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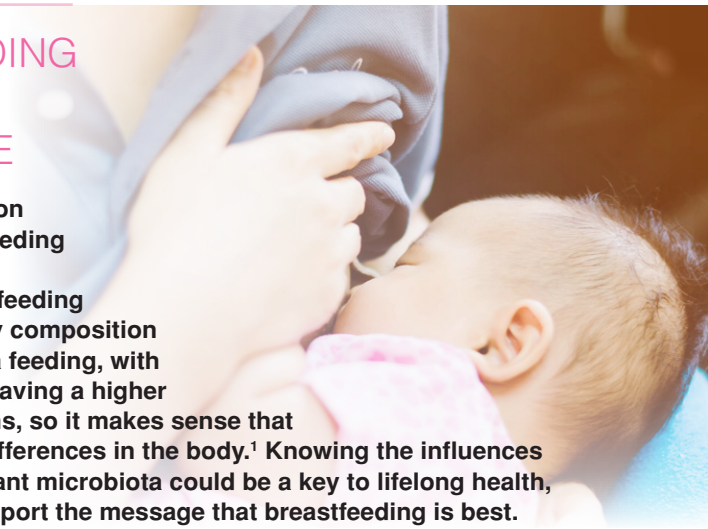
BREASTFEEDING AND THE MICROBIOME



This article focuses on the effect of breastfeeding on the microbiome. We know that breastfeeding leads to altered body composition compared to formula feeding, with formula-fed babies having a higher fat mass at 12 months, so it makes sense that there will be other differences in the body.[1] Knowing the influences of feeding on the infant microbiota could be a key to lifelong health, it is important to support the message that breastfeeding is best.

The rates of breastfeeding in the UK are low, with only 1% of babies being breastfed exclusively until six months versus 36% globally.[6,7] The DOH and WHO guidelines are for exclusive breastfeeding for the first six months and then to continue breastfeeding alongside solid foods until age two years or older. However, it is rare to see mums breastfeeding two-year-olds in the UK.

A lot of mums start off breastfeeding and then stop due to a range of factors. Having breastfed three children myself for an extended period, I can understand and empathise with the difficulties. As a culture, it is not always easy to breastfeed and it can be frowned upon if you are feeding a toddler. However, breastfeeding can have a hugely positive effect on the long-term health of a child, which, in turn, can have a knock-on effect on our healthcare costs. Having all the information to hand on how breastfeeding can help improve a child's health can be a great way to encourage mums to continue when breastfeeding is proving tricky.

MICROBIOTA

Bacterial colonisation of a baby begins at birth. When the baby is born, the infant microbiota is sterile, the microbes then change rapidly from birth until two to three years of age, progressing to a dense mixture in adulthood.[2] Both the way the baby is born and the mother's microbiome impact on the infant's gut bacteria. Infants born by caesarean section have different microbial composition compared to infants born vaginally, due to the way they pick up bacterial communities.

In vaginal births, this is largely from the birth canal or the skin, whilst in a C-section birth, this is influenced by maternal skin, hospital staff and the environment.[4,10] For example, a 24-week study compared the microbiota of full-term infants who had a spontaneous vaginal birth with those delivered by C-section (cohort 192). Infants born full-term by a C-section had an increased amount of Firmicutes and less Actinobacteria after the first week of life.

At week one, vaginally delivered babies had higher Actinobacteria. The microbiome of the C-section infants gradually changed over eight weeks to closer resemble that of the vaginally birthed infants, but at 24 weeks, there were still significant differences, with C-section infants having a less

REFERENCES

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Breastmilk is the best form of nutrition for infants, and exclusive breastfeeding is recommended for the first 6 months (26 weeks) of an infant's life. Thereafter breastfeeding should continue for as long as the mother and baby wish, while gradually including a more varied diet.
NHS England. (2015). Statistical Release. Breastfeeding Initiation and Breastfeeding.

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SCAN ME!

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beneficial array of bacteria.[2] This bacteria is shown by some studies to still exist up to six months of age.[10] This may explain why babies born by C-section are at higher risk for allergy and obesity later in life.[10]

A mother cannot always choose the way she births the baby, but the information I present below suggests that breastfeeding can help alter the gut bacteria and microbiome of an infant, so the method of feeding baby could make a difference.

