the early postnatal period are pivotal in influencing the establishment of the microbiome. This early seeding and colonisation has lifelong health implications. Type of birth and infant feeding method are the two most significant factors in the establishment of the infant microbiome. However, maternal diet and lifestyle during pregnancy, exposure to antibiotics and environmental factors also play a role. Current research suggests that the optimal conditions for the development of a healthy infant microbiome include: a prebiotic and probiotic diet during pregnancy; avoidance of antibiotics, antimicrobial products, smoking and stress; a vaginal birth in the mother's own environment and early exposure to maternal microbiota; avoidance of contact with non-family microbes; and exclusive breastfeeding. However, it is not always possible to provide the optimal conditions for all babies, and strategies to enhance seeding and colonisation for these babies are being developed.

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References

1. Proctor LM (2011) The Human Microbiome Project in 2011 and beyond. Cell Host and Microbe. Volume 10. DOI: 10.1016/j.chom.2011.10.001
2. Matamoros S et al (2013) Development of intestinal microbiota in infants and its impact on health. Trends in Microbiology Volume 21, Issue 4. DOI: 10.1016/j.tim.2012.12.001.
3. Rautava S et al (2012) Microbial contact during pregnancy and intestinal colonisation and human disease. Nature Reviews Gastroenterology and Hepatology Volume 9. DOI: 10.1038/nrgastro.2012.144.
4. Biedermann L et al (2013) Smoking cessation induces profound changes in the composition of the intestinal microbiota in humans. PLoS ONE Volume 8, Issue 3. DOI: 10.1371/journal.pone.0059260
5. Bengmark S (2012) Gut microbiota, immune development and function. Pharmacological Research Volume 69, Issue 1. DOI: 10.1016/j.phrs.2012.09.002.

6. Cotter PD et al (2012) The impact of antibiotics on the gut microbiota as revealed by high throughput DNA. Sequencing Discovery Medicine Volume 13, Issue 70.
7. United States Food and Drug Administration (2013) FDA taking closer look at 'antibacterial' soap. www.fda.gov/ForConsumers/ConsumerUpdates/ucm378393.htm
8. Zijlmans MAC et al (2015) Maternal prenatal stress is associated with the infant intestinal microbiota. Psychoneuroendocrinology Volume 53. DOI: dx.doi.org/10.1016/j.psyneuen.2015.01.006
9. Azad MB et al (2013) Gut microbiota of healthy Canadian infants: profiles by mode of delivery and infant diet at 4 months. Canadian Medical Association Journal Volume 185, Issue 5. DOI: 10.1503/cmaj.121189.
10. Penders J et al (2006) Factors influencing the composition of the intestinal microbiota in early infancy. Paediatrics Volume 118, Issue 2.
11. Cabrera-Rubio R et al (2012) The human milk microbiome changes over lactation and is shaped by maternal weight and mode of delivery. American Journal of Clinical Nutrition Volume 96. DOI: 10.3945/ajcn.112.037382.