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**1-312-791-6610**

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks  
1-630-590-7738  
[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

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**Study Finds Cause of Visual Impairment in Astronauts**

**AT A GLANCE**

- **Astronauts on long-duration missions experience visual impairments due to volume changes in cerebrospinal fluid.**
- **Researchers studied astronauts from the International Space Station and space shuttle missions.**
- **Compared to short-duration missions, astronauts on long-duration flights had significant increases in post-flight flattening of their eyeballs, increased optic nerve protrusion and increases in CSF.**

CHICAGO – A visual problem affecting astronauts who serve on lengthy missions in space is related to volume changes in the clear fluid that is found around the brain and spinal cord, according to new research being presented today at the annual meeting of the Radiological Society of North America (RSNA).

Over the last decade, flight surgeons and scientists at NASA began seeing a pattern of visual impairment in astronauts who flew long-duration space missions. The astronauts had blurry vision, and further testing revealed, among several other structural changes, flattening at the back of their eyeballs and inflammation of the head of their optic nerves. The syndrome, known as visual impairment intracranial pressure (VIIP), was reported in nearly two-thirds of astronauts after long-duration missions aboard the International Space Station (ISS).

“People initially didn’t know what to make of it, and by 2010 there was growing concern as it became apparent that some of the astronauts had severe structural changes that were not fully reversible upon return to earth,” said study lead author Noam Alperin, Ph.D., professor of radiology and biomedical engineering at the University of Miami Miller School of Medicine in Miami, Fla.

Scientists previously believed that the primary source of the problem was a shift of vascular fluid toward the upper body that takes place when astronauts spend time in the microgravity of space. But researchers led by Dr. Alperin recently investigated another possible source for the problem: cerebrospinal fluid (CSF), the clear fluid that helps cushion the brain and spinal cord while circulating nutrients and removing waste materials. The CSF system is designed to accommodate significant changes in hydrostatic pressures, such as when a person rises from a lying to sitting or standing position. However, the microgravity of space presents new challenges.

“On earth, the CSF system is built to accommodate these pressure changes, but in space the system is confused by the lack of the posture-related pressure changes,” Dr. Alperin said.

To learn more about the role of CSF in spaceflight-induced visual impairment and eye changes, Dr. Alperin and colleagues performed high-resolution orbit and brain MRI scans before and shortly after spaceflights for seven long-duration mission ISS astronauts.

They compared results with those from nine short-duration mission space shuttle astronauts. Using advanced quantitative imaging algorithms, the researchers looked for any correlation between changes in CSF volumes and the structures of the visual system.

The results showed that, compared to short-duration astronauts, long-duration astronauts had significantly increased post-flight flattening of their eyeballs and increased optic nerve protrusion. Long-duration astronauts also had significantly greater post-flight increases in orbital CSF volume, or the CSF around the optic nerves within the bony cavity of the skull that holds the eye, and ventricular CSF volume—volume in the cavities of the brain where CSF is produced. The large post-spaceflight ocular changes observed in ISS crew members were associated with greater increases in intraorbital and intracranial CSF volume.

“The research provides, for the first time, quantitative evidence obtained from short- and long-duration astronauts pointing to the primary and direct role of the CSF in the globe deformations seen in astronauts with visual impairment syndrome,” Dr. Alperin said.

There were no significant post-flight changes of gray matter volume or white matter volume in either group of astronauts.

Identifying the origin of the space-induced ocular changes is necessary, Dr. Alperin said, for the development of countermeasures to protect the crew from the ill effects of long-duration exposure to microgravity.

“If the ocular structural deformations are not identified early, astronauts could suffer irreversible damage,” he noted. “As the eye globe becomes more flattened, the astronauts become hyperopic, or far-sighted.”

According to Dr. Alperin, NASA is studying a number of possible measures to simulate the conditions that lead to VIIP and testing various countermeasures.

Co-authors on the study are Ahmet M. Bagci, Ph.D., Sang H. Lee, M.S., and Byron L. Lam, M.D.

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[lb Brooks@rsna.org](mailto:lb Brooks@rsna.org)

Maureen Morley

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[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Monday, Nov. 21, 2016, at 5:00 a.m. ET*

## **Obesity in Adolescence May Cause Permanent Bone Loss**

### **AT A GLANCE**

- **Having a high amount of visceral fat and a low amount of muscle mass may lead to bone loss in obese adolescents.**
- **Bone loss during adolescence increases fracture risk later in life.**
- **More than one-third of children and adolescents in the U.S. are overweight or obese.**

CHICAGO – Teenagers who are obese may be doing irreparable damage to their bones, according to a new study being presented next week at the annual meeting of the Radiological Society of North America (RSNA).

Obesity in childhood and adolescence is associated with a number of health risks, including cardiovascular disease and diabetes. For the new study, researchers are looking at how excess weight may affect bone structure.

“While obesity was previously believed to be protective of bone health, recent studies have shown a higher incidence of forearm fractures in obese youths,” said the study’s lead author, Miriam A. Bredella, M.D., radiologist at Massachusetts General

Hospital and associate professor of radiology at Harvard Medical School in Boston.

Dr. Bredella and colleagues set out to determine the relationship between adolescent obesity and bone structure. The researchers have recruited 23 obese adolescents with a mean age of 17 years and a mean body mass index (BMI) of 44 kg/m<sup>2</sup> for the ongoing study.

“Adolescence is the time where we accrue our peak bone mass, so bone loss during this time is a serious problem,” Dr. Bredella said. “We know from other chronic states that lead to bone loss in adolescence, such as anorexia nervosa, that increased fracture risk persists in adulthood, even after normalization of body weight. Therefore, it is important to address this problem early on.”

The researchers performed 3D HR-pQCT—a type of computed tomography exam designed specifically for measuring bone mineral density and bone microarchitecture in the arms and legs—to determine the bone structure of the distal radius, an area of the forearm near the wrist. They also performed dual-energy x-ray absorptiometry (DXA) exams to determine body composition, including lean mass and visceral fat mass. Visceral fat is the deep fat in the abdomen that surrounds the internal organs.

