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Oldest footprints of pre-humans identified in Crete

Oldest known footprints of pre-humans found on the island of Crete are at least six million years old

The oldest known footprints of pre-humans were found on the Mediterranean island of Crete and are at least six million years old, says an international team of researchers from Germany, Sweden, Greece, Egypt and England, led by Tübingen scientists Uwe Kirscher and Madelaine Böhme of the Senckenberg Center for Human Evolution and Palaeoenvironment at the University of Tübingen. Their study has been published in the journal *Scientific Reports*.

Tracks in the sand: One of over 50 footprints of predecessors of early humans identified in 2017 near Trachilos, Crete. Dating techniques have now shown them to be more than six million years old. **Credit: University of Tübingen**

The footprints from fossilized beach sediments were found near the west Cretan village of Trachilos and published in 2017. Using geophysical and micropaleontological methods, researchers have now dated them to 6.05 million years before the present day, making them the oldest direct evidence of a human-like foot used for walking. "The tracks are almost 2.5 million years older than the tracks attributed to Australopithecus afarensis (Lucy) from Laetoli in Tanzania," Uwe Kirscher says. This puts the Trachilos footprints at the same age as the fossils of the upright-walking Orrorin tugenensis from Kenya. Finds connected with this biped include femurs, but there are no foot bones or footprints.

The dating of the Cretan footprints therefore sheds new light on the early evolution of human perambulation more than six million years ago. "The oldest human foot used for upright walking had a ball, with a strong parallel big toe, and successively shorter side toes," says Per Ahlberg, professor at Uppsala University and co-author of the study. "The foot had a shorter sole than Australopithecus. An arch was not yet pronounced and the heel was narrower."

Six million years ago, Crete was connected to the Greek mainland via the Peloponnese. According to Professor Madelaine Böhme, "We cannot rule out a connection between the producer of the tracks and the possible pre-human Graecopithecus freybergi." Several years ago, Böhme's team identified that previously unknown pre-human species in what is now Europe on the basis of fossils from 7.2 million-year-old deposits in Athens, just 250 kilometers away.

The study furthermore confirms recent research and theses of the Böhme team, according to which six million years ago the European and Near East mainland were separated from humid East Africa by a relatively brief expansion of the Sahara. Geochemical analysis of Crete's six-million-year-old beach deposits suggests that desert dust from North Africa was transported there by wind. The team arrived at an age of between 500 and 900 million years before present when dating dust-sized mineral grains. These time periods are typical for North African desert dust, the authors said.

Recent research in paleoanthropology also suggested that the African ape Sahelanthropus could be ruled out as a biped, and that Orrorin tugenensis, which originated in Kenya and lived 6.1 to 5.8 million years ago, is the oldest pre-human in Africa, Böhme says. Short-term desertification and the geographic distribution of early human predecessors could therefore be more closely related than previously thought. On the one hand, a desertification phase 6.25 million years ago in Mesopotamia could have initiated a migration of European mammals, possibly including apes, to Africa. On the other hand, the second-phase sealing off of the continents by the

Sahara 6 million years ago could have enabled a separate development of the African pre-human Orrorin tugenensis in parallel with a European pre-human. According to this principle, called "desert swing" by Böhme, successive short-term desertifications in Mesopotamia and the Sahara caused a migration of mammals from Eurasia to Africa.

More information: *Uwe Kirscher et al, Age constraints for the Trachilos footprints from Crete, Scientific Reports (2021). DOI: 10.1038/s41598-021-98618-0*

https://bit.ly/3j12X2E

Oldest evidence of humans using tobacco discovered in Utah

Discovery reveals humans used tobacco nearly 10,000 years earlier than previously thought

By Charles Q. Choi

Charred seeds found in the Utah desert represent the earliest-known human use of tobacco, evidence that some of the first people to arrive in the Americas used the plant, according to new research. The discovery reveals that humans used tobacco nearly 10,000 years earlier than previously thought, the researchers said.

Archaeologists found charred tobacco seeds in the remains of a hearth in Great Salt Lake Desert in Utah, dating back more than 12,000 years. Here, Kelly McGuire is digging at the hearth. **(Image credit: Daron Duke)**

Of all the intoxicant plants that humans use and abuse, tobacco has arguably had the most critical social and economic impact, the scientists of the new study said. It often played sacred, ceremonial or medical roles among the ancient Maya and other Indigenous American groups, and it helped drive the American colonial economy and thus Western expansion across the New World.

In addition to smoking, chewing and snuffing, people have used tobacco in a variety of different ways over the centuries. For example, ancient Maya rituals may have at times used intoxicating enemas of tobacco-laced fluids, and 18th-century English doctors gave drowning victims enemas of tobacco smoke in attempts to save their lives.

Until now, the earliest known evidence of human tobacco use was nicotine found in smoking pipes in Alabama that dated back about 3,300 years, according to research published in 2018 in the Journal of Archaeological Science: Reports. Now, scientists have unearthed signs that people used tobacco about 9,000 years earlier than previously thought.

In the new study, archaeologists excavated the remains of a hunter-gatherer camp on mud flats in the Great Salt Lake Desert in Utah. Wind helped expose the site over time, said study lead author Daron Duke, an archaeologist with the Far Western Anthropological Research Group in Henderson, Nevada.

The scientists identified an intact ancient fireplace surrounded by stone artifacts, such as spear tips commonly used to hunt large game. The hearth also contained more than 2,000 bones and bone fragments, mostly belonging to ducks, which cut marks and other evidence suggested the people there cooked and ate.

The fireplace held pieces of charred willow wood that was probably the best firewood option in the region, as it commonly is now in modern nearby areas. The researchers then analyzed the wood with carbon dating, which involves measuring the amount of a radioactive form of carbon with a known rate of decay; the results suggested this wood was about 12,300 years old.

