

## Healthcare industry BW

### Cow sheds and asthma genetics

**Shortness of breath when playing football, wheezing and bouts of coughing are all typical symptoms of bronchial asthma, and they are all a huge strain for children and young people. Many genes are known to play a role in the development of this chronic lung disease. Dr. Andrea Heinzmann's team at the University Medical Centre Freiburg has investigated some of these genes and is also interested in epigenetic factors. It is known that asthma is not only caused by genetic factors, but can also be triggered by mechanisms that affect the genes without changing the genetic code. These mechanisms are sensitive to environmental influences and can also be inherited. What has the farm environment or pregnant women smoking got to do with the molecular processes underlying the development of asthma?**



CT image of a human lung  
© Andreas Heinemann/Zeppelinzentrum Karlsruhe

Asthma is the most common chronic disease in children. One in ten children suffer from bronchial restriction and produce elevated amounts of lung mucus. These symptoms are caused by the chronic

inflammation of the small airways. Ninety per cent of children affected by asthma also suffer from allergies. Typical symptoms of asthma include coughing, shortness of breath during physical activity and difficulties when breathing out. Some patients need to use asthma sprays or tablets to counteract acute or chronic centres of inflammation in the lung. "It is essential that we identify potential causes in order to explain why people develop asthma," said Dr. Andrea Heinzmann from the University Medical Centre Freiburg. "New medications could be given a lot earlier and could therefore have a preventive effect."