“There are several mechanisms by which visceral fat exerts negative effects on bone,” Dr. Bredella said. “Visceral fat secretes substances that promote chronic inflammation, and chronic inflammation stimulates formation of osteoclasts, which are the cells that resorb or break-down bone. In addition,

vitamin D, which is important for bone health, is soluble in adipose tissue and gets trapped within fat cells.”

She noted that growth hormone, which is important for bone health, is also lower in adolescents with visceral obesity.

The study results showed that BMI was positively associated with cortical thickness and area. Cortical bone is dense and compact and forms the outer shell of most bones. Visceral fat mass was positively associated with cortical porosity.

Lean mass was positively associated with trabecular density, volume and integrity. Trabecular bone is a spongy inner layer of bone that provides support and flexibility.

The findings suggest that having a high amount of visceral fat coupled with a low amount of muscle mass puts adolescents at risk for weakened bone structure.

“The best way to prevent bone loss is a healthy diet that contains adequate amounts of calcium and vitamin D, along with sufficient exercise, as we have shown in our study that muscle mass is good for bone health,” Dr. Bredella said.

According to the Centers for Disease Control and Prevention (CDC), obesity has more than quadrupled in adolescents over the past 30 years. It is estimated that more than one-third of children and adolescents in the U.S. are overweight or obese.

Co-authors on the study are Fatima C. Stanford, M.D., M.P.H., M.P.A., Vibha Singhal, M.D., M.B.B.S., Stijn A. Bos, B.S., Ryan Woolley, B.S., Alexander Toth, B.S., and Madhusmita Misra, M.D., M.P.H.

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1-630-590-7738

[lb Brooks@rsna.org](mailto:lb Brooks@rsna.org)

Maureen Morley

1-630-590-7754

[mmorley@rsna.org](mailto:mmorley@rsna.org)

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## **Head Impacts Lead to Brain Changes in High School Football Players**

### **AT A GLANCE**

- **Imaging exams found that high school football players without concussion showed structural and functional changes in the brain that correlated with exposure to head impacts.**
- **Players were imaged pre- and post-season, and wore special helmets that measured the magnitude, location and direction of each hit through one season.**
- **The findings showed that players who had greater head impact exposure had the greatest change in diffusion imaging and MEG metrics.**

CHICAGO – Brain imaging exams performed on high school football players after just one season revealed changes in both the gray and white matter that correlated with exposure to head impacts, according to a new study that will be presented today at the annual meeting of the Radiological Society of North America (RSNA).

“It’s important to understand the potential changes occurring in the brain related to youth contact sports,” said Elizabeth Moody Davenport, Ph.D., a postdoctoral researcher at UT Southwestern Medical Center in Dallas, Texas, who led this analysis. “We know that some professional football players suffer from a serious condition called chronic traumatic encephalopathy, or CTE. We are attempting to find out when and how that process starts, so that we can keep sports a healthy activity for millions of children and adolescents.”

The study included 24 players from a high school football team in North Carolina, each of whom wore a helmet outfitted with the Head Impact Telemetry System (HITS) during all practices and games. The helmets are lined with six accelerometers, or sensors, that measure the magnitude, location and direction of a hit. Data from the helmets can be uploaded to a computer for analysis.

“We saw changes in these young players’ brains on both structural and functional imaging after a single season of football,” Dr. Davenport said.

In the study, each player underwent pre- and post-season imaging: a specialized MRI scan, from which diffusion tensor imaging (DTI) and diffusion kurtosis imaging (DKI) data were extracted to measure the brain’s white matter integrity, and a magnetoencephalography (MEG) scan, which records and analyzes the magnetic fields produced by brain waves. Diffusion imaging can measure the structural white matter changes in the brain, and MEG assesses changes in function.

“MEG can be used to measure delta waves in the brain, which are a type of distress signal,” Dr. Davenport said. “Delta waves represent slow wave activity that increases after brain injuries. The delta

waves we saw came from the surface of the brain, while diffusion imaging is a measure of the white matter deeper in the brain.”

The research team calculated the change in imaging metrics between the pre- and post-season imaging exams. They measured abnormalities observed on diffusion imaging and abnormally increased delta wave activity on MEG. The imaging results were then combined with player-specific impact data from the HITS. None of the 24 players were diagnosed with a concussion during the study.

Players with greater head impact exposure had the greatest change in diffusion imaging and MEG metrics.

“Change in diffusion imaging metrics correlated most to linear acceleration, similar to the impact of a car crash,” Dr. Davenport said. “MEG changes correlated most to rotational impact, similar to a boxer’s punch. These results demonstrate that you need both imaging metrics to assess impact exposure because they correlate with very different biomechanical processes.”

Dr. Davenport said similar studies are being conducted this fall, and a consortium has been formed to continue the brain imaging research in youth contact sports across the country.

“Without a larger population that is closely followed in a longitudinal study, it is difficult to know the long-term effects of these changes,” she said. “We don’t know if the brain’s developmental trajectory is altered, or if the off-season time allows for the brain to return to normal.”

Co-authors on the study are Jillian Urban, Ph.D., Ben Wagner, B.S., Mark A. Espeland, Ph.D., Christopher T. Whitlow, M.D., Ph.D., Joel Stitzel, Ph.D., and Joseph A. Maldjian, M.D.

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks  
1-630-590-7738  
[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Emma Day  
1-630-590-7791  
[eday@rsna.org](mailto:eday@rsna.org)

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**Musical Training Creates New Brain Connections in Children**

**AT A GLANCE**

- **Diffusion tensor imaging shows musical instruction improves brain connections in children.**
- **After nine months of musical training, results showed brain fiber growth and new connections in areas of the brain associated with autism spectrum disorders and ADHD.**
- **The results could help researchers create targeted strategies for treatment of these disorders.**

CHICAGO – Taking music lessons increases brain fiber connections in children and may be useful in treating autism and Attention Deficit Hyperactivity Disorder (ADHD), according to a study being presented next week at the annual meeting of the Radiological Society of North America (RSNA).

