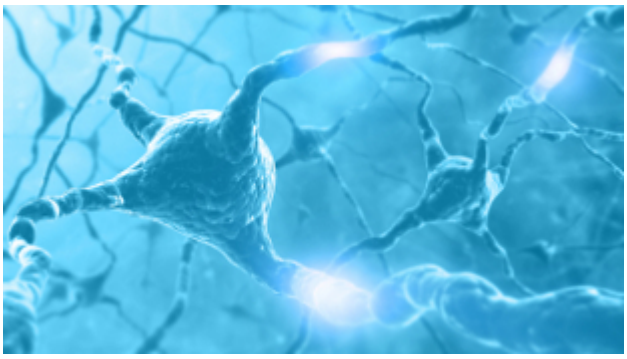
TheScientist
EXPLORING LIFE, INSPIRING INNOVATION

Iron Builds a Better Brain

Brain imaging and gene analyses in twins reveal that white matter integrity is linked to an iron homeostasis gene.

By Ruth Williams | January 9, 2012


SHUTTERSTOCK, IDESIGN

Iron deficiency is a well-known cause of impaired cognitive, language, and motor development, but a report out today (January 9) in *Proceedings of the National Academy of Sciences* reveals that even in apparently healthy young adults, variations in iron levels correlate with variations in brain structure integrity.

"[The researchers] make a very interesting connection between the issue of iron metabolism and the integrity of white matter, more specifically myelin"—the cellular sheath that enwraps and insulates neuronal axons—said George Bartzokis of the University of California, Los Angeles, who was not involved in the study. "This would have been predicted by what is known about myelin, because it actually contains a lot of iron, so it is important that [they have] directly demonstrated this in humans with imaging."

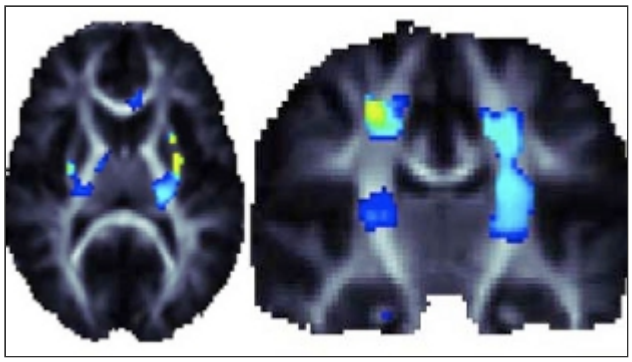
Children that are iron deficient—often as a result of poor diet—score poorly in mathematics and language tests. Given such effects, Paul Thompson of the UCLA and his colleagues decided to "look to see if, even among normal healthy kids, variations in their iron levels that are fairly subtle end up mattering. And the surprise is, they matter a lot."

The team measured blood serum transferrin levels—an inverse but more reliable measure of available iron—in adolescents, and then performed brain scans when these teens reached their early twenties. Among other things, the team looked at myelin function using a technique called diffusion tensor imaging, and found a strong positive correlation between teen iron levels and myelin integrity in the twenty-something subjects.

"We're very surprised at how much of a difference it makes to your brain to have good iron in your diet when you're developing," said Thompson. "The simplest message is that the iron in your diet as a teenager is associated with better brain integrity when you grow up."

Popul

Thompson and colleagues also investigated whether there was a genetic contribution to iron availability and brain structure. Of the study subjects, which were either identical or non-identical twins, the link between iron levels and myelin integrity between twins was stronger if they were identical. That is, high iron levels in one twin could better predict myelin integrity in the other.



Brain scans showing that a genetic variant that promotes higher brain integrity in the areas highlighted in blue and yellow
NEDA JAHANSHAD AND PAUL THOMPSON/UCLA

Further investigation of two iron homeostasis genes revealed that a polymorphism in one—HFE, which regulates cellular absorption of transferrin-bound iron—was associated with both high iron levels and improved white matter integrity.

Of course having this polymorphism does not automatically mean better brain function. The current study has not investigated such a link with the polymorphism, or indeed with serum transferrin or white matter integrity—something that would be important to show, said James Connor of Penn State University. "You want to see whether these differences matter in terms of their cognitive skills."

And even if the HFE variant did improve brain function, there is a risk that the same polymorphism might pose a problem in older adults. Iron accumulation in the brain has been suggested to be a contributing factor to a number of neurodegenerative disorders, explained Thompson. "So it's a double-edged sword."

One thing is certain, said Connor: given the prevalence of this polymorphism—which is carried by about 12-15 percent of Caucasians—whichever way the results shake out, "these data are going to be relevant to a large percentage to the population."

N. Jahanshad et al., "Brain structure in healthy adults is related to serum transferrin and the H63D polymorphism in the HFE gene," *PNAS*, doi/10.1073/pnas.1105543109, 2011.

Tags

transferrin, iron deficiency, iron, homeostasis, developmental biology, cell & molecular biology, brain development and brain

Add a Comment

You

Sign In with your LabX Media Group Passport to leave a comment

Not a member? Register Now!

Comments

jhnycmltly
Posts: 65

January 13, 2012

The 'iron deficiency' diagnosed in the population is in fact the bodies own immune system at work. The iron withholding mechanism , part and parcel of the bodies immune system. This withholding of iron is called ,

anemia of chronic disease , which is when the body CREATES an anemia by trying to withhold iron from an invader. They've shown TRUE lack of iron / iron deficiency is in fact UNCOMMON."There are multiple causes of severe anemia in Malawian preschool children, but folate and iron deficiencies are not prominent among them. Even in the presence of malaria parasites, additional or alternative causes of severe anemia should be considered."It has been shown "low iron" , rather than being BAD for a person , low iron PROTECTS from diseases such as malaria."Infected animals from the intermediate-dietary iron(40- and 100-ppm) groups exhibited greater weight loss and anemia than those in the low (10-ppm)""Severe dietary iron restriction impairs hookworm development"Lowering iron has been even recommended for Aids."Can iron depletion inside macrophages serve to prolong HIV disease progression?"