Within the fireplace, the scientists found the remains of four charred tobacco seeds. "The tobacco seeds were an unanticipated surprise," Duke told Live Science.

Although the researchers cannot say for sure how people at this site used tobacco, they said the seeds hinted at the presence of nicotine-loaded tobacco leaves and flowering stems. Perhaps the people there chewed or smoked tobacco by the fireside, the team said.

The scientists noted that others might argue the tobacco was not used for its nicotine, but perhaps it came from the stomachs of the ducks that had eaten it, or it was used as fuel for burning. The researchers noted that birds do not eat tobacco, and that tobacco lacks woody material and so burns too quickly to generate a fire of enough strength or duration for most cooking.

These findings suggest that people used tobacco for thousands of years before the unknown point in time at which humans first domesticated this plant, Duke said.

"People in the past were the ultimate botanists and identified the intoxicant values of tobacco quickly upon arriving in the Americas," Duke said.

Further research on this and other ancient sites with tobacco-use evidence could help shed light on the driving cultural forces behind the cultivation, use and subsequent domestication of tobacco, the researchers said.

"We have been working to get Indigenous input about the meaning and importance of the find," Duke said.

"This will not only help us understand the find for the common scientific reasons, but also help us learn more about its values to the people whose forebears camped at the site and lived throughout the region. This is really important for the broader purpose of doing this science at all, so we can understand implications from a diverse set of interests."

The scientists detailed their findings online Monday (Oct. 11) in the journal Nature Human Behaviour.

https://bit.ly/2YPVdKd

Researchers say fossil shows humans, dogs lived in C. America in 10,000 BC

Fossil of a jaw bone could prove that domesticated dogs lived in Central America as far back as 12,000 years ago

by David Goldberg

The fossil of a jaw bone could prove that domesticated dogs lived in Central America as far back as 12,000 years ago, according to a study by Latin American scientists. The dogs, and their masters, potentially lived alongside giant animals, researchers say.

A 1978 dig in Nacaome, northeast Costa Rica, found bone remains from the Late Pleistocene.

Excavations began in the 1990s and produced the remains of a giant horse, Equus sp, a glyptodon (a large armadillo), a mastodon (an ancestor of the modern elephant) and a piece of jaw from what was originally thought to be a coyote skull.

Originally thought to be that of a coyote, the jaw sample's teeth are not as pointy and thus more likely to be that of a dog.

"We thought it was very strange to have a coyote in the Pleistocene, that is to say 12,000 years ago," Costa Rican researcher Guillermo Vargas told AFP. "When we started looking at the bone fragments, we started to see characteristics that could have been from a dog.

"So we kept looking, we scanned it... and it showed that it was a dog living with humans 12,000 years ago in Costa Rica."

The presence of dogs is a sign that humans were also living in a place. "We thought it was strange that a sample was classified as a coyote because they only arrived in Costa Rica in the 20th century."

First of its kind

The coyote is a relative of the domestic dog, although with a different jaw and more pointed teeth. "The dog eats the leftovers from human food. Its teeth are not so determinant in its survival," said Vargas. "It hunts large prey with its human companions. This sample reflects that difference."

Humans are believed to have emigrated to the Americas across the Bering Strait from Siberia to Alaska during the last great ice age.

"The first domesticated dogs entered the continent about 15,000 years ago, a product of Asians migrating across the Bering Strait," said Raul Valadez, a biologist and zooarcheologist from the National Autonomous University of Mexico. "There have never been dogs without people," Valadez told AFP by telephone.

The presence of humans during the Pleistocene has been attested in Mexico, Chile and Patagonia, but never in Central America, until now. "This could be the oldest dog in the Americas," said Vargas.

So far, the oldest attested dog remains were found in Alaska and are 10,150 years old.

Oxford University has offered to perform DNA and carbon dating tests on the sample to discover more genetic information about the animal and its age.

The fossil is currently held at Costa Rica's national museum but the sample cannot be re-identified as a dog without validation by a specialist review.

"This dog discovery would be the first evidence of humans in Costa Rica during a period much earlier" than currently thought, said Vargas. "It would show us that there were societies that could keep dogs, that had food surpluses, that had dogs out of desire and that these weren't war dogs that could cause damage."

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Few adverse health effects in wildlife exposed to low levels of radiation from the Fukushima nuclear accident

Conducting research on the effects of life-long radiation exposures to wildlife

by Mary Guiden

More than 10 years ago, the Great East Japan Earthquake and Tsunami damaged the Fukushima Dai-ichi Nuclear Power Plant, resulting in a massive release of radioactive material into the environment. Radiation dose rates led to the evacuation of over 150,000 residents from an area estimated at 444 square miles.

Although people were evacuated, wildlife remained within the Fukushima Exclusion Zone, as it is sometimes called, and generations of animals have since been exposed to radiation levels above the safety threshold for human occupancy.

The research team studied rat snakes and wild boar across a range of radiation exposures, examining biomarkers of DNA damage and stress.
Credit: Hannah Gerke/University of Georgia and Michael Eickelmann/Flickr

Colorado State University and the University of Georgia launched graduate student programs in collaboration with Fukushima University's Institute of Environmental Radioactivity to conduct research on the effects of life-long radiation exposures to wildlife. Their most recent results were published online in *Environment International* and appears in the October issue of the journal.

Between 2016 and 2018, the multi-disciplinary team studied wild boar and rat snakes across a range of radiation exposures in Fukushima. The team examined biomarkers of DNA damage and stress and did not find any significant adverse health effects.