“It’s been known that musical instruction benefits children with these disorders,” said Pilar Dies-Suarez, M.D., chief radiologist at the Hospital Infantil de México Federico Gómez in Mexico City, “but this study has given us a better understanding of exactly how the brain changes and where these new fiber connections are occurring.”

The researchers studied 23 healthy children between the ages of five and six years old. All of the children were right handed and had no history of sensory, perception or neurological disorders. None of the children had been trained in any artistic discipline in the past.

The study participants underwent pre- and post-musical-training evaluation with diffusion tensor imaging (DTI) of the brain. DTI is an advanced MRI technique, which identifies microstructural changes in the brain’s white matter.

“Experiencing music at an early age can contribute to better brain development, optimizing the creation and establishment of neural networks, and stimulating the existing brain tracts,” Dr. Dies-Suarez said.

The brain’s white matter is composed of millions of nerve fibers called axons that act like communication cables connecting various regions of the brain. Diffusion tensor imaging produces a measurement, called fractional anisotropy (FA), of the movement of extracellular water molecules along axons. In healthy white matter, the direction of extracellular water molecules is fairly uniform and measures high in fractional anisotropy. When water movement is more random, FA values decrease, suggesting abnormalities.

Over the course of life, the maturation of brain tracts and connections between motor, auditory and other areas allow the development of numerous cognitive abilities, including musical skills. Previous studies have linked autism spectrum and ADHD with decreases in volume, fiber connections and FA in the minor and lower forceps, tracts located in the frontal cortex of the brain. This suggests that low connectivity in the frontal cortex, an area of the brain involved in complex cognitive processes, is a biomarker of these disorders.

After the children in the study completed nine months of musical instruction using Boomwhackers—percussion tubes cut to the exact length to create pitches in a diatonic scale, DTI results showed an increase in FA and axon fiber length in different areas of the brain, most notably in the minor forceps.

“When a child receives musical instruction, their brains are asked to complete certain tasks,” Dr. Dies-Suarez said. “These tasks involve hearing, motor, cognition, emotion and social skills, which seem to activate these different brain areas. These results may have occurred because of the need to create more connections between the two hemispheres of the brain.”

The researchers believe that the results of this study could aid in creating targeted strategies for intervention in treating disorders like autism and ADHD.

Co-authors on this study were Silvia Hidalgo-Tobon, Ph.D., Benito De Celis Alonso, Ph.D., Coral Guerrero, and Eduardo Castro Sierra, M.D.

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[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

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## **Diabetes Proves Deadly for Smokers**

### **AT A GLANCE**

- **Researchers analyzed risk for all-cause mortality among current and former smokers with and without diabetes in the National Lung Screening Trial (NLST).**
- **The results showed diabetes doubles the risk for all-cause mortality and non-lung cancer mortality among heavy smokers.**
- **The results also found an increased risk of lung cancer death among female smokers with diabetes.**

CHICAGO – While it is well known that smoking causes lung cancer, heavy smokers with diabetes are also at increased risk of death from causes other than lung cancer, according to a study being presented next week at the annual meeting of the Radiological Society of North America (RSNA).

Diabetes is a chronic illness in which there are high levels of glucose in the blood. More than 29 million people in the U.S. have diabetes, up from the previous estimate of 26 million in 2010, according to a report released by the Centers for Disease Control and Prevention. One in four people with diabetes doesn't know he or she has it. Having diabetes can also put people at risk for numerous other health complications.

To determine the extent to which diabetes is associated with deaths from lung cancer, other cancers, and other causes among heavy smokers, researchers examined the risk for all-cause mortality among people with and without diabetes within the National Lung Screening Trial (NLST), a massive, multicenter trial that compared low-dose helical CT with chest X-ray for early detection of lung cancer in current and former heavy smokers.

“In our study, we found a statistically significant link between diabetes and all-cause deaths, non-lung cancer deaths and lung cancer deaths in women,” said Kavita Garg, M.D., professor of radiology from the University of Colorado – Denver.

For the study, Dr. Garg and colleagues looked at data from 53,454 participants in the NLST and identified 5,174 participants who reported having diabetes at screening.

They conducted an analysis of the relative risk for overall mortality, lung cancer mortality, and non-lung cancer mortality associated with diabetes, adjusting for age, gender, body mass index (BMI), and pack-years of smoking. Over the course of the study, there were 3,936 total deaths, including 1,021 from lung cancer and 826 from cancers not of the lung.

Participants with diabetes tended to be older, reported more pack-years of smoking, and had a higher BMI than those without diabetes. There were 650 deaths (12.6 percent of patients) among participants with diabetes and 3,286 deaths (6.8 percent of patients) among participants without diabetes.

“We found that diabetes doubles the risk for all-cause mortality and non-lung cancer mortality among heavy smokers,” Dr. Garg said. “We also found that women with diabetes have an increased risk of lung-cancer mortality, but did not find the same effect in men.”

The researchers continue to analyze data in an effort to better understand the underlying cause. In the meantime, Dr. Garg emphasizes the importance of taking control of diabetes and undergoing lung cancer screening if you’re a smoker.

“Patients have to take care of their diabetes to maximize the benefit of CT screening for lung cancer,” she said. “It truly makes a magnitude of difference in mortality risk.”

Co-authors on the study are Janet Snell-Bergeon, Ph.D., Samuel Chang, M.D., Nayana U. Patel, M.D., and Satish K. Garg, M.D.

