How Does MDMA Affect the Brain?

MDMA exerts its primary effects in the brain on neurons that use the chemical (or neurotransmitter) serotonin to communicate with other neurons. The serotonin system plays an important role in regulating mood, aggression, sexual activity, sleep, and sensitivity to pain. MDMA binds to the serotonin transporter, which is responsible for removing serotonin from the synapse (or space between adjacent neurons) to terminate the signal between neurons; thus MDMA increases and prolongs the serotonin signal. MDMA also enters the serotonergic neurons via the transporter (because MDMA resembles serotonin in chemical structure) where it causes excessive release of serotonin from the neurons. MDMA has similar effects on another neurotransmitter—norepinephrine, which can cause increases in heart rate and blood pressure. MDMA also releases dopamine, but to a much lesser extent.

MDMA can produce confusion, depression, sleep problems, drug craving, and severe anxiety. These problems can occur soon after taking the drug or, sometimes, even days or weeks after taking MDMA. In addition, chronic users of MDMA perform more poorly than nonusers on certain types of cognitive or memory tasks, although some of these effects may be due to the use of other drugs in combination with MDMA. Research in animals indicates that MDMA can be harmful to the brain—one study in nonhuman primates showed that exposure to MDMA for only 4 days caused damage to serotonin nerve terminals that was still evident 6 to 7 years later. Although similar neurotoxicity has not been shown definitively in humans, the wealth of animal research indicating MDMA’s damaging properties strongly suggests that MDMA is not a safe drug for human consumption.

What Other Adverse Effects Does MDMA Have on Health?

MDMA can also be dangerous to overall health and, on rare occasions, lethal. MDMA can have many of the same physical effects as other stimulants, such as cocaine and amphetamines. These include increases in heart rate and blood pressure—which present risks of particular concern for people with circulatory problems or heart disease—and other symptoms such as muscle tension, involuntary teeth clenching, nausea, blurred vision, faintness, and chills or sweating.

In high doses, MDMA can interfere with the body’s ability to regulate temperature. On rare but unpredictable occasions, this can lead to a sharp increase in body temperature (hyperthermia), which can result in liver, kidney, cardiovascular system failure, or death. MDMA can interfere with its own metabolism (breakdown within the body); therefore, potentially harmful levels can be reached by repeated MDMA administration within short periods of time. Other drugs that are chemically similar to MDMA, such as MDA (methylenedioxyamphetamine, the parent drug of MDMA) and PMA (paramethoxyamphetamine, associated with fatalities in the United States and Australia),5 are sometimes sold as ecstasy. These drugs can be neurotoxic or create additional health risks to the user. Furthermore, ecstasy tablets may contain other substances, such as ephedrine (a stimulant); dextromethorphan (DXM, a cough suppressant); ketamine (an anesthetic used mostly by
veterinarians); caffeine; cocaine; and methamphetamine. Although the combination of MDMA with one or more of these drugs may be inherently dangerous, users who also combine these with additional substances such as marijuana and alcohol may be putting themselves at even higher risk for adverse health effects.