Dr. Kelly Cunningham, first author of the paper and a recent graduate of CSU's Doctor of Veterinary Medicine program, said the biggest takeaway is that perhaps people do not need to be as fearful of moving back into the remediated areas—10 years after the accident—following this type of chronic, low-dose environmental radiation exposure.

The wildlife study is relevant to humans because human physiology is not so dissimilar to wild boar, said co-author James Beasley, an associate professor from the University of Georgia's Savannah River Ecology Lab and Warnell School of Forestry and Natural Resources. While mice have traditionally been used as a radiation

biology model from which human effects are extrapolated, pigs—which are descendants of wild boar—are physiologically more like humans than mice and thus a more appropriate biomedical model species, he said.

Researchers respond to local residents' questions

Hiroko Ishiniwa, a co-author and project assistant professor at Fukushima University, said the research helped respond to questions from local residents. In Fukushima, there have been many unfounded rumors about health effects related to radioactivity, she said.

"With hopes of explaining the situation, many local people took part in research activities, including capturing wild boars," she said.

Thomas Hinton, a co-author on the paper and retired professor from Fukushima University, said environmental radiation decreased precipitously after the accident.

By the time this research began in 2016 to 2018, cesium-134, one of the major radionuclides released from the accident, had decreased by as much as 90% because of its short half-life. Hinton received his bachelor's, master's and doctoral degrees from CSU.

What signs of stress did researchers see for wildlife?

CSU Professor Susan Bailey, senior author on the paper, is an expert on assessing markers of stress and DNA damage due to radiation exposure.

She was a principal investigator on the groundbreaking NASA Twins Study, which examined the effects of space on identical twin astronauts Scott and Mark Kelly while one of them remained on Earth during a space mission. Bailey studies telomeres, or the protective "caps" on the ends of human, as well as wildlife, chromosomes.

Bailey said the telomeres of the boar and snakes could provide clues as to whether the animals were stressed from radiation exposures. "If the boar were stressed, we would see telomeres shortening," she explained. "We didn't see any changes related to radiation dose, and we didn't see it in the snakes either."

The researchers thought that with wild boar rooting behavior and snakes living in contaminated soil they would have received large doses of radiation. Hinton said they spent a great deal of time quantifying the dosimetry—how much of the radiation was absorbed by wildlife—as precisely as possible.

The researchers also found lower levels of the hormone cortisol, a primary indicator of stress, in wild boar living within the Exclusion Zone. Bailey said this finding is supported by the fact that animal populations are thriving in areas where humans have not returned.

"It's similar to what they're seeing in Chernobyl," she said. "The animals are flourishing mostly because there aren't people around, and they don't experience the related stress that brings."

Cunningham, now working as a veterinarian in New Zealand, said being able to conduct this research while pursuing a DVM degree at CSU was amazing. "It taught me about this other world of science aside from veterinary medicine," she explained. "I had an opportunity to work with some of the leading radiation scientists from all over the world, and I could contribute with my veterinary skill set."

She said being a member of the research team also helped her develop an interest in public health and epidemiology, which she hopes to explore more as her career progresses.

More information: *Kelly Cunningham et al, Evaluation of DNA damage and stress in wildlife chronically exposed to low-dose, low-dose rate radiation from the Fukushima Dai-ichi Nuclear Power Plant accident, Environment International (2021).* *DOI: 10.1016/j.envint.2021.106675*

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Is Junk DNA What Makes Human Brain Unique?

Researchers have examined what it is in our DNA that makes human and chimpanzee brains different and found that the answer lies in non-coding DNA

In the genome of *Homo sapiens*, about 98% of DNA sequences are non-coding regions that were previously disregarded as 'junk DNA.' In fact, junk DNA contains a variety of regions which precisely control the expression of genes. Now, a team of stem cell researchers at Lund University has examined what it is in our DNA that makes human and chimpanzee brains different and found that the answer lies in non-coding DNA.

"Instead of studying living humans and chimpanzees, we used stem cells grown in a lab," said senior author Professor Johan Jakobsson, a neuroscientist in the Department of Experimental Medical Science at the Wallenberg Neuroscience Center and Lund Stem Cell Center at Lund University.

"The stem cells were reprogrammed from skin cells. Then we examined the stem cells that we had developed into brain cells."

Using the stem cells, Professor Jakobsson and colleagues specifically grew brain cells from humans and chimpanzees and compared the two cell types. They then found that humans and chimpanzees use a part of their DNA in different ways, which appears to play a considerable role in the development of our brains.

"The part of our DNA identified as different was unexpected," Professor Jakobsson said. "It was a so-called structural variant of DNA that were previously called junk DNA, a long repetitive DNA string which has long been deemed to have no function."

"Previously, researchers have looked for answers in the part of the DNA where the protein-producing genes are — which only makes up about 2% of our entire DNA — and examined the proteins themselves to find examples of differences."

"The new findings indicate that the differences appear to lie outside the protein-coding genes." "This suggests that the basis for the human brain's evolution are genetic mechanisms that are probably a lot more complex than previously thought, as it was supposed that the answer was in those two per cent of the genetic DNA."

"Our results indicate that what has been significant for the brain's development is instead perhaps hidden in the overlooked 98%, which appears to be important. This is a surprising finding."

The authors believe that in the future their new results may also contribute to genetically-based answers to questions about psychiatric disorders such as schizophrenia.

"But there is a long way to go before we reach that point, as instead of carrying out further research on the two per cent of coded DNA, we may now be forced to delve deeper into all 100% — a considerably more complicated task for research," Professor Jakobsson said.

The findings appear in the journal *Cell Stem Cell*.