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Maureen Morley  
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[mmorley@rsna.org](mailto:mmorley@rsna.org)

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**New Report Warns of Chest Injuries in Children after ATV Accidents**

**AT A GLANCE**

- **Chest injuries—including bruised or collapsed lungs and fractured ribs—are common in children involved in ATV accidents.**
- **Forty percent of children with ATV-related chest injuries in the study required ICU care.**
- **In 2014, 24,800 children were treated in U.S. emergency rooms for ATV-related injuries.**

CHICAGO – Children in all-terrain vehicle (ATV) accidents are likely to suffer chest injuries, many of them serious, according to a new study presented today at the annual meeting of the Radiological Society of North America (RSNA).

“The sheer incidence of chest injuries in pediatric patients evaluated after ATV accidents is rather alarming and not necessarily the type of injuries patients and their families give much forethought to when considering the risks of ATV use,” said study author Kelly N. Hagedorn, M.D., radiology resident at McGovern Medical School at The University of Texas Health Science Center at Houston.

ATVs—motorized vehicles with large, low-pressure tires, designed for off-highway use—have an average weight of 300 to 400 pounds and travel up to 75 miles per hour. ATV-associated injuries can be caused by crashes, rollovers, ejections or even disregard of simple safety precautions.

According to the Consumer Product Safety Commission (CPSC), 24,800 children under the age of 16 were treated in hospital emergency rooms nationwide in 2014 for ATV-related injuries. This figure represents more than a quarter of all ATV-related injuries treated that year. While the American Academy of Pediatrics recommends that children under the age of 16 be prohibited from riding ATVs, regulations vary from state to state.

Dr. Hagedorn and colleagues performed a retrospective review of records from 1992 to 2013 for patients between 0 and 18 years old who underwent chest imaging at Memorial Hermann Red Duke Trauma Institute, a level 1 trauma center in Houston, after ATV-related incidents. During the study period, 455 patients were admitted. Of these, 102 (22 percent) had a chest injury. Patients with chest injuries were the focus of the study.

“While this study only highlights a specific subset of potential injuries, their incidence and clinical significance cannot be overlooked,” Dr. Hagedorn said. “Other studies have demonstrated the prevalence of orthopedic and neurologic injuries, and the most recent CPSC report estimates that 23 percent of ATV-related fatalities since 1982 have occurred in children younger than 16.”

Main causes of chest injury included rollover (43 percent), collision with landscape (20 percent) or falls (16 percent). The injured child was the driver of the ATV in 41 cases, and the passenger in 33 cases. In the remaining 28 cases, it was unknown whether the injured child was the driver or passenger. Patients with chest injuries were, on average, 13 years old.

The most common chest injury identified in the study was pulmonary contusion, or bruising of the lung, occurring in 61 percent of patients. In pulmonary contusion, blood and other fluids collect in the lung tissue, potentially leading to oxygen deficiency.

Other chest injuries included pneumothorax, or collapsed lung (45 percent of patients), and rib fractures (34 percent of patients).

Forty percent of patients with chest injuries required care in the intensive care unit (ICU), compared to 22 percent of patients without chest injuries. Patients with chest injuries also had longer hospital stays. Eight children with chest injuries died.

“Our study further supports the need for increased public awareness of the risks—and potentially devastating consequences—of ATV use among children,” Dr. Hagedorn said.

Co-authors on the study are Jennifer H. Johnston, M.D., Sean K. Johnston, M.D., Nagaramesh Chinapuvvula, M.B.B.S., and Chunyan Cai, Ph.D.

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## **Alcohol Consumption Shows No Effect on Coronary Arteries**

### **AT A GLANCE**

- **Researchers assessed the association between alcohol consumption and the presence of coronary artery disease.**
- **Atherosclerosis, clinical risk factors and patient drinking habits were evaluated.**
- **The results showed alcohol consumption had neither harmful nor protective effects on the arteries of the heart.**

CHICAGO – Researchers using coronary computed tomography angiography (CCTA) have found no association between light to moderate alcohol consumption and coronary artery disease (CAD), according to a study being presented today at the annual meeting of the Radiological Society of North America (RSNA).

Some previous studies have suggested that light alcohol consumption may actually reduce the risk for CAD. However, data regarding regular alcohol consumption and its association with the presence of CAD remains controversial. For the new study, researchers looked at alcohol consumption, type of alcohol consumed, and

presence of coronary plaques using CCTA.

“CCTA is an excellent diagnostic modality to noninvasively depict the coronary wall and identify atherosclerotic lesions,” said study author Júlia Karády, M.D., from the MTA-SE Cardiovascular Imaging Research Group, Heart and Vascular Center at Semmelweis University in Budapest, Hungary. “Furthermore, we’re able to characterize plaques and differentiate between several types. Prior studies used cardiovascular risk factors—like high cholesterol levels—and cardiovascular outcomes to study the effects of alcohol, but our study is unique in that we analyzed both drinkers and non-drinkers using CCTA, which may shed some light on how alcohol may or may not contribute to the development of fatty plaques in the arteries of the heart.”

The researchers studied 1,925 consecutive patients referred for CCTA with suspected CAD. Information on alcohol consumption habits was collected using questionnaires about the amount and type of alcohol consumed. Using an in-house reporting platform that contained the patients’ clinical and CCTA data, researchers were able to assess the relationship between atherosclerosis, clinical risk factors and patient drinking habits.

“About 40 percent of our patients reported regular alcohol consumption, with a median of 6.7 alcohol units consumed weekly,” Dr. Karády said.

One unit translates to approximately 2 deciliters (dl) or 6.8 fluid ounces of beer, 1 dl or 3.4 ounces of wine, or 4 centiliters (cl) or 1.35 ounces of hard liquor.

The results showed that the amount of weekly alcohol consumption, whether light or moderate, was not associated with the presence of CAD. In addition, when researchers looked at different types of alcohol and the presence of coronary atherosclerosis, no associations were found.

“When we compared consumption between patients who had coronary artery plaques and those who had none, no difference was detected,” Dr. Karády said. “Evaluating the relationship between light alcohol intake (maximum of 14 units per week) and presence of CAD, we again found no association. Furthermore, we analyzed the effect of different types of alcohol (beer, wine and hard liquor) on the presence of CAD, but no relationship was found.”

