

NIH News in Health

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About Faces

The Biology of Face and Head Formation

There's a reason we can spot a friend in a crowd—humans are wired to focus on faces. We're incredibly skilled at recognizing small differences in a face, like a square jaw, arched brows, or high cheekbones. The uniqueness of faces inspires artists and poets. It also enables facial recognition technology. The distinct features of each face help to define who we are.



“There's a lot of information in a face,” says Dr. Seth Weinberg, who studies genes that affect the face and head at the University of Pittsburgh. “It's how we connect with each other, understand emotions, and interpret social cues.”

Despite its importance, the underlying biology that creates each face remains unclear. And scientists are not yet certain what goes wrong to cause birth defects of the head and face. These are called craniofacial disorders. They can make it hard to eat, hear, speak, see, and breathe. Craniofacial disorders can also harm the growing brain.

NIH-funded researchers are working to unravel the mysteries behind how the head and face develop. Their findings could not only help prevent or treat craniofacial disorders, like cleft lip and palate. They could shed light on the function and development of

other body parts, since the head and face include many nerve cells, bones, immune cells, and more.

Molding the Face and Head •

One way to decipher the underlying biology of the face and head is to gather data—lots of it. Scientists analyze genetic information, take images of people's faces, and collect other biological information from both humans and animals. And they share this data with other scientists to enable discoveries.

So far, researchers have linked over 300 areas of our DNA to facial features like nose height, eye width, and chin shape. In one study, Weinberg and colleagues analyzed images of the head from more than 6,000 children. This helped them uncover previously unknown sets of genes that can affect the shape of the human head. These findings, in turn,

could shed light on genetic disorders that affect the skull.

But genes alone don't tell the whole story. Even identical twins with the same genes don't always look exactly alike.

“From our research, our genes only explain about 14% of the variation in facial features,” Weinberg says. Our age, diet, environment, exposure to chemicals, and many other factors can mold the shapes of our faces before and after birth.

Tailoring Treatment • While scientists haven't yet pinpointed all the factors that affect our faces, they do know that when craniofacial disorders arise, they generally begin before birth. These disorders occur when bones, nerves, and tissues in the face and head don't form properly as a baby is growing in the womb.

For example, cleft lip and palate is a birth defect that arises around the second or third month of pregnancy. It occurs when the right and left

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sides of the lip, the roof of the mouth (called the palate), or both don't join all the way. This creates a gap, or cleft.

“Cleft lip and palate is the most common craniofacial disorder. Instead of a continuous lip, there is a notch or there's a defect that extends up into the nose, so the lip is in two segments,” explains NIH's Dr. Janice Lee, who specializes in surgery for the face, head, neck, and jaw. “Typically, we can identify it while the baby is growing in the womb or at birth.” With 3D imaging techniques, doctors can now assess cleft disorders before birth and begin to plan repairs.

Newborns with cleft lip or palate are often referred to a team of surgeons, dentists, geneticists, pediatricians, and speech therapists for care. These experts may follow their patients from birth to adulthood, repairing the cleft and guiding recovery. Cleft lip and palate can affect a child's oral health and social well-being. The goal is to tailor care for each patient and lessen the disorder's impact on their lives. With treatment, most children

with cleft lip or palate do well and lead a healthy life.

Finding New Options • Surgeries for the face and head can be complex and tough on the body. Even after surgery, some children may have trouble eating, breathing, and speaking. Scientists are continuing to develop new surgical techniques to help patients speak better and improve how their faces look. Others are creating computer programs and artificial intelligence tools to plan surgery for cleft lip or palate.

Researchers are also exploring ways to fix craniofacial disorders while reducing surgical procedures. Dr. Yang Chai at the University of Southern California aims to find ways to correct a craniofacial disorder called craniosynostosis.

Normally, a newborn's skull bones are separated by flexible joints that make space for the brain to grow. But in babies with craniosynostosis, the joints close too soon. This can change a baby's head shape and brain growth.

“During my surgical training, I performed surgeries to fix these conditions but couldn't explain to parents why their kids had them,” Chai says. “This became a strong drive for me to better understand the disease and find a better solution for these patients.”