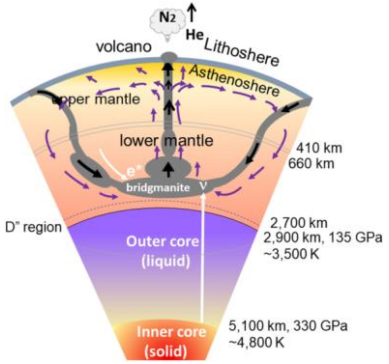
Pia A. Johansson et al. A cis-acting structural variation at the ZNF558 locus controls a gene regulatory network in human brain development. Cell Stem Cell, published online October 7, 2021; doi: 10.1016/j.stem.2021.09.008

https://bit.ly/2Xeqzco

Challenging the big bang puzzle of heavy elements

Are some elements created deep within the Earth's mantle by convection dynamics driven by plate tectonics?

It has long been theorized that hydrogen, helium, and lithium were the only chemical elements in existence during the Big Bang when the universe formed, and that supernova explosions, stars exploding at the end of their lifetime, are responsible for transmuting these elements into heavier ones and distributing them throughout our universe.



Cross-section of the Earth's interior: crust, upper- and lower-mantle, and outer- and inner-cores. **Credit: Mikio Fukuhara, Alexander Yoshino, and Nobuhisa Fujima**

Researchers in Japan and Canada are now challenging a piece of the Big Bang puzzle.

Do all of the elements heavier than iron really originate from stars exploding, or are some created deep within the Earth's mantle, thanks to convection dynamics driven by plate tectonics?

In *AIP Advances*, the group proposes an alternative model for the formation of nitrogen, oxygen, and water based on the history of the Earth's atmosphere.

They postulate that the 25 elements with atomic numbers smaller than iron (26) were created via an endothermic nuclear transmutation of two nuclei, carbon and oxygen.

These nuclei could be confined within the natural aragonite lattice core of the Earth's lower mantle at high temperatures and pressures during lithosphere subduction, which occurs when two tectonic plates converge.

The group describes the endothermic nuclear transformation process as being "aided by the physical catalysis of excited electrons generated by the stick-slipping movement of mineral compounds of geoneutrinos produced deep within the Earth's mantle by nuclear fusion of deuterons or radioactive decay of elements."

"Our study suggests that the Earth itself has been able to create lighter elements by nuclear transmutation," said Mikio Fukuhara, a co-author from Tohoku University's New Industry Creation Hatchery Center in Japan.

If accurate, this is a revolutionary discovery because "it was previously theorized that all of these elements were sourced from supernova explosions, whereas we postulate a supplementary theory," Fukuhara said. This work will have a considerable impact on the field of geophysics and may, as a result, "indicate possible research directions for the potential to create the elements required for future space development," said Fukuhara.

More information: *Mikio Fukuhara et al, Earth factories: Creation of the elements from nuclear transmutation in Earth's lower mantle, AIP Advances (2021). DOI: 10.1063/5.0061584*

https://wb.md/3FTucWN

Synthetic Chemical in Consumer Products Linked to Early Death, Study Says

Daily exposure to phthalates may lead to hundreds of thousands of early deaths each year

Carolyn Crist

Daily exposure to phthalates, which are synthetic chemicals founds in many consumer products, may lead to hundreds of thousands of early deaths each year among older adults in the U.S., according to a new study published Tuesday in the peer-reviewed journal *Environmental Pollution*.

The chemicals are found in hundreds of types of products, including children's toys, food storage containers, makeup, perfume, and shampoo. In the study, those with the highest levels of phthalates had a greater risk of death from any cause, especially heart disease.

"This study adds to the growing database on the impact of plastics on the human body and bolsters public health and business cases for reducing or eliminating the use of plastics," Leonardo Trasande, MD, the lead author and a professor of environmental medicine and population health at NYU Langone Health, told CNN.

Trasande and colleagues measured the urine concentration of phthalates in more than 5,000 adults ages 55-64 and compared the levels to the risk of early death over an average of 10 years. The research team controlled for preexisting heart diseases, diabetes, cancer, poor eating habits, physical activity, body mass, and other known hormone disruptors such as bisphenol A, or BPA, an industrial chemical that's been used since the 1950s to make certain plastics and resins, according to the Mayo Clinic

The research team found that phthalates could contribute to 91,000 to 107,000 premature deaths per year in the U.S. These early deaths could cost the nation $40 billion to $47 billion each year in lost

economic productivity, researchers estimated.

Phthalates interrupt the body's endocrine system and hormone production. Previous studies have found that the chemicals are linked with developmental, reproductive, and immune system problems, according to NYU Langone Health. They've also been linked with asthma, childhood obesity, heart issues, and cancer.

"These chemicals have a rap sheet," Trasande told CNN. "And the fact of the matter is that when you look at the entire body of evidence, it provides a haunting pattern of concern."

Phthalates are often called "everywhere chemicals" because they are so common, CNN reported. Also called "plasticizers," they are added to products to make them more durable, including PVC plumbing, vinyl flooring, medical tubing, garden hoses, food packaging, detergents, clothing, furniture, and automotive materials. People are often exposed when they breathe contaminated air or consume food that comes into contact with the chemical, according to the CDC. Children may be exposed by touching plastic items and putting their hands in their mouth.

Trasande told CNN that it's possible to lessen exposure to phthalates and other endocrine disruptors such as BPA by using unscented lotions, laundry detergents, and cleaning supplies, as well as substituting glass, stainless steel, ceramic, and wood for plastic food storage.

"First, avoid plastics as much as you can. Never put plastic containers in the microwave or dishwasher, where the heat can break down the linings so they might be absorbed more readily," he said. "In addition, cooking at home and reducing your use of processed foods can reduce the levels of the chemical exposures you come in contact with."