Dr. Karády added that while no protective effect was detected among light drinkers, as previously thought, no harmful effects were detected either.

The researchers are in the process of expanding the study to include more patients and perform further analyses.

Independently of whether alcohol has any effect on the coronary arteries, moderate alcohol consumption has been associated with a number of potential side effects, including negative long-term effects on the brain and heart.

Co-authors on this study were Balint Szilveszter, M.D., Zsolia D. Drobni, M.D., Marton Kolossvary, M.D., Andrea Bartykowszki, M.D., Mihaly Karolyi, M.D., Ph.D., Adam Jermendy, M.D., Alexis Panajotu, M.D., Zsolt Bagyura, M.D., and Pal Maurovich-Horvat, M.D., Ph.D., M.P.H.

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**RSNA Newsroom 1-312-791-6610**

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks  
1-630-590-7738  
[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Wednesday, Nov. 30, 2016, at 5:00 a.m. ET*

## **Aerobic Exercise Preserves Brain Volume and Improves Cognitive Function**

### **AT A GLANCE**

- **Aerobic exercise may increase brain volume and cognitive function in people with mild cognitive impairment.**
- **MRI results showed increased local gray matter volume in patients who engaged in either aerobic or stretching exercises for six months, but some white matter atrophy in the stretching group.**
- **Cognitive testing revealed the aerobic exercise group also showed improvement in executive function after six months.**

CHICAGO – Using a new MRI technique, researchers found that adults with mild cognitive impairment (MCI) who exercised four times a week over a six-month period experienced an increase in brain volume in specific, or local, areas of the brain, but adults who participated in aerobic exercise experienced greater gains than those who just stretched. The study will be presented today at the annual meeting of the Radiological Society of North America (RSNA).

“Even over a short period of time, we saw aerobic exercise lead to a remarkable change in the brain,” said the study’s lead investigator, Laura D. Baker, Ph.D., from Wake Forest School of Medicine (WFSM) in Winston-Salem, N.C.

The study included 35 adults with MCI participating in a randomized, controlled trial of exercise intervention. Individuals with MCI are at risk of developing Alzheimer’s disease (AD), the most common form of dementia, which affects more than 5 million Americans today.

The participants were divided into two groups. Sixteen adults (average age 63 years) engaged in aerobic activity, including treadmill, stationary bike or elliptical training, four times per week for six months. A control group of 19 adults (average age 67 years) participated in stretching exercises with the same frequency. High-resolution brain MR images were acquired from all participants before and after the six-month activity period. The MRI results were compared using conventional and biomechanical metrics to measure the change in both brain volume and shape.

“We used high-resolution MR images to measure anatomical changes within areas of the brain to obtain both volumetric data and directional information,” said Jeongchul Kim, Ph.D., co-investigator on the study from WFSM.

The analysis revealed that for both the aerobic and stretching groups, brain volume increased in most gray matter regions, including the temporal lobe, which supports short-term memory.

“Compared to the stretching group, the aerobic activity group had greater preservation of total brain volume, increased local gray matter volume and increased directional stretch of brain tissue,” Dr. Kim said.

Among participants of the stretching group, the analysis revealed a local contraction, or atrophy, within the white matter connecting fibers. According to Dr. Kim, such directional deformation, or shape change, is partially related to volume loss, but not always.

“Directional changes in the brain without local volume changes could be a novel biomarker for neurological disease,” he said. “It may be a more sensitive marker for the tiny changes that occur in a specific brain region before volumetric changes are detectable on MRI.”

He said both MRI measures are important to the treatment of MCI and AD, which require the careful tracking of changes in the brain while patients engage in interventions including diet and exercise to slow the progression of the disease.

Study participants were tested to determine the effect of exercise intervention on cognitive performance. Participants in the aerobic exercise group showed statistically significant improvement in executive function after six months, whereas the stretching group did not improve.

“Any type of exercise can be beneficial,” Dr. Kim said. “If possible, aerobic activity may create potential benefits for higher cognitive functioning.”

Other co-authors on the study are Suzanne Craft, Ph.D., Youngkyoo Jung, Ph.D., and Christopher T. Whitlow, M.D., Ph.D.

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Linda Brooks  
1-630-590-7738  
[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Friday, Dec. 2, 2016, at 5:00 a.m. ET*

## **Short-term Sleep Deprivation Affects Heart Function**

### **AT A GLANCE**

- **After working a 24-hour shift with limited sleep, doctors showed increases in cardiac contractility, heart rate, blood pressure and stress hormones.**
- **This is the first study to use CMR strain analysis to study cardiac effects of sleep deprivation.**
- **The findings allow insight to the effects that workload and shift duration have on health.**

CHICAGO – Too little sleep takes a toll on your heart, according to a new study to be presented today at the annual meeting of the Radiological Society of North America (RSNA).

People who work in fire and emergency medical services, medical residencies and other high-stress jobs are often called upon to work 24-hour shifts with little opportunity for sleep. While it is known that extreme fatigue can affect many physical, cognitive and emotional processes, this is the first study to examine how working a 24-hour shift specifically affects cardiac function.

“For the first time, we have shown that short-term sleep deprivation in the context of 24-hour shifts can lead to a significant increase in cardiac contractility, blood pressure and heart rate,” said study author Daniel Kuetting, M.D., from the Department of Diagnostic and Interventional Radiology at the University of Bonn in Bonn, Germany.

For the study, Dr. Kuetting and colleagues recruited 20 healthy radiologists, including 19 men and one woman, with a mean age of 31.6 years. Each of the study participants underwent cardiovascular magnetic resonance (CMR) imaging with strain analysis before and after a 24-hour shift with an average of three hours of sleep.

“Cardiac function in the context of sleep deprivation has not previously been investigated with CMR strain analysis, the most sensitive parameter of cardiac contractility,” Dr. Kuetting said.