Chai and his colleagues are testing ways to grow more tissue between the skull joints in young mice with craniosynostosis. The researchers are using stem cells to fix the skull shape and reverse learning and memory problems in mice. Stem cells are special cells that can turn into many other types of cells, including bone, skin, and muscle. Their findings suggest that stem cell therapy may one day be a less

invasive treatment for craniofacial disorders.

Predicting who might be more likely to have craniofacial disorders is another area that scientists are excited about. “If we can understand who's at greatest risk or which families are at risk, we can do things that could potentially prevent these conditions from occurring,” Lee says. “We're not there yet. But prediction and early treatment is really something we're all working toward.” ■



Wise Choices

Preventing Birth Defects

It's not always possible to prevent craniofacial disorders and other birth defects. But you can improve your chances for healthy outcomes by taking care of your own health before and during pregnancy:

- **Talk with a health care provider.** Be sure to discuss any family history of birth defects and medical conditions that might affect pregnancy, like diabetes or obesity.
- **Avoid harmful substances.** Using nicotine-containing products, drinking alcohol, or using illicit drugs can cause birth defects and other problems.
- **Take care of your overall health.** Prevent infections, take care of existing health conditions like diabetes, and try to keep a healthy weight.
- **Get 400 micrograms of folic acid every day.** Having enough folic acid in your body before and during pregnancy can help prevent birth defects of the brain and spine.

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Web Links

For more about face and head development, see “Find More Information” in the online article: newsinhealth.nih.gov/2025/01/about-faces

Working Out to Stay Sharp

Can Exercise Keep Your Brain Healthier?

We've all heard that exercise is good for us. Experts recommend getting at least 150 minutes of moderate-intensity aerobic activity each week. This can include brisk walking, biking, playing tennis, or even pushing a lawnmower. Strength training exercises, like lifting weights, push-ups, or sit-ups, are recommended at least two days a week.

Many benefits of exercise are well-known. Aerobic exercise can help you maintain a healthy weight by burning fat. It can also keep your heart healthy. Strength training can help to build muscle mass and strengthen your bones. Stretching can improve flexibility and range of motion. And balance exercises can prevent falls. Scientists are finding out that exercise may also improve our brain health.

Research has shown that when you exercise, many different molecules are released into your bloodstream. These molecules travel to different organs and tissues, where they trigger changes that help your cells withstand the physical stress of exercise.

"You're basically telling your body, 'You need to prepare for something,'" explains Dr. Saul Villeda, who studies the aging brain at the University of California, San Francisco. In preparing to withstand exercise, cells also seem to get better at withstanding the effects of aging.

As we age, our **cognitive** abilities often start to decline. We may have difficulty with learning and memory. That's because our brains undergo cellular changes as we get older. The protective barrier around the brain also changes, altering which substances can get into your brain.



Some of these have potentially harmful effects.

Studies in mice and rats have shown that exercise can partially offset these changes. And it can prevent at least some of the cognitive decline that occurs with age. These benefits haven't just been seen in mice, either. Research has also shown a link between aerobic exercise and better memory in people.

Certain exercise-induced molecules have been shown to boost cognitive functions in mice. Villeda and colleagues are studying one called GPLD1. They've found that it's at least partly responsible for why exercise improves new brain cell formation, learning, and memory in aged mice.

Villeda's team has also shown that more active older adults have more GPLD1 in their blood. This suggests that GPLD1 may have a similar function in people. GPLD1 production has shown effects similar to exercise in the brains of mice. So, Villeda hopes that one day GPLD1 can help

improve the health of people who aren't able to exercise.

Don't be discouraged if the recommended amount of exercise seems overwhelming. It's okay to start small. "A little bit goes a long way," Villeda says. "Even just moving a few minutes extra that you wouldn't have done already has a benefit." He notes that his research findings have motivated him to start exercising, which he didn't do before. "Even though I'm dealing with mice, the benefits that I can physically see in them have compelled a couch potato [like me] to actually get up and start exercising."