INFLUENCES ON THE MIOCROBIOME

Prolonged breastfeeding has been found to have a significant effect on the gut bacteria of full-term C-section delivered infants.[2] No differences were seen in those infants breastfed for less than four months, but in those breastfed for longer than four months, there was a significant affect seen. Five genera of bacteria were more abundant in infants who were breastfed for longer and four genera were more abundant in those breastfed for a shorter time.[2] A 12-month study on 107 mother-infant pairs found that almost 30% of the infants' gut bacteria came from breast milk and 10% from areolar skin in the first 30 days of life.[5] So, it is not just the breastmilk alone that influences the microbiome, but the mother and the environment.

Exclusively breasted infants have been shown to have lower bacterial counts and higher levels of Staphylococcus bacteria. This is the most dominant bacteria in the infant gut.[10] A study comparing the impact of breastfeeding versus mixed feeding on the infant microbiome, in vaginally delivered full-term infants, found no impact in the first week. However, at four and 12 months, there was a marked difference with the formula-fed babies, as having a seemingly older microbiota, their microbes were changing to the diverse adult strains sooner. This was also found in a study of C-section infants at four months.[3]

Increasing evidence suggests that this early colonisation can influence gut maturation, immune, brain and metabolic development.[10] At four months, notable differences exist in the types of bacteria found in the gut. Exclusive breastfed babies have increased levels of probiotics (L. *johnsoii*/L. *gasseri*, L. *paracasei*/L. *casei*, B. b*ifidum* and B. *longum*) and formula-fed infants have elevated levels of C. *difficile*, G. *adiacens*, Citrobacter, C. *leptim* and E. *allocate*.[3,10] Results of a study on 108 infants suggests that vaginal delivery combined with breastfeeding favours the colonisation by B. *bifidum* and L. *gasseri* and that C-section infants who are breastfed tend to catch up on their gut bacteria, having more of these species than formula-fed babies. Infants born by C-section and formula fed were colonised more by L. *reuteri*, which is a strain that is found in formula-fed babies only.[10]

Variations in the gut microbial profile are associated with immune-related disease in infants. For example, greater abundances of E. *coli* and C. *difficile* are associated with a higher risk of developing eczema, recurrent wheeze and allergic sensitisation.[4] There has been an increase in the incidence of CDI (Clostridium difficile infection) seen in children.[9] So, any advice we can give to parents to help decrease this, other than reducing antibiotic use, is helpful. It is likely that the lower levels of

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diarrhoea and GI infections seen in breastfed babies is due to these difference in gut bacteria such as C. *difficile*. The finding of lower bacterial richness in formula-fed infants is proposed to be due to the presence of oligosaccharides found in breastmilk which act as selective food substrates for certain microbiota.[4]

The gut microbiome is an important producer of vitamins and essential amino acids for the body. At four months, the transporters in the gut indicate that the newborn is starting to move towards a more mature stage and, interestingly, breastfeeding has an impact on this. Infants who were formula fed had different transporters in their system and more adult systems available to them, for things like bile acid biosynthesis and methanogenesis for example, whereas breastfed infants had higher levels of modules involved in oxidative phosphorylation and B vitamin synthesis.[3]

THE EFFECT OF STOPPING BREASTFEEDING

The cessation of breastfeeding also has profound effects on the microbiome of the infant. Studies comparing infants who stopped breastfeeding at 12 months to those who continued, show large differences. In infants not breastfed past 12 months, there was a shift of the microbiota towards a more adult like state containing Bacteroides, Bilophila, Roseburia, Clostridium and Anaerostipes, which makes the microbiota age of these infants appear older.[3] This shows a role for extended breastfeeding and how it shapes the gut bacteria for the first year of life. It is the cessation of breastfeeding rather than the introduction of solid foods that was the major influencer in the development of a more mature microbiome.

SUMMARY

There are potential lifelong effects of breastfeeding on the microbiome, with possible metabolic and long-term health effects.

Having information to hand to explain to mothers how breastfeeding can have a long-term impact on their child's health can be a positive motivator. Other good reasons for encouraging a mum to breastfeed include that it protects against infections and decreases the risk of ear infections, GI infections and of diarrhoea. It can also improve IQ and school readiness, which in turn is linked to higher income in adult life. It also has positives for the mother's health too, as it decreases the risk of breast cancer.

We also know that antibiotics and birth age have an effect, with pre-term babies and those receiving antibiotics having more GI problems and altered gut bacteria. So, can the type of feeding also play a role in influencing the microbiota for these infants too? It certainly looks likely. This would be a great area for more research.