The researchers also collected blood and urine samples from the participants and measured blood pressure and heart rate.

Following short-term sleep deprivation, the participants showed significant increases in mean peak systolic strain (pre = -21.9; post = -23.4), systolic (112.8; 118.5) and diastolic (62.9; 69.2) blood pressure and heart rate (63.0; 68.9). In addition, the participants had significant increases in levels of thyroid stimulating hormone (TSH), thyroid hormones FT3 and FT4, and cortisol, a hormone released by the body in response to stress.

Although the researchers were able to perform follow-up examinations on half of the participants after regular sleep, Dr. Kuetting notes that further study in a larger cohort is needed to determine possible long-term effects of sleep loss.

“The study was designed to investigate real-life work-related sleep deprivation,” Dr. Kuetting said. “While the participants were not permitted to consume caffeine or food and beverages containing theobromine, such as chocolate, nuts or tea, we did not take into account factors like individual stress level or environmental stimuli.”

As people continue to work longer hours or work at more than one job to make ends meet, it is critical to investigate the detrimental effects of too much work and not enough sleep. Dr. Kuetting believes the results of this pilot study are transferable to other professions in which long periods of uninterrupted labor are common.

“These findings may help us better understand how workload and shift duration affect public health,” he said.

Co-authors on the study are Andreas Feisst, M.D., Rami Homsy, M.D., Julian A. Luetkens, M.D., Daniel Thomas, M.D., Ph.D., Hans H. Schild, M.D., and Darius Dabir, M.D.

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**RSNA Newsroom**

**1-312-791-6610**

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks  
1-630-590-7738  
[lb Brooks@rsna.org](mailto:lb Brooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Monday, Nov. 28, 2016, at 5:00 a.m. ET*

## **Large Study Finds No Evidence for Age-Based Mammography Cut-Off**

### **AT A GLANCE**

- **A study of screening mammography in more than 2.5 million women found no definitive cut-off age for breast cancer screening.**
- **Over 5.6 million mammograms performed in 150 facilities across 31 U.S. states over a 7-year period were analyzed.**
- **Based on increasing age, performance metrics demonstrated an upward trend for cancer detection rate and positive predictive values, and a downward trend in recall rates until age 90.**

CHICAGO – In the largest-ever study on screening mammography outcomes, researchers found that there is no clear cut-off age to stop breast cancer screening. The findings will be presented today at the annual meeting of the Radiological Society of North America (RSNA). This research adds support for guidelines that encourage screening decisions based on individual patients and their health status.

Mammography is the standard imaging exam for breast cancer screening. Guidelines on what age to stop breast cancer screening have been a source of controversy and confusion in recent years. In 2009, the United States Preventive Services Task Force (USPSTF) released new guidelines which stated there was not enough evidence to assess the balance of benefits and harms of screening mammography in women aged 75 years or older.

“All prior randomized, controlled trials excluded women older than 75, limiting available data to small observational studies,” said Cindy S. Lee, M.D., assistant professor in residence at the University of California, San Francisco. “There has been a lot of controversy, debate and conversation regarding the different breast cancer screening guidelines, even among major national organizations, over the past few years.”

Using data from the National Mammography Database, Dr. Lee and her research team analyzed data from over 5.6 million screening mammograms performed over a 7-year period between January 2008 and December 2014 in 150 facilities across 31 states in the U.S. The research team looked at patient demographics, screening mammography results and biopsy results. Data from over 2.5 million women over age 40 were sorted into patient groups by age in 5-year intervals (40-44, 45-49, etc.).

Four standard performance metrics were calculated to evaluate the performance of screening mammography for each age group: cancer detection rate, recall rate, positive predictive value for biopsy recommended (PPV2) and biopsy performed (PPV3). Recall rate is the percentage of patients called back for follow-up testing after a screening exam. Positive predictive value reflects the percentage of

cancers found among exams for which biopsy was recommended or performed. Ideal screening performances would have a higher cancer detection rate, PPV2 and PPV3, and a low recall rate.

Overall, researchers found mean cancer detection rate of 3.74 per 1,000 patients, recall rate of 10 percent, PPV2 of 20 percent and PPV3 of 29 percent. Based on increasing age from 40 to 90 years old, these performance metrics demonstrated a gradual upward trend for cancer detection rate, PPV2 and PPV3, but a downward trend in recall rate.

“The continuing increase of cancer detection rate and positive predictive values in women between the ages of 75 and 90 does not provide evidence for age-based mammography cessation,” Dr. Lee said.

The findings lend support to the argument that the decision whether or not to stop screening should be informed by an individual’s personal health history and preferences.

“We know that the risk of breast cancer increases with age,” Dr. Lee said. “With the uncertainty and controversy about what age to stop breast cancer screening, we want to address this gap in knowledge using a large national database.”

Co-authors on the study are Debapriya Sengupta, M.B.B.S., M.P.H., Judy Burleson, Mythreyi Bhargaven-Chatfield, Ph.D., Edward A. Sickles, M.D., Elizabeth S. Burnside, M.D., M.P.H., and Margarita L. Zuley, M.D.

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**RSNA Newsroom**

**1-312-791-6610**

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks  
1-630-590-7738  
[lb Brooks@rsna.org](mailto:lb Brooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Monday, Nov. 21, 2016, at 5:00 a.m. ET*

## **Researchers Generate 3-D Virtual Reality Models of Unborn Babies**

### **AT A GLANCE**

- **New technology transforms MRI and ultrasound data into a 3-D virtual reality model of a fetus.**
- **The fetal models are remarkably similar to the postnatal appearance of the newborn baby, and recreate the whole internal structure of the fetus.**
- **Wearing a virtual reality headset, users can hear the baby's heartbeat and, by moving their head, study the baby's anatomy.**

CHICAGO – Parents may soon be able to watch their unborn babies grow in realistic 3-D immersive visualizations, thanks to new technology that transforms MRI and ultrasound data into a 3-D virtual reality model of a fetus, according to research being presented next week at the annual meeting of the Radiological Society of North America (RSNA).