Sources

Environmental Pollution: "Phthalates and attributable mortality: A population-based longitudinal cohort study and cost analysis."

CNN: "Synthetic chemical in consumer products linked to early death, study finds."

NYU Langone Health: "Deaths Linked to 'Hormone Disruptor' Chemical Costs Billions in Lost U.S. Productivity."

CDC: "National Biomonitoring Program: Phthalates Factsheet."

https://bit.ly/3lQegwB

Drug trial offers new hope for those with metastatic breast cancer

Scientists are studying whether talazoparib could help treat those with incurable breast cancer

Andrew Gregory Health editor

Scientists have launched a new trial that could offer hope to those with incurable breast cancer.

They are studying whether an existing drug, talazoparib, also known by the brandname Talzenna, may offer a new treatment to people with incurable breast cancer that has spread to the brain.

Secondary breast cancer, also known as metastatic breast cancer, occurs when the cancer has spread from the breast to other parts of the body, where it becomes incurable. Last month, it claimed the life of Girls Aloud singer Sarah Harding.

The new trial, funded by the charity Breast Cancer Now, will see researchers assess whether talazoparib could help those with terminal breast cancer. The drug is a PARP inhibitor, which works by preventing cancer cells from repairing, forcing them to die.

Experts from RCSI University of Medicine and Health Sciences in Dublin will use tumours and breast cancer cells donated by patients to see in the lab whether talazoparib is effective in treating secondary breast cancer in the brain. Further tests will examine the drug in mice, as well as models that mimic the brain's protective system.

"Our previous research has shown that, in many cases, secondary breast cancer tumours in the brain have changes in the way they repair their DNA and we believe this could make them vulnerable to PARP inhibitor drugs like talazoparib," said Prof Leonie Young,

one of the co-leads of the research team.

Natalie Woodford, 57, from Surrey, who was diagnosed with secondary breast cancer in 2017, welcomed the launch of the research. “It’s really encouraging to learn about the new secondary breast cancer research happening,” she said. “I hope that this study will be a success and lead to new treatments for women like me in the future.”

Dr Simon Vincent, director of research, support and influencing at Breast Cancer Now, added: “An estimated 35,000 people in the UK are living with incurable secondary breast cancer, and the fear and uncertainty around when this devastating disease will cut their lives short. “We desperately need to discover new ways to treat this incurable disease, including for those whose breast cancer has spread to the brain and who have very limited treatment options.”

https://bit.ly/3ASCESm

Popular theory of Native American origins debunked by genetics and skeletal biology

Findings likely to have a major impact on understanding how Indigenous Americans' arrived in the Western Hemisphere

by Taylor & Francis

A widely accepted theory of Native American origins coming from Japan has been attacked in a new scientific study, which shows that the genetics and skeletal biology "simply does not match-up".

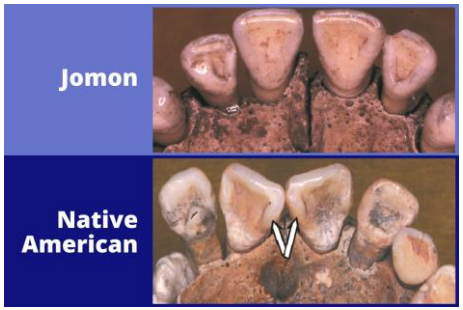
The findings, published today in the peer-reviewed journal *PaleoAmerica*, are likely to have a major impact on how we understand Indigenous Americans' arrival to the Western Hemisphere.

Based on similarities in stone artifacts, many archaeologists currently believe that Indigenous Americans, or 'First Peoples', migrated to the Americas from Japan about 15,000 years ago.

It is thought they moved along the northern rim of the Pacific Ocean, which included the Bering Land Bridge, until they reached the northwest coast of North America.

From there the First Peoples fanned out across the interior parts of the continent and farther south, reaching the southern tip of South America within less than two thousand years.

The theory is based, in part, on similarities in stone tools made by the 'Jomon' people (an early inhabitant of Japan, 15,000 years ago), and those found in some of the earliest known archaeological sites inhabited by ancient First Peoples.



Jomon teeth vs Native American teeth. **Credit: G. Richard Scott, University of Nevada Reno**

But this new study, out today in *PaleoAmerica*—the flagship journal of the Center for the Study of the First Americans at Texas A&M University—suggests otherwise.

Carried out by one of the world's foremost experts in the study of human teeth and a team of Ice-Age human genetics experts, the paper analysed the biology and genetic coding of teeth samples from multiple continents and looked directly at the Jomon people.

"We found that the human biology simply doesn't match up with the archaeological theory," states lead author Professor Richard Scott, a recognized expert in the study of human teeth, who led a team of multidisciplinary researchers.

"We do not dispute the idea that ancient Native Americans arrived via the Northwest Pacific coast—only the theory that they originated with the Jomon people in Japan.

"These people (the Jomon) who lived in Japan 15,000 years ago are an unlikely source for Indigenous Americans. Neither the skeletal biology or the genetics indicate a connection between Japan and the America. The most likely source of the Native American population

appears to be Siberia."

In a career spanning almost half a century, Scott—a professor of anthropology at the University of Nevada-Reno—has traveled across the globe, collecting an enormous body of information on human teeth worldwide, both ancient and modern. He is the author of numerous scientific papers and several books on the subject.

This latest paper applied multivariate statistical techniques to a large sample of teeth from the Americas, Asia, and the Pacific, showing that quantitative comparison of the teeth reveals little relationship between the Jomon people and Native Americans. In fact, only 7% of the teeth samples were linked to the non-Arctic Native Americans (recognized as the First Peoples).

