

His study, a placebo-controlled double blind randomised trial, took 231 volunteer prisoners and assigned half to a regime of multivitamin, mineral and essential fatty acid supplements and half to placebos. The supplement aimed to bring the prisoners' intakes of nutrients up to the level recommended by government. It was not specifically a fatty acid trial, and Gesch points out that nutrition is not pharmacology but involves complex interactions of many nutrients.

Prison trial

Aylesbury was at the time a prison for young male offenders, aged 17 to 21, convicted of the most serious crimes. Trevor Hussey was then deputy governor and remembers it being a tough environment. "It was a turbulent young population. They had problems with their anger. They were all crammed into a small place and even though it was well run you got a higher than normal number of assaults on staff and other prisoners."

Although the governor was keen on looking at the relationship between diet and crime, Hussey remembers being sceptical himself at the beginning of the study. The catering manager was good, and even though prisoners on the whole preferred white bread, meat and confectionery to their fruit and veg, the staff tried to encourage prisoners to eat healthily, so he didn't expect to see much of a result.

But quite quickly staff noticed a significant drop in the number of reported incidents of bad behaviour. "We'd just introduced a policy of 'earned privileges' so we thought it must be that rather than a few vitamins, but we used to joke 'maybe it's Bernard's pills'."

But when the trial finished it became clear that the drop in incidents of bad behaviour applied only to those on the supplements and not to those on the placebo.

The results, published in 2002, showed that those receiving the extra nutrients committed 37% fewer serious offences involving violence, and 26% fewer offences overall. Those on the placebos showed no change in their behaviour. Once the trial had finished the number of offences went up by the same amount. The office the researchers had used to administer nutrients was restored to a restraint room after they had left.

"The supplements improved the functioning of those prisoners. It was clearly something significant that can't be explained away. I was disappointed the results were not latched on to. We put a lot of effort into improving prisoners' chances of not coming back in, and you measure success in small doses."

Gesch believes we should be rethinking the whole notion of culpability. The overall rate of violent crime in the UK has risen since the 1950s, with huge rises since the 1970s. "Such large changes are hard to explain in terms of genetics or simply changes of reporting or recording crime. One plausible candidate to explain some of the rapid rise in crime could be changes in the brain's environment. What would the future have held for those 231 young men if they had grown up with better nourishment?" Gesch says.

He said he was currently unable to comment on any plans for future research in prisons, but studies with young offenders in the community are being planned.

For Hibbeln, the changes in our diet in the past century are "a very large uncontrolled experiment that may have contributed to the societal burden of aggression, depression and cardiovascular death." To ask whether we have enough evidence to change diets is to put the question the wrong way round. Whoever said it was safe to change them so radically in the first place?

Young offender's diet

One young offender had been sentenced by the British courts on 13 occasions for stealing trucks in the early hours of the morning.

Bernard Gesch recorded the boy's daily diet as follows:

Breakfast: nothing (asleep)

Mid morning: nothing (asleep)

Lunchtime: 4 or 5 cups of coffee with milk and 2½ heaped teaspoons of sugar

Mid afternoon: 3 or 4 cups of coffee with milk and 2½ heaped sugars

Tea: chips, egg, ketchup, 2 slices of white bread, 5 cups of tea or coffee with milk and sugar

Evening: 5 cups of tea or coffee with milk and sugar, 20 cigarettes, £2 worth of sweets, cakes and if money available 3 or 4 pints of beer.

Omega-3, junk food and the link between violence and what we eat

Research with British and US offenders suggests nutritional deficiencies may play a key role in aggressive behaviour

Felicity Lawrence

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The Guardian [England]

That Dwight Demar is able to sit in front of us, sober, calm, and employed, is "a miracle," he declares in the cadences of a prayer-meeting sinner. He has been rocking his 6' 2" bulk to and fro while delivering a confessional account of his past into the middle distance. He wants us to know what has saved him after 20 years on the streets: "My dome is working. They gave me some kind of pill and I changed. Me, myself and I, I changed."

Demar has been in and out of prison so many times he has lost count of his convictions. "Being drunk, being disorderly, trespass, assault and battery; you name it, I did it. How many times I been in jail? I don't know, I was locked up so much it was my second home."

Demar has been taking part in a clinical trial at the US government's National Institutes for Health, near Washington. The study is investigating the effects of omega-3 fatty acid supplements on the brain, and the pills that have effected Demar's "miracle" are doses of fish oil.

A Nutrition Article of Great Social Significance

The results emerging from this study are at the cutting edge of the debate on crime and punishment. In Britain we lock up more people than ever before. Nearly 80,000 people are now in our prisons, which reached their capacity this week.

But the new research calls into question the very basis of criminal justice and the notion of culpability. It suggests that individuals may not always be responsible for their aggression. Taken together with a study in a high-security prison for young offenders in the UK, it shows that violent behaviour may be attributable at least in part to nutritional deficiencies.