MRI provides high-resolution fetal and placental imaging with excellent contrast. It is generally used in fetal evaluation when ultrasound cannot provide sufficiently high-quality images.

Researchers in Brazil created virtual reality 3-D models based on fetal MRI results. Sequentially-mounted MRI

slices are used to begin construction of the model. A segmentation process follows in which the physician selects the body parts to be reconstructed in 3-D. Once an accurate 3-D model is created—including the womb, umbilical cord, placenta and fetus—the virtual reality device can be programmed to incorporate the model.

“The 3-D fetal models combined with virtual reality immersive technologies may improve our understanding of fetal anatomical characteristics and can be used for educational purposes and as a method for parents to visualize their unborn baby,” said study co-author Heron Werner Jr., M.D., Ph.D., from the Clínica de Diagnóstico por Imagem, in Rio de Janeiro, Brazil.

The virtual reality fetal 3-D models are remarkably similar to the postnatal appearance of the newborn baby. They recreate the entire internal structure of the fetus, including a detailed view of the respiratory tract, which can aid doctors in assessing abnormalities.

For the virtual reality device, Dr. Werner and colleagues used the latest-generation Oculus Rift 2 headset. Oculus Rift 2 places the user in an immersive environment, complete with heartbeat sounds derived from the ultrasound of the fetus. Users can study the 3-D fetal anatomy simply by moving their head.

“The experience with the Oculus Rift has been wonderful,” Dr. Werner said. “It provides fetal images that are sharper and clearer than ultrasound and MR images viewed on a traditional display.”

The technology has numerous potential applications, including assessment of fetal airway patency. Airway patency, or the state of airways being open and unblocked, is an important issue for a developing fetus. For example, if ultrasound showed an abnormal mass near the fetal airway, physicians could use the 3-D images and the headset to assess the entire length of the airway and make better informed decisions about delivery.

The technology also can help coordinate care with multidisciplinary teams and provide better visual information to parents to help them understand malformations and treatment decisions.

“The physicians can have access to an immersive experience on the clinical case that they are working on, having the whole internal structure of the fetus in 3-D in order to better visualize and share the morphological information,” Dr. Werner said. “We believe that these images will help facilitate a multidisciplinary discussion about some pathologies in addition to bringing a new experience for parents when following the development of their unborn child.”

The researchers have used the technique on patients at a clinic in Rio de Janeiro, including cases where the fetus had evidence of an abnormality that required postnatal surgery. They hope to use the technology more broadly over the next year.

Co-authors on the study are Bianca Guedes Ribeiro, M.D., Jorge Lopes, Ph.D., Gerson Ribeiro, Pedro Daltro, M.D., Tatiana M. Fazecas, M.D., Renata A. Nogueira, M.D., and Leise Rodrigues, M.D.

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks  
1-630-590-7738  
[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Maureen Morley  
1-630-590-7754  
[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Tuesday, Nov. 29, 2016, at 5:00 a.m. ET*

**Depression in Soldiers Linked to Brain Disruption from Injury**

**AT A GLANCE**

- **Using MRI techniques, researchers found changes in the brains of military service members who have depression symptoms after mTBI.**
- **Imaging results showed changes in white and gray matter in brain regions critical for cognitive and emotional control in mTBI patients with depression.**
- **Of 130 mTBI patients in the study, 75 showed moderate to severe depression symptoms.**

CHICAGO – Using multiple brain imaging techniques, researchers have found that a disruption of the circuitry in the brain’s cognitive-emotional pathways may provide a physical foundation for depression symptoms in some service members who have suffered mild traumatic brain injury (mTBI) in combat. The researchers will present their findings today at the annual meeting of the Radiological Society of North America (RSNA).

“We can link these connectivity changes in the brain to poor top-down emotional processing and greater maladaptive rumination, or worrying, in symptomatic depressed soldiers after mTBI,” said Ping-Hong Yeh, Ph.D., scientist and physicist at the National Intrepid Center of Excellence, Walter Reed National Military Medical Center in Bethesda, Md.

According to the Defense and Veterans Brain Injury Center, 352,619 service members worldwide have been diagnosed with TBI since 2000, the majority of these cases being mTBI. In addition, psychiatric disorders, such as anxiety and major depressive disorders, are becoming common in military personnel with brain injuries.

“With the increased survival of soldiers due to improvements in body armor and advanced medical care, there has been an increase in the number of soldiers surviving major trauma. Consequently, a large number of soldiers are returning from war with mTBI,” Dr. Yeh said. “Mood disorders are very common in military-related mTBI patients. This is an ongoing problem facing a large number of warriors in current areas of conflict, and it is likely to be a persistent problem for the foreseeable future.”

For the study, researchers used two MRI techniques to examine 130 active male service members diagnosed with mTBI and a control group of 52 men without mTBI. Diffusion-weighted imaging (DWI) is an MRI technique that measures how water moves through tissue. Resting-state functional MRI (fMRI), examines the brain in its resting state, when not focused on a particular task.

Depression symptoms were rated based on the Beck Depression Inventory (BDI), a 21-item, self-reporting assessment that measures characteristic attitudes and symptoms of depression. Patients with a BDI score greater than 20 are considered to have moderate to severe depression symptoms.

BDI scores showed that 75 of the mTBI patients were classified as having moderate to severe depression symptoms.

Imaging results showed that white matter tracts—the circuits that connect brain regions critical for cognitive and emotional control—were disrupted in the patients with moderate to severe depression symptoms. Researchers also saw changes in the gray matter cognitive-emotional networks in these patients.

“We found consistencies in the locations of disrupted neurocircuitry as revealed by DWI and resting-state fMRI that are unique to the clinical symptoms of mTBI patients,” Dr. Yeh said. “We have related the brain structural and functional changes in cognitive-emotional networks to depressive symptoms in mTBI patients.”