And, the genetics show the same pattern as the teeth—little relationship between the Jomon people and Native Americans.

"This is particularly clear in the distribution of maternal and paternal lineages, which do not overlap between the early Jomon and American populations," states co-author Professor Dennis O'Rourke, who was joined by fellow human geneticists—and expert of the genetics of Indigenous Americans—at the University of Kansas, Jennifer Raff. "Plus, recent studies of ancient DNA from Asia reveal that the two peoples split from a common ancestor at a much earlier time," adds Professor O'Rourke.

Together with their colleague and co-author Justin Tackney, O'Rourke and Raff reported the first analysis of ancient DNA from Ice-Age human remains in Alaska in 2016. Other co-authors include specialists in Ice-Age archaeology and ecology.

Shortly before publication of the paper, two other new studies on related topics were released.

A new genetics paper on the modern Japanese population concluded that it represents three separate migrations into Japan, rather than two, as previously believed. It offered more support to the authors' conclusions, however, about the lack of a biological relationship between the Jomon people and Indigenous Americans.

And, in late September, archaeologists reported in another paper the startling discovery of ancient footprints in New Mexico dating to 23,000 years ago, described as "definitive evidence" of people in North America before the Last Glacial Maximum—before expanding glaciers probably cut off access from the Bering Land Bridge to the Western Hemisphere. It remains unclear who made the footprints and how they are related to living Native Americans, but the new paper provides no evidence that the latter are derived from Japan.

Professor Scott concludes that "the Incipient Jomon population represents one of the least likely sources for Native American peoples of any of the non-African populations."

Limitations of the study include that available samples of both teeth and ancient DNA for the Jomon population are less than 10,000 years old, i.e., do not antedate the early Holocene (when the First Peoples are understood to arrive in America).

"We assume," the authors explain however, "that they are valid proxies for the Incipient Jomon population or the people who made stemmed points in Japan 16,000–15,000 years ago."

PaleoAmerica, www.tandfonline.com/doi/full/1 … 0555563.2021.1940440

https://bit.ly/3AOvOqA

Life on Venus may never have been possible

Venus was always too hot for oceans, a new study suggests.

By Mike Wall

Venus may not be such a tantalizing target for alien hunters after all.

In recent years, researchers have increasingly come to regard Venus, the second rock from the sun, as a potential abode for life. For example, modeling studies have suggested that ancient Venus had big oceans and a clement climate that might have persisted for several billion years.

Venus is famously hellish today, of course; its surface is bone-dry

and hot enough to melt lead. But some scientists have argued that Venus life, if it ever existed, could persist there still, floating in the clouds about 30 miles (50 kilometers) up, where temperatures and pressures are similar to what we enjoy at sea level here on Earth.

A new study throws some cold water onto such hopes, however.

Dueling models of ancient Venus

Like all newborn planets, young Venus was extremely hot — far too toasty for liquid-water oceans. Its available water was pretty much all vaporized, creating sauna conditions on a planetary scale.

The previous, life-friendly modeling work determined that the planet cooled down enough to host liquid surface water thanks in large part to clouds, which bounced a lot of solar radiation back into space. The "faint young sun" was a contributing factor as well; in the early days of the solar system, our star was just 70% as luminous as it is now.

In the new study, which was published online today (Oct. 13) in the journal Nature, scientists led by Martin Turbet, a postdoctoral researcher at the Geneva Astronomical Observatory in Switzerland, simulated the climate of ancient Venus using a new model. And they came up with very different results.

Turbet and his team found that conditions on young Venus likely limited clouds to the planet's nightside, where they were worse than useless as far as the establishment of life is concerned. (Venus isn't tidally locked to the sun, so it doesn't have a permanent nightside; the term here refers to whatever hemisphere happens to be facing away from the sun at the time.)

Not only did these clouds bounce no sunlight away, they actually warmed Venus via a greenhouse effect, trapping lots of heat. So Venus never cooled down enough for rain to fall, and for rivers, lakes and oceans to form.

"If the authors are correct, Venus was always a hellhole," astronomers James Kasting and Chester Harman, of Penn State University and NASA's Ames Research Center, respectively, wrote in an accompanying "News & Views" piece in the same issue of Nature. (Kasting and Harman are not members of the study team.)

More in-depth study of the Venusian surface could provide some clarity on the planet's ancient climate. For instance, Kasting and Harman point to "highly deformed regions" of the planet known as tesserae, which are thought to be similar in composition to continental rocks on Earth.

"On our planet, such rocks form by metamorphic processes (in which minerals change form without melting) that occur in the presence of liquid water," Kasting and Harman wrote. "If the tesserae turn out instead to be basaltic, like normal seafloor on Earth, liquid water would not have been needed to generate them, further supporting Turbet and colleagues' hypothesis."

NASA's newly selected VERITAS (short for "Venus Emissivity, Radio Science, InSAR, Topography and Spectroscopy") mission, which is scheduled to launch in 2028, will study the tesserae from orbit, if all goes according to plan. But it may take a Venus lander to get a firm understanding of these intriguing features, Kasting and Harman wrote.

Implications for Earth and beyond

The new study also found that Earth would likely have taken the Venusian route if the sun had been a bit brighter long ago: A young sun with 92% of the current brightness rather than 70% would probably have consigned our planet to hothouse status, according to the model developed by Turbet and his team.

The results also have implications for worlds that orbit other suns, and for the researchers who aim to understand them, as Kasting and Harman pointed out.

"Exoplanets that orbit near the inner edge of the conventional habitable zone, where liquid water can exist on a planet’s surface, might not actually be habitable," the duo wrote.

https://go.nature.com/3BKSf7M

Electroacupuncture activates neurons to switch off inflammation

Neurons that express a specific molecular marker are activated by 'electroacupuncture' stimulation. They can then mediate the treatment's anti-inflammatory effects in a mouse model of the inflammatory condition sepsis.

