

# Brain abnormality found in group of SIDS cases

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Credit: Anna Langova/public domain

More than 40 percent of infants in a group who died of sudden infant death syndrome (SIDS) were found to have an abnormality in a key part of the brain, researchers report. The abnormality affects the hippocampus, a brain area that influences such functions as breathing, heart rate, and body temperature, via its neurological connections to the brainstem. According to the researchers, supported by the National

Institutes of Health, the abnormality was present more often in infants who died of SIDS than in infants whose deaths could be attributed to known causes.

The researchers believe the abnormality may destabilize the brain's control of breathing and heart rate patterns during [sleep](#), or during the periodic brief arousals from sleep that occur throughout the night.

"The new finding adds to a growing body of evidence that brain abnormalities may underlie many cases of sudden infant death syndrome," said Marian Willinger, Ph.D, special assistant for SIDS at NIH's Eunice Kennedy Shriver National Institute of Child Health and Human Development, which funded the study. "The hope is that research efforts in this area eventually will provide the means to identify vulnerable infants so that we'll be able to reduce their risk for SIDS."

SIDS is the sudden death of an infant younger than 1 year of age that is still unexplained after a complete post mortem investigation by a coroner or medical examiner. This investigation includes an autopsy, a review of the death scene, and review of family and medical histories. In the United States, SIDS is the leading cause of death between one month and one year of age. The deaths are associated with an infant's sleep period.

The study was published online in *Acta Neuropathologica* and conducted by Hannah C. Kinney, M.D., and colleagues at Boston Children's Hospital and Harvard Medical School in Boston, and colleagues from the San Diego County Medical Examiner's office in San Diego, and Baylor College of Medicine in Houston.

The hippocampus is involved in memory, learning, spatial orientation, and, through its connections to the brainstem, some aspects of breathing and cardiac function. Specifically, the researchers traced the abnormality to a structure within the hippocampus known as the [dentate gyrus](#).

In the SIDS cases, the researchers found that the dentate gyrus, at certain intervals along its length, contained a double layer of nerve cells instead of the usual single layer. This abnormality is called focal granule cell bilamination.

"The pattern of abnormal changes in the dentate gyrus suggests to us there was a problem in its development at some point in late fetal life or in the months right after birth," Dr. Kinney said. "We didn't see any signs of injury to the brain by low oxygen levels in the tissue we examined, such as scarring and loss of nerve cells."

The researchers undertook their study after finding abnormalities in the hippocampal region of brain tissue from SIDS cases that were sent to them for diagnostic consultation. Another clue to the possibility of an abnormality in the hippocampus came from earlier findings by members of the research team that a group of children who died suddenly and unexpectedly after 1 year of age also had an abnormality in this brain structure. These children died of [sudden unexplained death in childhood](#) (SUDC) which occurs from 1 year of age through adolescence. It is far less common than SIDS, but, like SIDS, it is also defined by inability to identify a cause of death after a complete autopsy or death scene investigation.

To conduct the study, the researchers examined sections of hippocampus from 153 infants autopsied at the San Diego, medical examiner's office. The infants had died suddenly and unexpectedly between 1991 and 2012. The deaths were classified as unexplained (which included SIDS and other cases in which the cause of death was unknown,) or explained, with death, due to such known causes of death as infection, accident, homicide, or asphyxia (oxygen deprivation).

After examining the hippocampal samples, the researchers found the abnormality in the dentate gyrus in 41.2 percent of the unexplained

group and in 7.7 percent of the explained (control) group. When the researchers considered the 86 cases within the unexplained group that were classified as SIDS, about 43 percent (37) had the abnormality.

Dr. Kinney and her colleagues believe that the dentate gyrus abnormality in the SIDS cases may lead to instability in the brain areas directly responsible for breathing and heart function. The researchers found the abnormality in SIDS cases that were discovered in unsafe sleep environments such as face down, as well as in safe sleep environments such as with infants found on their backs.

Dr. Kinney said the findings suggest that in infants with the hippocampal abnormality, an unsafe sleep environment may trigger an underlying instability in heart or breathing function. However, because many of the SIDS deaths also occurred in safe sleep environments, Dr. Kinney said that more research is needed to determine what might have triggered the underlying instability in these cases as well. Dr. Kinney noted that additional research is needed to find ways to detect the hippocampal abnormality in a live infant.

In their article, the researchers noted that the hippocampal abnormality they found in the SIDS cases is similar to a hippocampal abnormality found at autopsy in some cases of temporal lobe epilepsy. Epilepsy is a brain disorder in which a person has repeated seizures over time. Seizures are episodes of disturbed brain activity that cause changes in attention, behavior, breathing, and heart function. The epilepsies are a spectrum of brain disorders ranging from severe, life-threatening and disabling, to others that are less severe.

"One of the brain areas prone to generate seizures is the hippocampus," Dr. Kinney said.

Previous research groups have theorized that SIDS could be due to an

unwitnessed seizure that stops the heart and breathing. Dr. Kinney stressed however, that more research is needed to prove that seizure is the cause of death in many SIDS cases.

The researchers do not know why they didn't find the hippocampal abnormality in all of the SIDS cases they examined, but only in about 43 percent. Dr. Kinney explained, however, that SIDS is a syndrome that likely results from a number of different causes and not the result of only a single abnormality or underlying disorder. Similarly, the researchers don't know whether or not the hippocampal abnormality played a role in the death of the very small number of control cases in the study who also had this abnormality.

In earlier work, Dr. Kinney and her colleagues found that many infants who died of SIDS had abnormalities in serotonin metabolism. The SIDS infants had low levels of the neurotransmitter serotonin, and of the different types of serotonin receptors in the parts of the brainstem involved in breathing, heart rate patterns, blood pressure, temperature regulation, and arousal during sleep. They theorized that an abnormality in serotonin-producing parts of the brainstem could result in abnormal development of the dentate gyrus. Dr. Kinney's group is now investigating the potential relationship of the hippocampal abnormality to brainstem serotonin abnormalities in SIDS babies.

The NICHD-led [Safe to Sleep Campaign](#) advises that infants should be placed on their backs for sleep, in their own sleep area, on a firm sleep surface, such as a mattress in a safety-approved crib. These practices reduce the risk of SIDS and SIDS rates have declined by half since more babies have been placed to sleep on their backs.

"The story of SIDS research is far from complete," Dr. Kinney said. "Until it is, the best ways to reduce the risk for SIDS is by following the recommendations for safe sleep and other infant care practices of the

Safe to Sleep campaign."

Provided by National Institutes of Health

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