

Iron deficiency during infancy reduces vaccine efficacy

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About 40 percent of children around the globe suffer from anemia because they do not consume enough iron. Now, studies by ETH researchers show that iron deficiency also reduces the protection

provided by vaccinations.

Despite the fact that global immunization programs are now reaching more people than ever, about 1.5 million [children](#) still die every year from diseases that vaccination could have prevented. Vaccination is also less effective in low-income countries than in high-income countries, although it is not yet clear why.

Babies have smaller iron reserves

Findings from two [clinical studies](#) with children in Kenya now suggest that [iron deficiency](#) during infancy may reduce the protection that vaccinations provide. In their first study, the research group led by Michael Zimmermann from the Department of Health Sciences and Technology worked in collaboration with scientists from Kenya, the UK, the Netherlands and the US. Their aim was to determine the levels of body iron and antibodies against antigens from the administered vaccines in [blood samples](#) of 303 Kenyan children followed from birth to age 18 months.

"In Switzerland, babies are born with iron stores that are normally sufficient for their first six months of life," says Zimmermann, Professor of Human Nutrition. "But in Kenya and other sub-Saharan countries, iron reserves in babies are much lower, especially in those born to anemic mothers or with a low birth weight." This is aggravated by infections and bloody diarrhea, and their iron reserves are often exhausted after two to three months, he explains.

More than twice the risk

The study showed that more than half the children were already suffering from anemia at the age of 10 weeks, and by 24 weeks, more

than 90 percent had low hemoglobin and red blood cell counts. Using statistical analyzes, the researchers, led by Zimmerman, were able to show the following: despite several vaccinations, the risk of finding a lack of protective antibodies against diphtheria, pneumococci and other pathogens in the blood of 18-month-olds was more than twice as high in anemic infants compared to those who were not anemic.

In a second study, the researchers administered a powder containing micronutrients to 127 infants slightly over six months old on a daily basis for four months. In 85 of these children, the powder also contained iron; the other 42 children received no iron supplement. When the children were vaccinated against measles at the age of nine months—as stipulated by the Kenyan vaccination schedule—those children who also received iron as a [dietary supplement](#) developed a stronger immune response in two respects: not only did they have more measles antibodies in their blood at the age of 12 months, but their antibodies were also better at recognizing the pathogens.

Iron as a dietary supplement to stave off anemia

The World Health Organization (WHO) recommends feeding infants exclusively with breastmilk for the first six months to avoid infection with diseases transmitted in contaminated water. For that reason, Zimmermann and his research team did not give the children the dietary supplement powder until they were seven months old, although most of the vaccinations had generally been administered by this point; the measles vaccination was the only exception.

However, Zimmermann says that many places have made great progress with their water supply and [health systems](#) in recent years, which is why discussions in professional circles about updating the WHO's recommendation are becoming ever more important. He believes that adapting the recommendation would be a good move because preventing

anemia in young children by supplementing the [iron](#) in their diet would improve the protection provided by other vaccinations. In turn, this may help to prevent many of the 1.5 million annual deaths due to [vaccine](#)-preventable diseases.

More information: Nicole U. Stoffel et al. Iron Deficiency Anemia at Time of Vaccination Predicts Decreased Vaccine Response and Iron Supplementation at Time of Vaccination Increases Humoral Vaccine Response: A Birth Cohort Study and a Randomized Trial Follow-Up Study in Kenyan Infants, *Frontiers in Immunology* (2020). [DOI: 10.3389/fimmu.2020.01313](#)

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