Luis Ulloa

Neuronal networks have evolved to control organ functions. A technique called electroacupuncture, in which specific points on the body called acupoints are stimulated electrically, has long been used to activate these networks and thereby modulate the functions of certain organs to treat various disorders. It is a key part of an emerging medical field known as bioelectronic medicine[1,2]. However, little is known about the neuronal networks that mediate the effects of electroacupuncture at specific acupoints[1,3]. Writing in *Nature*, Liu *et al.*[4] show in mice that a set of neurons expressing the protein Prokr2 are needed for electrical stimulation of a hindlimb acupoint to rein in the unbridled inflammatory responses that characterize lethal sepsis.

Acupoints have been selected on the basis of people's responses to stimulation at these sites[1]. However, some acupoints are controversial, because their stimulation can produce different effects depending on the type of stimulation. The leg Zusanli (ST36) acupoint, located about 2 centimetres below the knee in humans, is the most frequently stimulated site for relieving inflammation. However, electroacupuncture stimulation (ES) of ST36 can induce opposing effects depending on the intensity. Whereas high-intensity ES of ST36 activates the sympathetic nervous system, which supports 'fight or flight' responses to stress, low-intensity stimulation activates the parasympathetic nervous system, which regulates physiological functions that occur during rest. Determining the neuronal networks required to activate each system will enable us to design more reliable, specific and effective treatments than are currently available.

Stimulation of ST36 has the potential to suppress severe inflammation in various diseases, including infections and autoimmune disorders. A dramatic example is severe sepsis, a condition in which the body's inflammatory reactions to an infection run out of control, eventually damaging organs and becoming more dangerous than the original infection[5]. Sepsis is a leading cause of death in hospitals, accounting for about 9% of all deaths in the United States[6], despite the use of modern antibiotics to treat initial infections.

Previous work showed that low-intensity ES of ST36 activates a parasympathetic network in which the vagal nerve carries signals from the brain to the adrenal glands, which are located on top of the kidneys, to curb severe inflammation[7]. Liu *et al.* injected mice with a bacterial molecule to provoke an uncontrolled inflammatory reaction, which led to the production of harmful levels of inflammatory factors. The authors showed that activation of the vagal–adrenal network is mediated by Prokr2-expressing neurons at the acupoint. Selectively destroying these neurons prevented low-intensity ST36 ES from dampening the inflammation, but did not alter the ability of high-intensity ST36 ES to activate the sympathetic nervous system. Conversely, artificial activation of Prokr2-expressing neurons mimics the effects of low-intensity ST36 ES, also activating the vagal–adrenal network and controlling inflammation. These results provide, for the first time, a molecular marker of neurons that might be targeted in designing specific methods of stimulation to control discrete organ functions.

The vagal–adrenal network activated by low-intensity ST36 ES was previously found to exert its anti-inflammatory effects by inducing the production of catecholamine molecules by the adrenal glands[7].

Catecholamines control many processes in the healthy body, and are used to treat various disorders, including low blood pressure. The catecholamines dopamine and noradrenaline can restrain the inflammatory response by inhibiting specific immune cells and their release of inflammatory factors; they do this by activating dopaminergic type 1 receptors and β_2-adrenergic receptors on these cells, respectively[7–9].

Liu and colleagues' findings reveal the cellular route by which ST36 ES activates the vagal–adrenal network. The cell bodies of the sensory neurons that express Prokr2 are located in structures called dorsal root ganglia in the lower spinal cord, and have long processes in the sciatic (hindlimb) nerve that innervate the ST36 acupoint. These neurons carry sensory information from the hindlimb up the spinal cord towards the nucleus tractus solitarius (NTS), a structure in the brain that receives sensory information from the body's internal organs. In the NTS, Prokr2-expressing neurons coordinate various physiological functions by activating discrete networks of neurons, such as those in the dorsal motor nuclei, brain regions that contain the cell bodies of neurons that make up the vagus nerve[10].

The distribution of Prokr2-expressing neurons provides crucial information about the nerves that activate this vagal–adrenal network (Fig. 1). The ST36 acupoint is situated at the point at which the sciatic nerve splits into the sural, tibial and peroneal nerves that extend down the calf, and it was not known which of these nerves is most effective for stimulation with acupuncture[7,11]. The location of Prokr2-expressing neurons in the deep tissues below ST36 predicts that the anti-inflammatory effects of low-intensity ST36 ES depend on the deep innervations of the common peroneal nerve, rather than on the more-superficial skin innervations of the cutaneous sural nerves. Indeed, the authors confirmed that cutting the peroneal nerve, but not the tibial or sural nerves, blocks the anti-inflammatory effects of ST36 stimulation.

Similarly, the presence of Prokr2-expressing neurons in other parts of the body might be associated with other acupoints that can activate the vagal–adrenal network. The authors did not observe Prokr2-expressing neurons in the abdominal fascia, a sheet of tissue that wraps around the abdominal organs, and confirmed that stimulation of abdominal acupoints such as the abdominal Tianshu (ST25) does not evoke the adrenal response[12].

By contrast, the enrichment of Prokr2-expressing neurons in the upper regions of the spinal cord that innervate the forelimbs suggested that stimulation of the elbow Shousanli (LI10) acupoint could also evoke catecholamine production, as confirmed by the authors.