Sign in to Report

Posts: 0

January 13, 2012

The 'iron deficiency' diagnosed in the population is in fact the bodies own immune system at work. The iron withholding mechanism , part and parcel of the bodies immune system. This withholding of iron is called , anemia of chronic disease , which is when the body CREATES an anemia by trying to withhold iron from an invader. They've shown TRUE lack of iron / iron deficiency is in fact UNCOMMON."There are multiple causes of severe anemia in Malawian preschool children, but folate and iron deficiencies are not prominent among them. Even in the presence of malaria parasites, additional or alternative causes of severe anemia should be considered."It has been shown "low iron" , rather than being BAD for a person , low iron PROTECTS from diseases such as malaria."Infected animals from the intermediate-dietary iron(40- and 100-ppm) groups exhibited greater weight loss and anemia than those in the low (10-ppm)""Severe dietary iron restriction impairs hookworm development"Lowering iron has been even recommended for Aids."Can iron depletion inside macrophages serve to prolong HIV disease progression?"

Sign in to Report

Posts: 0

January 13, 2012

The 'iron deficiency' diagnosed in the population is in fact the bodies own immune system at work. The iron withholding mechanism , part and parcel of the bodies immune system. This withholding of iron is called , anemia of chronic disease , which is when the body CREATES an anemia by trying to withhold iron from an invader. They've shown TRUE lack of iron / iron deficiency is in fact UNCOMMON."There are multiple causes of severe anemia in Malawian preschool children, but folate and iron deficiencies are not prominent among them. Even in the presence of malaria parasites, additional or alternative causes of severe anemia should be considered."It has been shown "low iron" , rather than being BAD for a person , low iron PROTECTS from diseases such as malaria."Infected animals from the intermediate-dietary iron(40- and 100-ppm) groups exhibited greater weight loss and anemia than those in the low (10-ppm)""Severe dietary iron restriction impairs hookworm development"Lowering iron has been even recommended for Aids."Can iron depletion inside macrophages serve to prolong HIV disease progression?"

Sign in to Report

roberttu
Posts: 1

January 16, 2012

HFE variants (C282Y, H63D and other rarer ones) are the most common genetic disorders in European ancestored persons. Homozygosity or double heterozygosity leads to iron overload (hemachromatosis) that causes excess mortality in elderly patients whose iron overload is not controlled. What the genetic advantage in carriers of a HFE gene mutation is a mystery. Perhaps they are smarter than non-carriers and thus more evolutionarily fit than non-carriers. A similar explanation for the persistence of BRCA1 has been made.

Sign in to Report

Posts: 0

January 16, 2012

HFE variants (C282Y, H63D and other rarer ones) are the most common genetic disorders in European ancestored persons. Homozygosity or double heterozygosity leads to iron overload (hemachromatosis) that causes excess mortality in elderly patients whose iron overload is not controlled. What the genetic advantage in carriers of a HFE gene mutation is a mystery. Perhaps they are smarter than non-carriers and thus more evolutionarily fit than non-carriers. A similar explanation for the persistence of BRCA1 has been made.

Sign in to Report

Posts: 0

January 16, 2012

HFE variants (C282Y, H63D and other rarer ones) are the most common genetic disorders in European ancestored persons. Homozygosity or double heterozygosity leads to iron overload (hemachromatosis) that causes excess mortality in elderly patients whose iron overload is not controlled. What the genetic advantage in carriers of a HFE gene mutation is a mystery. Perhaps they are smarter than non-carriers and thus more evolutionarily fit than non-carriers. A similar explanation for the persistence of BRCA1 has been made.

Sign in to Report

Posts: 0

February 12, 2012

Very interesting how consuming a good amount of iron as a kid determines if your brain develops in a better way as you grow up.

Sign in to Report

Posts: 0

February 12, 2012

Very interesting how consuming a good amount of iron as a kid determines if your brain develops in a better way as you grow up.

Sign in to Report

Ana Duzan
Posts: 1457

February 12, 2012

Very interesting how consuming a good amount of iron as a kid determines if your brain develops in a better way as you grow up.

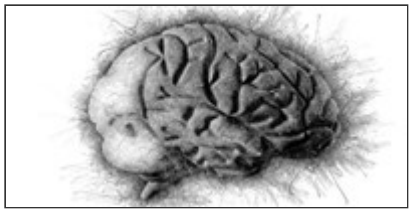
Sign in to Report

Related Articles

Study Pinpoints Potential "Master Regulator" of Age-Related Cognitive Decline

By Shawna Williams

Upping a gene's expression in rat brains made them better learners and normalized the activity of hundreds of other genes to resemble the brains of younger animals.



Thousands of Mutations Accumulate in the Human Brain Over a Lifetime

By Ruth Williams

Single-cell genome analyses reveal the amount of mutations a human brain cell will collect from its fetal beginnings until death.

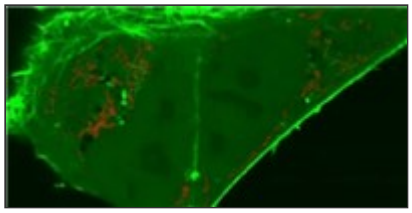


Image of the Day: Actin Burst

By *The Scientist* Staff

Researchers are looking at actin polymerization and calcium uptake in human cells to study mitochondrial division.