The UK prison trial at Aylesbury jail showed that when young men there were fed multivitamins, minerals and essential fatty acids, the number of violent offences they committed in the prison fell by 37%. Although no one is suggesting that poor diet alone can account for complex social problems, the former chief inspector of prisons Lord Ramsbotham says that he is now "absolutely convinced that there is a direct link between diet and antisocial behaviour, both that bad diet causes bad behaviour and that good diet prevents it."

The Dutch government is currently conducting a large trial to see if nutritional supplements have the same effect on its prison population. And this week, new claims were made that fish oil had improved behaviour and reduced aggression among children with some of the most severe behavioural difficulties in the UK.

Deficiency

For the clinician in charge of the US study, Joseph Hibbeln, the results of his trial are not a miracle, but simply what you might predict if you understand the biochemistry of the brain and the biophysics of the brain cell membrane. His hypothesis is that modern industrialised diets may be changing the very architecture and functioning of the brain.

We are suffering, he believes, from widespread diseases of deficiency. Just as vitamin C deficiency causes scurvy, deficiency in the essential fats the brain needs and the nutrients needed to metabolise those fats is causing of a host of mental problems from depression to aggression. Not all experts agree, but if he is right, the consequences are as serious as they could be. The pandemic of violence in western societies may be related to what we eat or fail to eat. Junk food may not only be making us sick, but mad and bad too.



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In Demar's case the aggression has blighted many lives. He has attacked his wife. "Once she put my TV out the door, I snapped off and smacked her." His last spell in prison was for a particularly violent assault. "I tried to kill a person. Then I knew something need be done because I was half a hundred and I was either going to kill somebody or get killed."

Demar's brain has blanked out much of that last attack. He can remember that a man propositioned him for sex, but the details of his own response are hazy.

When he came out of jail after that, he bought a can of beer and seemed headed for more of the same until a case worker who had seen adverts for Hibbeln's trial persuaded him to take part.

The researchers at the National Institute on Alcohol Abuse and Alcoholism, which is part of NIH, had placed adverts for aggressive alcoholics in the Washington Post in 2001. Some 80 volunteers came forward and have since been enrolled in the double blind study. They have ranged from homeless people to a teacher to a former secret service agent. Following a period of three weeks' detoxification on a locked ward, half were randomly assigned to 2 grams per day of the omega-3 fatty acids EPA and DHA for three months, and half to placebos of fish-flavoured corn oil.

An earlier pilot study on 30 patients with violent records found that those given omega-3 supplements had their anger reduced by one-third, measured by standard scales of hostility and irritability, regardless of whether they were relapsing and drinking again. The bigger trial is nearly complete now and Dell Wright, the nurse administering the pills, has seen startling changes in those on the fish oil rather than the placebo. "When Demar came in there was always an undercurrent of aggression in his behaviour. Once he was on the supplements he took on the ability not to be impulsive. He kept saying, 'This is not like me'."

Demar has been out of trouble and sober for a year now. He has a girlfriend, his own door key, and was made employee of the month at his company recently. Others on the trial also have long histories of violence but with omega-3 fatty acids have been able for the first time to control their anger and aggression. J, for example, arrived drinking a gallon of rum a day and had 28 scars on his hand from punching other people. Now he is calm and his cravings have gone. W was a 19th barrel of a man with convictions for assault and battery. He improved dramatically on the fish oil and later told doctors that for the first time since the age of five he had managed to go three months without punching anyone in the head.

Threat to society

Hibbeln is a psychiatrist and physician, but as an employee of the US government at the NIH he wears the uniform of a commander, with his decorations for service pinned to his chest. As we queued to get past the post-9/11 security checks at the NIH federal base, he explained something of his view of the new threat to society.

Over the last century most western countries have undergone a dramatic shift in the composition of their diets in which the omega-3 fatty acids that are essential to the brain have been flooded out by competing omega-6 fatty acids, mainly from industrial oils such as soya, corn, and sunflower. In the US, for example, soya oil accounted for only 0.02% of all calories available in 1909, but by 2000 it accounted for 20%. Americans have gone from eating a fraction of an ounce of soya oil a year to downing 25lbs (11.3kg) per person per year in that period. In the UK, omega-6 fats from oils such as soya, corn, and sunflower accounted for 1% of energy supply in the early 1960s, but by 2000 they were nearly 5%. These omega-6 fatty acids come mainly from industrial frying for takeaways, ready meals and snack foods such as crisps, chips, biscuits, ice-creams and from margarine. Alcohol, meanwhile, depletes omega-3s from the brain.

To test the hypothesis, Hibbeln and his colleagues have mapped the growth in consumption of omega-6 fatty acids from seed oils in 38 countries since the 1960s against the rise in murder rates over the same period. In all cases there is an unnerving match. As omega-6 goes up, so do homicides in a linear progression. Industrial societies where omega-3 consumption has remained high and omega-6 low because people eat fish, such as Japan, have low rates of murder and depression.