Dr. Yeh noted that this research can possibly lead to treatment strategies in the future.

“Though the results of this study were not applied directly to patient care, the neuroimaging changes we found might be incorporated into treatment plans for personalized medicine in the future,” he said.

Co-authors on the study are John Graner, Ph.D., Cheng Guan Koay, Ph.D., Gerard Riedy, M.D., Ph.D., Grant Bonavia, M.D., Ph.D., and John Ollinger, Ph.D.

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**RSNA Media Relations 1-630-590-7762**

Linda Brooks

1-630-590-7738

[lbrooks@rsna.org](mailto:lbrooks@rsna.org)

Maureen Morley

1-630-590-7754

[mmorley@rsna.org](mailto:mmorley@rsna.org)

*Embargoed for release on Tuesday, Nov. 22, 2016, at 5:00 a.m. ET*

## **New Studies Provide More Insight into Zika Effects**

### **AT A GLANCE**

- **A pattern of CT findings show that Zika virus causes several types of congenital brain damage.**
- **Some adults who contract Zika virus develop serious neurological conditions, such as Guillain-Barré syndrome.**
- **Knowledge of abnormalities present in the central nervous system due to Zika infection may give hints about the pathophysiology of the disease.**

CHICAGO – Three new studies reporting on the effects of the Zika virus outbreak in Brazil will be presented next week at the annual meeting of the Radiological Society of North America (RSNA).

The first study looks at CT findings of the central nervous system in 16 newborn babies with congenital Zika virus infection confirmed by tests in cerebral spinal fluid.

The researchers identified a pattern of CT brain findings in the babies, including decreased brain volume, simplified gyral pattern, calcifications, ventricular dilatation and prominent occipital bone.

“We live in Pernambuco, a state in northeastern Brazil, which had the highest number of patients with microcephaly during the Zika outbreak in our country,” said study author Natacha Calheiros de Lima Petribu, M.D., from the Department of Radiology at Barão de Lucena Hospital. “Our study proves that Zika virus infection can

cause congenital brain damage in babies with and without microcephaly.”

Another study analyzed the imaging results of three target groups affected by Zika: adults who developed acute neurological syndrome, newborns with vertical infection with neurological disorders, and pregnant women with rash outbreaks suggestive of Zika.

Many of the adults had symptoms of Guillain-Barré syndrome, a rare disorder in which the body’s immune system attacks the nervous system causing rapid onset muscle weakness. A few showed inflammation of the brain and spinal cord (Bickerstaff’s encephalitis) or brain stem and spinal cord lesions. Common MRI findings included enhancement of certain spinal and facial nerves. In the newborns, MRI showed orbital injuries and anatomical changes in brain tissue.

“It was alarming to find so many cases of neurological syndromes in adults, some very serious, related to Zika virus infection,” said study author Emerson de Melo Casagrande, M.D., from the Department of Radiology at Antonio Pedro University Hospital - Federal Fluminense University. “We have also noticed a difference between these syndromes, even though the trigger was the same.”

In a third study, ultrasound and fetal MRI were performed on pregnant patients with Zika virus infection at different gestational ages. Once the babies were born, they underwent ultrasound, CT and MRI. The researchers

then created 3-D virtual and physical models of the skulls. More than half the babies had microcephaly, brain calcifications and loss of brain tissue volume, along with other structural changes.

“The emergence of Zika virus in the Americas has coincided with increased reports of babies born with microcephaly,” said study author Heron Werner Jr., M.D., Ph.D., from the Department of Radiology at Clínica de Diagnóstico por Imagem. “An early diagnosis may help in treating these babies after birth. Moreover, the knowledge of abnormalities present in the central nervous system may give hints about the pathophysiology of the disease.”

Zika is mainly spread to humans via the bite of an infected mosquito. Symptoms may include fever, rash, joint or muscle pain, headache and bloodshot eyes. More serious conditions, such as Guillain-Barré syndrome, have been associated with Zika infection in adults, but are uncommon. Many adults infected with Zika have no symptoms at all.

Zika appears to be most dangerous when transmitted from a pregnant mother to her fetus during the first trimester of pregnancy, increasing the likelihood of severe brain defects in the baby, including microcephaly. Zika has also been linked to eye defects, hearing impairment and stunted growth in babies.

Pregnant women and women who are considering becoming pregnant should avoid visiting areas where infected mosquitos are known to be present. However, if women live in areas where the mosquitos are present, the [recommendation of the Centers for Disease Control and Prevention \(CDC\)](#) is to wear clothes that protect from mosquito bites, use mosquito repellent and get appropriate testing, including routine prenatal care and an ultrasound at 18 to 20 weeks. Pregnant women who are worried that they may have contracted the virus should speak with their obstetrician to initiate testing.

Although these reports focus on the Zika outbreak in Brazil, the infection has spread to countries and territories around the world, including the United States.

“Common Findings on Head Computed Tomography in Neonates with Confirmed Congenital Zika Syndrome”: Natacha Calheiros de Lima Petribu, M.D., Marília B. Abath, M.D., Andreza C. Vieira Fernandes, M.D., Felipe R. Queiroz, M.D., Jannie D. Araujo, M.D., Glauber B. Carvalho, M.D., and Vanessa van der Linden, M.D.

“Neuroradiological Findings Related to Zika Epidemic: Experience from a Brazilian University Hospital”: Cristina A. Fontes, M.D., M.Mc., Alair Augusto S. Santos, M.D., Ph.D., Emerson de Melo Casagrande, M.D., Victor M. Bussed, M.D., Daniel G. Neves, M.D., and Alessandro S. Melo, M.D., Ph.D.

“Essentials of Intrauterine Zika Virus Infection: Pre and Postnatal CNS Findings”: Bianca Guedes Ribeiro, M.D., Heron Werner, M.D., Luiz Celso H. Da Cruz, M.D., Pedro Daltro, M.D., Renata A. Nogueira, M.D., and Tatiana M. Fazecas, M.D.

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