

## **Further Information:**

### **What is the microbiome?**

The human microbiome is the community of microbes - bacteria, viruses and fungi - that live on and in our bodies. With an estimated 30 trillion microbes per person, we each have as many microbial cells as human cells. [\[link1\]](#) We commonly hear that microbes are 'bad', but this isn't the whole picture. They are vital for human health, living on skin surfaces and in vast numbers in the gut. There are at least 5,000 different species of microbes in the human gut microbiota [\[link2\]](#) and they are thought to play important roles in digestion, in regulating the immune system and in protecting against disease.

### **Where does the microbiome come from?**

A baby can pick up bacteria and other microbes from many sources, starting with their mother during delivery. The study [\[link3\]](#) found that vaginally born babies got many of their gut bacteria from their mother, and that these are mainly from bacteria originating the mother's gut. The baby will also pick up microbes from the surrounding environment in the hospital, especially in the case of caesarean birth. After birth, the mother also passes microbes to the baby during feeding and holding the baby. Further microbes come from contact with the rest of the family and other people and pets, the home, foods, and the environment, including soil and plants. Once in the baby's mouth, the microbes get swallowed and travel to the baby's gut and contribute to the gut microbiome.

### **Why could the microbiome be important for health?**

Scientists are studying the microbiome to understand how the different microbes can influence health and disease. While much is still unknown, an imbalance of the normal gut microbes has been linked with gastrointestinal conditions such as inflammatory bowel disease (IBD). The healthy gut microbiome has also been implicated in regulating the immune system, and imbalance in the microbiome is thought to contribute to development of immune diseases such as type 2 diabetes, allergies and asthma.

Babies born by caesarean have a slightly higher risk of some inflammatory diseases including asthma and allergies [\[link4\]](#). Early contact with microbes in the first hours and days of life have been shown to have an impact on the baby's developing immune system [\[link5\]](#). Based on this current knowledge, some scientists think that the changes in baby's gut microbiome (lack of contact with maternal gut microbes during a caesarean birth) might be the reason for the slightly increased risk of immune-related diseases in childhood and later life. However, no study to date has confirmed this yet and the long-term health effects of differences in this earliest microbiome are not yet known. Further research, with large studies following up into later life, is needed to fully understand the implications of birth method on the future health of the baby.

### **I'm having or have had a Caesarean – should I be worried?**

There is an increasing number of babies born every year by caesarean delivery (approximately 29% of births in the UK currently) [\[link6\]](#) and it continues to be an important procedure in improving health outcomes for mothers and babies. Caesareans can be a lifesaving procedure for mothers and babies. The exact role of the microbiome in newborn babies is not yet known and more research is

needed to understand this. Further research is essential before we can understand whether caesarean also carries some longer term risks associated with the microbiome and what we could do to reduce any risks.

The Royal College of Obstetricians and Gynaecologists believes that if a woman needs, or chooses to have a caesarean, she should be supported, as recommended by guidance from The National Institute for Health and Care Excellence [\[link7\]](#). These findings should not deter women from having a caesarean birth if they need one, or choose to have one.

While the initial differences in gut microbiomes are clear between caesarean and vaginally born babies, growing babies swallow bacteria when they are fed and from many other sources, and by the time they have been weaned, the differences in gut microbiomes between babies born vaginally and by caesarean have largely evened out.

Further research is needed as we don't yet know whether the initial differences to the microbiome will have any health implications.

### **I'm having a caesarean, should I use vaginal seeding?**

Vaginal seeding is where vaginal fluids are put in the mouth of a newborn caesarean baby in an attempt to mimic the effects of travelling down the birth canal. This comes with a risk that babies might get serious infections, such as group B Streptococcus — a common vaginal bacterium that can, in rare cases, be fatal in newborns.

In 2017, the American College of Obstetricians and Gynecologists issued guidelines stating that vaginal seeding should not be performed except in the context of a clinical trial, which can screen for microbes [\[link8\]](#). The Royal College of Obstetricians and Gynaecologists supports this position [\[link\]](#):

Despite clinical trials announced for vaginal seeding, there is no evidence yet that vaginal bacteria form the major part of the baby's gut microbiome or that this practice is beneficial – and in fact, it may be harmful. The study reported today [\[link9\]](#) found that the microbiome of vaginally delivered newborns contained very few vaginal bacteria, and no more than caesarean babies. Instead, the vaginally born babies had many bacteria from the mother's gut at day 4. The results suggest that swabbing vaginal bacteria is unlikely to change the baby's gut microbiome.

### **Can I do anything to help my baby's microbiome? Are any bacterial therapies available?**

Babies get bacteria and a range of other microbes from the people and environment around them.

More research is urgently needed to understand the role of the early microbiome in health and disease. There are currently no bacterial therapies available, as we don't yet know if they are needed. The ultimate aim of the Babybiome study is to understand which microbes are important for babies' health. Further research could help us understand if there is a need for bacterial therapies and potentially develop therapeutics to create a healthy microbiome.

### **Does breastfeeding help form the microbiome?**

Previous studies in older babies (during first year of life) have reported that breast feeding is an important factor in shaping a babies' gut microbiome as well as providing many other health benefits. The BabyBiome study focused on babies in the first three weeks of life and showed that breast feeding did have some positive effect on gut microbes of babies over 7 days old, but the effect was smaller than that of the birth mode.

Studies on breast feeding are needed from early life, with detailed information collected about babies' diet and the mix of breast and formula milk.

### **How do antibiotics affect the microbiome?**

Antibiotics are drugs designed to kill bacteria, and have an effect on the gut microbiome as shown in previous studies.

Newborn babies can be exposed to antibiotics directly after birth and/or indirectly through antibiotics given to mothers during birth via the placenta. We found that both of these events have an impact on the baby's gut microbiome, changing the number of mother's gut bacteria in the baby's gut - albeit having a smaller effect than the delivery method.

Antibiotics are given to mothers in all caesarean births and to some mothers prior to vaginal delivery, in order to prevent infections, including serious infections or sepsis. The study findings should not deter women from having antibiotics where needed.

### **What about antibiotic resistance? Does my caesarean baby have more antibiotic resistant bacteria?**

The study found that caesarean newborn babies carry higher levels of bacteria carrying antimicrobial resistance in their gut microbiome. However, all the babies were healthy and the long-term health implications of this finding are not known. By the time they have been weaned, the differences in gut microbiomes between caesarean and vaginally-born babies have largely evened out. More research is needed to follow up and find out about the persistence of these bacteria in the gut and the implications for future health.

#### **Links:**

1. <https://www.nature.com/news/scientists-bust-myth-that-our-bodies-have-more-bacteria-than-human-cells-1.19136>
2. <https://bmcbiol.biomedcentral.com/articles/10.1186/s12915-019-0667-z>
3. <https://doi.org/10.1038/s41586-019-1560-1>
4. <https://pediatrics.aappublications.org/content/135/1/e92>
5. <https://www.ncbi.nlm.nih.gov/p>
6. <https://digital.nhs.uk/data-and-information/publications/statistical/maternity-services-monthly-statistics/april-2019>

7. <https://www.nice.org.uk/guidance/cg132>

8. <https://www.nhs.uk/news/pregnancy-and-child/c-section-mums-warned-about-dangers-vaginal-seeding/>

9. <https://doi.org/10.1038/s41586-019-1560-1>