Of course, all these graphs prove is that there is a striking correlation between violence and omega 6-fatty acids in the diet. They don't prove that high omega-6 and low omega-3 fat consumption actually causes violence. Moreover, many other things have changed in the last century and been blamed for rising violence - exposure to violence in the media, the breakdown of the family unit and increased consumption of sugar, to take a few examples. But some of the trends you might expect to be linked to increased violence - such as availability of firearms and alcohol, or urbanisation - do not in fact reliably predict a rise in murder across countries, according to Hibbeln.

There has been a backlash recently against the hype surrounding omega-3 in the UK from scientists arguing that the evidence remains sketchy. Part of the backlash stems from the eagerness of some supplement companies to suggest that fish oils work might wonders even on children who have no behavioural problems.

Alan Johnson, the education secretary, appeared to be jumping on the bandwagon recently when he floated the idea of giving fish oils to all school children. The idea was quickly knocked down when the food standards agency published a

review of the evidence on the effect of nutrition on learning among schoolchildren and concluded there was not enough to conclude much, partly because very few scientific trials have been done.

Professor John Stein, of the department of physiology at Oxford University, where much of the UK research on omega-3 fatty acid deficiencies has been based, agrees: "There is only slender evidence that children with no particular problem would benefit from fish oil. And I would always say [for the general population] it's better to get omega-3 fatty acids by eating fish, which carries all the vitamins and minerals needed to metabolise them."

However, he believes that the evidence from the UK prison study and from Hibbeln's research in the US on the link between nutritional deficiency and crime is "strong," although the mechanisms involved are still not fully understood.

Hibbeln, Stein and others have been investigating what the mechanisms of a causal relationship between diet and aggression might be. This is where the biochemistry and biophysics comes in.

Essential fatty acids are called essential because humans cannot make them but must obtain them from the diet. The brain is a fatty organ - it's 60% fat by dry weight, and the essential fatty acids are what make part of its structure, making up 20% of the nerve cells' membranes. The synapses, or junctions where nerve cells connect with other nerve cells, contain even higher concentrations of essential fatty acids - being made of about 60% of the omega-3 fatty acid DHA.

Communication between the nerve cells depends on neurotransmitters, such as serotonin and dopamine, docking with receptors in the nerve cell membrane.

Omega-3 DHA is very long and highly flexible. When it is incorporated into the nerve cell membrane it helps make the membrane itself elastic and fluid so that signals pass through it efficiently. But if the wrong fatty acids are incorporated into the membrane, the neurotransmitters can't dock properly. We know from many other studies what happens when the neurotransmitter systems don't work efficiently. Low serotonin levels are known to predict an increased risk of suicide, depression and violent and impulsive behaviour. And dopamine is what controls the reward processes in the brain.

Laboratory tests at NIH have shown that the composition of tissue and in particular of the nerve cell membrane of people in the US is different from that of the Japanese, who eat a diet rich in omega-3 fatty acids from fish. Americans have cell membranes higher in the less flexible omega-6 fatty acids, which appear to have displaced the elastic omega-3 fatty acids found in Japanese nerve cells.

Hibbeln's theory is that because the omega-6 fatty acids compete with the omega-3 fatty acids for the same metabolic pathways, when omega-6 dominates in the diet, we can't convert the omega-3s to DHA and EPA, the longer chain versions we need for the brain. What seems to happen then is that the brain picks up a more rigid omega-6 fatty acid DPA instead of DHA to build the cell membranes - and they don't function so well.

Other experts blame the trans fats produced by partial hydrogenation of industrial oils for processed foods. Trans fats have been shown to interfere with the synthesis of essential fats in fetuses and infants. Minerals such as zinc and the B vitamins are needed to metabolise essential fats, so deficiencies in these may be playing an important part too.

There is also evidence that deficiencies in DHA/EPA at times when the brain is developing rapidly - in the womb, in the first 5 years of life and at puberty - can affect its architecture permanently. Animal studies have shown that those deprived of omega-3 fatty acids over two generations have offspring who cannot release dopamine and serotonin so effectively.

"The extension of all this is that if children are left with low dopamine as a result of early deficits in their own or their mother's diets, they cannot experience reward in the same way and they cannot learn from reward and punishment. If their serotonin levels are low, they cannot inhibit their impulses or regulate their emotional responses," Hibbeln points out.

Mental health

Here too you have one possible factor in cycles of deprivation (again, no one is suggesting diet is the only factor) and why criminal behaviour is apparently higher among lower socio-economic groups where nutrition is likely to be poorer.

These effects of the industrialisation of the diet on the brain were also predicted in the 1970s by a leading fats expert in the UK, Professor Michael Crawford, now at London's Metropolitan University. He established that DHA was structural to the brain and foresaw that deficiencies would lead to a surge in mental health and behavioural problems - a prediction borne out by the UK's mental health figures.

It was two decades later before the first study of the effect of diet on behaviour took place in a UK prison. Bernard Gesch, now a senior researcher at Stein's Oxford laboratory, first became involved with nutrition and its relationship to crime as a director of the charity Natural Justice in northwest England. He was supervising persistent offenders in the community and was struck by their diets. He later set out to test the idea that poor diet might cause antisocial behaviour and crime in the maximum security Aylesbury prison.