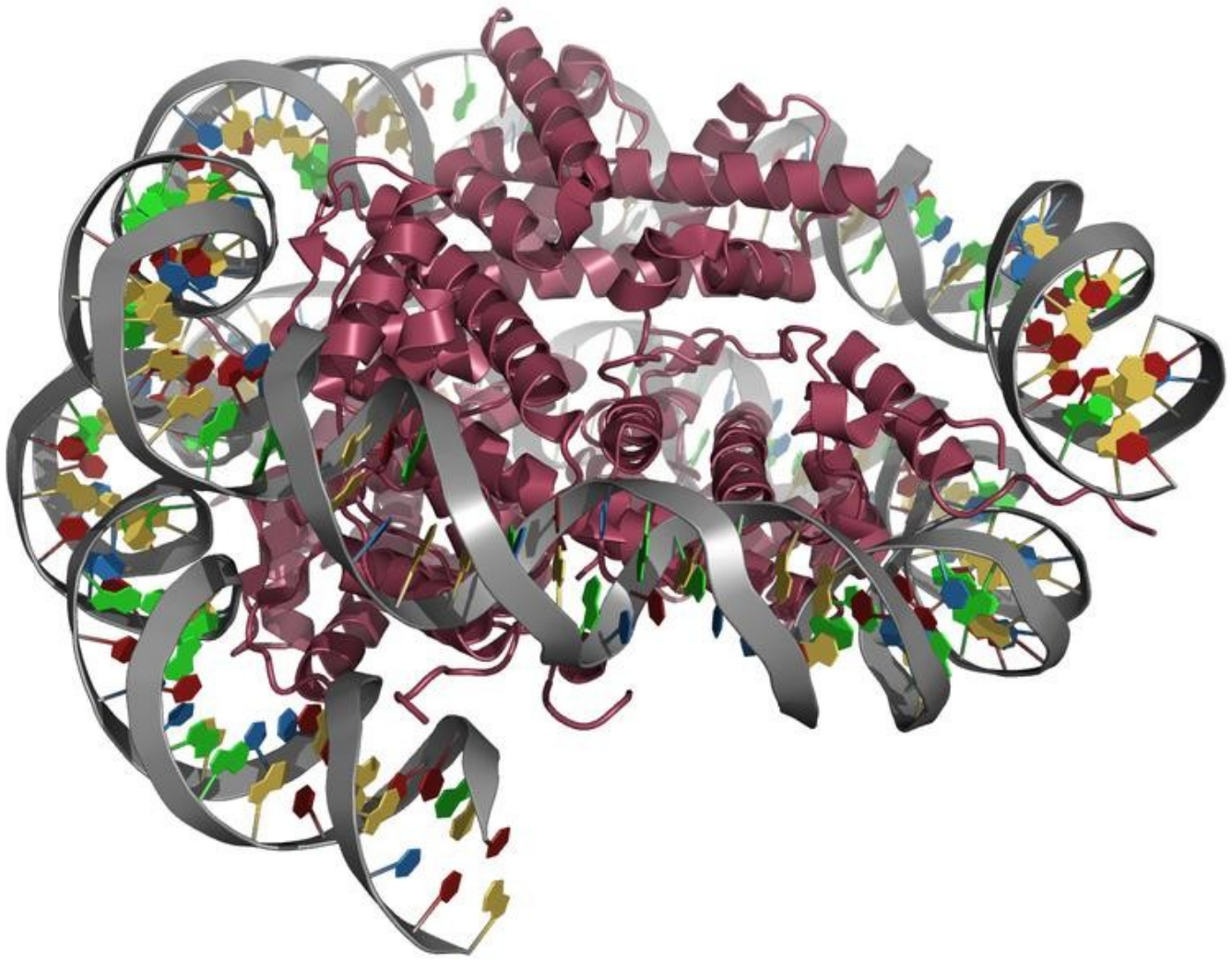
## Animals and epigenetic factors



Do frequent visits to farms in early childhood reduce a child's chances of developing asthma?  
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It is known that genetic factors play an important role in the development of asthma. Around one hundred genes are known to be associated with the development of asthma. Some of these genes have an important immunological role and can lead to the development of chronic lung inflammation when they are defective. However, over the last few years researchers have discovered a growing number of environmental factors that favour the development of asthma in children. It has been shown that exposure to farm life in early childhood reduces a child's chances of developing asthma. It appears that contact with farm animals and their germs strengthens the human immune system. On the other hand, acute exposure to allergens such as house dust mites seems to promote the development of asthma. In addition, the development of asthma also depends on whether a mother suffers from asthma and on the habits of a woman during pregnancy. "Children of women who smoke during pregnancy have a very high risk of developing asthma," said Heinzmann.

How do these environmental factors affect the molecular processes that eventually lead to lung



The DNA is packaged into nucleosomes (here: *Drosophila* nucleosome) by special proteins (histones). Epigenetic mechanisms can affect the tightness of packaging and hence the accessibility of the DNA for transcription enzymes.

© Wikipedia

diseases? Over the last few years, there has been growing evidence pointing to the important role that epigenetic effects play in asthma pathogenesis. Epigenetic effects refer to influences that do not involve changes to the underlying DNA sequence. Instead they affect the packaging of DNA in the cells, thereby regulating the activity of a particular gene. In addition, specific enzymes add small methyl molecules to the DNA. Methylated DNA regions of this kind cannot be transcribed, and hence they cannot be translated into a protein. The effect of methylation is therefore similar to that of a gene defect caused by a defective gene structure: a methylated/damaged gene cannot be processed into a functional protein. In contrast to a gene defect, epigenetic changes can be triggered by environmental influences, for example a person's dietary habits. A broad range of epigenetic mechanisms are known, all of which can ultimately alter the behaviour of cells.

## Differences in the epigenetic pattern?

“Over the last two years, we have focused on the role of epigenetic factors in the development of asthma,” said Heinzmann whose team is looking for genes that play a role in the development of asthma. In addition, the researchers have also been examining the genetic material of patients for epigenetic changes. They hope to clarify whether environmental factors actually contribute to the development of asthma or not.

These clarifications are based on a study in which the researchers take blood from the umbilical cord of newborns. The children were organised into four groups: children whose mother 1) smoked during pregnancy, 2) suffered from asthma herself, 3) had daily contact with a farm environment, 4) was healthy. Heinzmann and her team scan the chromosomes of the children to find regions with epigenetic modifications. How do these regions differ between the four groups? If the researchers find differences in the epigenetic patterns of the four groups, they will be able to make statements about the effect of different environmental influences on epigenetic changes.

“We have identified around one hundred regions with epigenetic modifications in the genome of the volunteers,” said Heinzmann. “We now need to clarify whether these regions code for proteins.” If this turns out to be the case, it will then be interesting to find out whether these proteins are already known to play a role in asthma pathogenesis or whether this method is useful for identifying new asthma-related genes. The researchers might well be able to establish a potential direct link between the child’s environment (womb) and the molecular level that is responsible for disease development. If a link can be established, the researchers will go on to study how the epigenetic modifications appear and to test whether drugs can interfere with this process. This would then open up completely new strategies for the prevention of asthma.

#### **Further information:**

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#### **Article**

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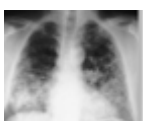
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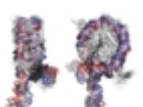
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#### **The article is part of the following dossiers**



Respiratory disease - congestion in the respiratory system



Epigenetics – heritable traits without changing the DNA sequence