See the Wise Choices box for tips on getting exercise in your day. ■



Wise Choices

Making Exercise Part of Your Routine

- **Make everyday activities more active.** For example, take the stairs instead of the elevator or park farther out in parking lots.
- **Get active with others.** Find a neighbor, family member, or friend that shares your goals.
- **Join a team, an exercise group, or class.**
- **Keep track of your progress.** Use an activity log or a fitness tracker. This can help you to set goals and stay motivated.
- **Find ways to make exercise more fun.** Dance, listen to music while you exercise, or do a combination of activities to keep from getting bored.
- **Do what you can.** Even five minutes of activity is better than none.



Definitions

Cognitive

Related to the ability to think, learn, and remember.



Web Links

For more about aging and exercise, see "Find More Information" in the online article: newsinhealth.nih.gov/2025/01/working-out-stay-sharp



Health Capsules

For links to more information, please visit our website and see these stories online.

Health Consequences of Early Exposure to Sugar

Experts recommend that kids eat no added sugars before age 2. Yet most kids are exposed to added sugars at a very early age, even before birth through their mother's bloodstream.

Scientists studied the long-term health effects of sugar exposure in the womb and early childhood. To do this, they looked at the health of adults in the United Kingdom who were conceived or born around the end of sugar rationing. The rationing had begun during World War II. The amount of sugar allowed for each person was within today's U.S. dietary guidelines. After rationing

ended, sugar intake nearly doubled.

The researchers looked at data from more than 60,000 people born in the U.K. between October 1951 and March 1956. Those born before July 1954 likely had reduced exposure to sugar due to rationing. Those born in July 1954 and later didn't experience sugar rationing. As a result, they were born into a more sugar-rich environment.

Kids exposed to less sugar early in life had a lower chance of getting diabetes or high blood pressure decades later. Health benefits increased with longer exposure

to rationing. For those with reduced sugar exposure for at least 19 months after birth, the risk of getting diabetes dropped by about 35%. The risk of high blood pressure dropped by about 20%.

"It is hard to find situations where people are randomly exposed to different nutritional environments early in life, and follow them for 50 to 60 years," says Dr. Tadeja Gracner of the University of Southern California, who led the study. "The end of rationing provided us with a novel natural experiment to overcome some of these challenges." ■

What Are PFAS?

Chemicals called PFAS are sometimes in the news. PFAS stands for perfluoroalkyl and polyfluoroalkyl substances. PFAS are widely used and long-lasting. They're found in everyday items like carpets, clothes, and cookware. They have many uses. For example, they can help keep food from sticking to packages and prevent stains on fabrics. PFAS are even used in some fire-fighting foams.

These chemicals do not break down easily in the environment. And they

can build up in the blood over time. Some studies have found that PFAS can be detected in the blood and urine of people and animals.

Scientists are working to better understand how PFAS might affect human health. Some studies have found links between PFAS and increased risk for some cancers. Others have found that PFAS are linked to changes in metabolism or body weight.

In the early 2000s, some PFAS chemicals were removed from con-

sumer products. One study found that blood levels of the chemicals dropped after that. But since then, new PFAS chemicals have been created. NIH-supported studies are continuing to assess the potential health effects of these new products. But because there are thousands of variations in PFAS chemicals, they can be hard to study.

To learn more, visit www.niehs.nih.gov/health/topics/agents/pfc. ■



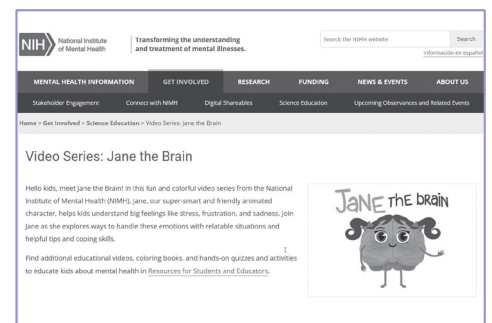
Featured Website

Jane the Brain

www.nimh.nih.gov/JaneTheBrain

Meet Jane the Brain. She's a super smart and friendly animated character. Like many of us, Jane has big feelings such as sadness, stress, and frustration. And she

has tips to help kids cope with these emotions. Watch these brief videos and get other mental health educational resources for students and educators.



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