



Infant nutrition and the development of the immune system by Carina Venter (Research Dietitian, Isle of Wight NHS Trust)

Good nutrition before and after birth can help your baby's natural immune system develop to the best of its ability. Eating well during pregnancy, breast feeding and then introducing a wide variety of nutritious foods during weaning, all help your baby to develop a healthy natural immune system and fight off infections.

Before birth

The baby's natural immune system starts to develop from the time of conception. Whilst there's nothing specific you can eat during pregnancy to support your baby's immune system, it is crucial that you eat a balanced and varied diet throughout pregnancy.

A healthy and varied diet is important both before and during pregnancy to make sure you are well nourished from the time of conception. This should include plenty of starchy carbohydrates, such as bread, pasta, rice and potatoes and plenty of fruit and vegetables. You should also include moderate amounts of milk and dairy foods as well as protein-containing foods, such as lean meat, eggs, beans and lentils. In addition you should aim to include two portions of fish of which one portion should be oily fish per week.

(The FSA advises that when you're pregnant or trying to get pregnant, you shouldn't take supplements containing cod liver oil, or other types of fish liver oil. This is because fish liver oil contains high levels of vitamin A, like liver and liver products such as liver pâté. If you have too much vitamin A, levels could build up in your body and may harm your unborn baby.)

If you have a strong family history of allergies (if either parent or a previous child has suffered from hay fever, asthma, eczema or food allergy), then you may wish to avoid peanuts or foods containing peanuts during pregnancy and while breast feeding in order to reduce the risk of your baby developing a nut allergy.

The bacteria that we all carry in our digestive system play an important part in our health and wellbeing. Some studies¹ have suggested that consuming a specific type of 'friendly' bacteria (such as those found in live yoghurts, but not available in the UK), in the last few weeks of pregnancy and postnatally may reduce the risk of children with a family history of developing eczema. However this does not indicate that all friendly bacteria are important for the development of the baby's natural immune system.

The birth itself

Although babies are born with the structure of their natural immune system in place, the newborn infant needs to be exposed to *antigens* in order for their immune system to mature. Antigens are proteins that trigger the production of antibodies, part of the body's natural defence mechanism. Antibodies are also found in breast milk.

Before birth, the infant's digestive system is sterile and exposure to antigens begins during the natural birth process. When the baby passes down the birth canal, they are exposed to bacteria from the mother, which then start to colonise the baby's gut.

¹ Kalliomaki M et al. Probiotics and prevention of atopic disease: 4 year follow-up of a randomised placebo controlled trial. *Lancet*. 2003. (361:1869-71)



Babies born by caesarean section are exposed to different types of bacteria to those born naturally and differences in the gut bacteria or 'flora' between infants born naturally and by caesarean section have been found to persist for at least the first six months of their life.

The importance of breast feeding

Breast milk is the perfect food for infants, containing just the right amounts of protein, fats, carbohydrates, vitamins and minerals to support your baby's development.

Breast milk also provides an array of protective components that are important for a baby's natural immune system, including antibodies, prebiotics and nucleotides (see below). Colostrum, the milk you produce in the first few days after the birth is full of antibodies and also contains white blood cells that help protect the baby against potentially harmful bacteria.

Breast fed babies have been shown to be less likely to suffer from diarrhoea and seem to have more protection against infections, such as respiratory infections. There is also some evidence that breast fed babies are less likely to suffer from allergies, such as eczema and asthma and other immune related diseases.

The role of prebiotics

Breast milk contains non-digestible carbohydrates called oligosaccharides which act as prebiotics because they encourage the growth of friendly bacteria in the infant's digestive system.

So called 'friendly' bacteria are not only important for healthy digestion and gut health, but also support the natural immune system.

For example, friendly bacteria help create an acidic environment in the gut. This acidity is well tolerated by the friendly bacteria, but it suppresses the growth of potentially harmful bacteria. Also, the friendly bacteria attach themselves to the lining of the gut, thus preventing potentially harmful bacteria from attaching, which could lead to infection.

Friendly bacteria can also support the cells lining the gut to produce more and 'thicker' mucous. This mucous layer forms a protective barrier lining the gut and helps stop harmful bacteria getting into the blood stream and the rest of the body.

The role of nucleotides

Nucleotides are the building blocks for DNA and are also believed to support the function of some of the cells involved in the natural immune system. Although nucleotides can be made in the body, they are also found in breast milk and this provides an important source for growing infants.

Nucleotides from breast milk or nucleotide-supplemented formula have been shown to help support the natural immune system.

For bottle fed babies

The effect of breast milk on the gut bacterial 'flora' is one of the many reasons why breast milk is considered to be the best form of nutrition for infants.



However, if you decide to bottle feed, some formula milks are now available with added prebiotics to try to mimic some of the benefits of the prebiotics in breast milk. These prebiotics are in the form of added oligosaccharides and have been shown to improve the balance of gut bacteria in a similar way to breast milk.

Weaning

Vitamin and mineral deficiencies have been shown to adversely affect the immune system function. Lack of vitamin A, iron, zinc and selenium, has been indicated to impair immune function and increase susceptibility to infection, not only during infancy but also pregnant and breast feeding mothers.

Breast milk provides all these nutrients and can provide all the nutrition the baby needs until 6 months of age. Around this time though, weaning should begin, as breast milk alone will be unable to provide sufficient nutrients, such as iron. The Department of Health recommends that weaning should not commence before 6 months, if this is not possible healthcare professionals highlight that 4 months (17 weeks) should be regarded as the earliest stage at which solids should be introduced.

At weaning, the development of the natural immune system continues. Here, the prebiotics in breast milk and (if present) in infant formula milks will still help to maintain the growth of friendly bacteria in the gut flora.

Good first foods to try include puréed fruit, vegetables, or baby rice. You can then move on to cooked, mashed lean chicken, or lentils and full fat dairy products such as fromage frais and yogurt. As solid food becomes a larger part of your baby's diet, try to offer a wider range of different foods. This is to provide your baby with all the vitamins and minerals they need.

If you have a family history of allergies, such as asthma, eczema or hay fever, then your baby may be more at risk of developing allergies. Therefore it is important to introduce foods which may cause allergies (e.g. gluten, tree nuts, sesame seed, mustard seed, cows' milk, eggs, fish, shellfish, soy, wheat, celery) one at a time and not until your baby is at least 6 months old. Also, if there is a family history of allergies then avoid introducing peanuts and foods containing peanuts until your child is at least three years old.

Sources for nutrients important for a baby's natural immune system:

Vitamin A is found in whole milk, dairy products, eggs, carrots and green leafy vegetables.

Iron is found in meat (particularly lean red meat), fish, pulses (beans and lentils) as well as dried fruit, dark green leafy vegetables, bread and fortified breakfast cereals.

Zinc is found in lean red meat, fish, milk and cheese, wholegrain cereals and pulses.

Selenium is also found in meat and fish as well as dairy foods, pulses, bread and breakfast cereals.

Remember:

- Eat a healthy and varied diet before, during and after pregnancy.
- Breast feed to help your baby's natural immune system to develop
- If you decide to bottle feed, consider using formula milk with added prebiotics.



Try to:

Breast feed exclusively for the first six months of life, or if you decide to bottle feed, it may help to use formula milk with prebiotics added.

Avoid introducing solids too early and for those at risk of developing an allergy, wean one at a time onto the more common allergenic foods, such as cows' milk, eggs, wheat, nuts and fish. However, peanuts should not be introduced before 3 years of age in those at risk of developing allergies.

Common myth:

Avoiding certain foods in pregnancy will not prevent your child from becoming allergic.