What do we know about nutrition, impulsivity and criminality?

Phineas Gage is probably the most famous patient in neuroscience. On the 13th September 1848, this American railroad engineer was compressing explosives into a hole, using a tapered iron rod, when the powder went off. The rod was blasted through his face and brain, damaging both sides of his prefrontal cortex (PFC). Astonishingly, he survived, but his behaviour changed for the worse. The pious, shrewd and steady foreman had become impulsive, capricious, profane and vacillating. Gage, said his friends, ‘was no longer Gage’.

Not all brain damage leads to bad behaviour, but frontal damage often can. fMRI studies of extremely dangerous criminals have found evidence of PFC damage or dysfunction. Prefrontal tumours have also been found in patients who have begun to show violent aggression for no apparent reason. The PFC appears to damp down signals from other regions, so that a person can take account of other information, such as moral rules, rather than impulsively reacting to a stimulus. High impulsivity – linked to poor PFC function – is a known risk factor for criminality.

Genetic and functional differences may also predispose to criminal behaviour. A form of the gene for the enzyme monoamine oxidase-A (MAO-A), which results in less of the enzyme that breaks down the transmitters, noradrenaline, dopamine and serotonin, has been linked to high aggression. Men with this form show activity differences in the brain circuits involved in emotional responses, including prefrontal areas. Self-control, less impulsive behaviour, and the ability to stop and think before acting are associated with healthy prefrontal activity, while hyperactivity and impulsivity have been linked to prefrontal dysfunction or (in children) immaturity. Levels of neurotransmitters such as GABA and serotonin in prefrontal cortex have also been linked to self-control.

Prefrontal areas are resource intensive and appear particularly susceptible to dietary influences such as essential fatty acid intake. An fMRI study in primary school boys (aged 8-10 years) found that DHA supplementation boosted PFC activity. Conversely, among UK children, high consumption of junk food was associated with later hyperactivity. Supplementation has also been linked to behavioural improvements, for example in self-control and concentration. A multivitamin-supplementation RCT on US schoolchildren aged 6-12, measuring disciplinary incidents, found that supplementation almost halved the rates of threats/fighting, vandalism, being disrespectful, disorderly conduct, defiance, obscenities, refusal to work or serve, endangering others, and nonspecified offenses.

In adults, too, improving diet may be a surprisingly effective way to tackle bad behaviour. Indeed, some of the strongest evidence for the positive effects of dietary intervention relates to criminal populations, where well-conducted RCTs have shown a significant link between better diet (via supplements) and better behaviour. Interestingly, the research has tended not to find links between diet and proxy (self-reported) measures of violence, such as aggression questionnaires. But actions speak louder than words; when actual violent behaviour is measured the link is clear.
For example, in 2002 a UK double-blind RCT of young offenders in prison gave the men multivitamin and fatty acid supplements, and recorded the number of disciplinary incidents before and during supplementation. The researchers found an average drop of 35% in the number of incidents in the supplemented prisoners, but not in the placebo group. A later Dutch study also found that supplementation reduced aggression and rule-breaking. A replication study of the 2002 research is currently underway; preliminary results support the conclusions of the above two studies.

Despite these clear results, policy-makers have been curiously reluctant to consider the implications. More research is needed, both to convince them and to extend the findings beyond prisons into the community. But dietary supplements are relatively easy to administer and have few side-effects. Therefore as an intervention that might reduce violent behaviour by a third or more, dietary improvement warrants further investigation.

ENDNOTES


7 The supplements, which were deliberately selected to be available ‘over-the-counter’, contained fatty acids (linoleic acid, gamma linolenic acid, eicosapentaenoic acid and docosahexaenoic acid), minerals (calcium, iron, copper, magnesium, zinc, iodine, manganese, potassium, phosphorus, selenium, chromium, molybdenum), and vitamins (A, D, B1, B2, B5, B6, B7, B9, C, E, K1, and nicotinamide, which is chemically similar to vitamin B3).