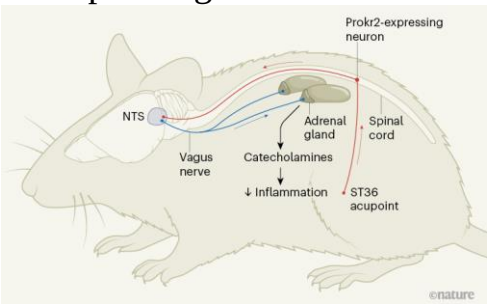


Figure 1 | ***Neuronal targets of electroacupuncture. In a treatment called electroacupuncture, certain sites on the body known as acupoints are stimulated electrically. For example, low-intensity stimulation of a leg acupoint called ST36 can reduce inflammation by activating the vagus nerve, which sends signals from the brain to the adrenal glands (located, as shown, on the kidneys), and promotes the release of anti-inflammatory catecholamine molecules such as dopamine and noradrenaline. Liu et al.[4] used a mouse model of sepsis — a potentially fatal condition in which the inflammatory reaction to an infection gets out of control — to identify a population of sensory neurons that express the protein Prokr2 and that are needed for the anti-inflammatory effects of low-intensity ST36 stimulation, but not high-intensity stimulation (not shown). These neurons have cell bodies in the lower spinal cord, and have processes (red lines) that extend down the hindlimb and up to a brain structure called the nucleus tractus solitarius (NTS), which influences the activity of the vagus nerve.***

These studies have considerable clinical implications because, during electroacupuncture, multiple acupoints are normally stimulated at the same time. Establishing where Prokr2-expressing

neurons are distributed could help to determine which acupoints can be stimulated together to improve treatment efficacy. Further studies are needed to determine whether stimulation of Prokr2-expressing neurons at different acupoints triggers the same responses or induces varying effects on the vagus nerve and its physiological functions.

The vagus is the longest parasympathetic nerve in the body and innervates multiple organs. Its stimulation can trigger various effects, including two anti-inflammatory mechanisms. First, it can induce the release of catecholamines (mostly dopamine and noradrenaline) from the adrenal glands into the bloodstream. Second, it can induce the production of noradrenaline in the spleen to activate immune cells called lymphocytes to produce the molecule acetylcholine, which inhibits another immune cell called a splenic macrophage[13–15]. Future studies should determine whether different acupoints can differentially induce these two mechanisms.

The ability to activate specific neuronal networks to induce desired effects while avoiding adverse side effects would have substantial clinical advantages. Many conventional drug treatments produce nonspecific side effects as the stable drug molecules spread through the body. By contrast, catecholamines have a comparatively short half-life, of about one to four minutes, and thus act more locally — for example, to promote contraction of muscles in the heart, or relaxation of the tubes that carry air to and from of the lungs. Thus, stimulation of specific neuronal networks could drive the production of catecholamines in discrete networks and induce local effects in specific organs, avoiding nonspecific side effects.

If electroacupuncture can selectively activate specific neuronal networks, it might be feasible to design ES treatments to induce local effects, similar to pacemakers (electronic devices implanted into the chest to control the heartbeat). Thus, it might eventually be possible to use ES to evoke local anti-inflammatory mechanisms in certain parts of the body — such as an arthritic knee or specific sections of the digestive tract in individuals with chronic inflammatory bowel disorders — without suppressing the whole immune system, increasing the risk of infection or leading to side effects elsewhere in the body. *doi: https://doi.org/10.1038/d41586-021-02714-0*

References

*1. Ulloa, L., Quiroz-Gonzalez, S. & Torres-Rosas, R. Trends Mol. Med. **23**, 1103–1120 (2017). PubMed Article Google Scholar*
*2. Pavlov, V. A. & Tracey, K. J. Nature Neurosci. **20**, 156–166 (2017). PubMed Article Google Scholar*
*3. Sharma, N. et al. Nature **577**, 392–398 (2020). PubMed Article Google Scholar*
4. Liu, S. et al. Nature https://doi.org/10.1038/s41586-021-04001-4 (2021). Article Google Scholar
*5. van der Poll, T., van de Veerdonk, F. L., Scicluna, B. P. & Netea, M. G. Nature Rev. Immunol. **17**, 407–420 (2017). PubMed Article Google Scholar*
*6. Ulloa, L. & Tracey, K. J. Trends Mol. Med. **11**, 56–63 (2005). PubMed Article Google Scholar*
*7. Torres-Rosas, R. et al. Nature Med. **20**, 291–295 (2014). PubMed Article Google Scholar*
*8. Bassi, G. S. et al. Neurosci. Biobehav. Rev. **112**, 363–373 (2020). PubMed Article Google Scholar*
*9. Vida, G. et al. FASEB J. **25**, 4476–4485 (2011). PubMed Article Google Scholar*
*10. Choi, S. et al. Nature **587**, 258–263 (2020). PubMed Article Google Scholar*
*11. Goldman, N. et al. Nature Neurosci. **13**, 883–888 (2010). PubMed Article Google Scholar*
*12. Liu, S. et al. Neuron **108**, 436–450 (2020). PubMed Article Google Scholar*
*13. Ulloa, L. Nature Rev. Drug Discov. **4**, 673–684 (2005). PubMed Article Google Scholar*
*14. Wang, H. et al. Nature **421**, 384–388 (2003). PubMed Article Google Scholar*
*15. Huston, J. M. et al. J. Exp. Med. **203**, 1623–1628 (2006). PubMed Article Google Scholar*
Download references

Competing Interests *The author declares no competing interests.*

https://bit.ly/3AQVk4Q

Ancient poop shows people in present-day Austria drank beer and ate blue cheese up to 2,700 years ago

Ancient fecal samples show presence of two fungal species used in the production of blue cheese and beer

Human feces don't usually stick around for long—and certainly not for thousands of years. But exceptions to this general rule are found in a few places in the world, including prehistoric salt mines of the Austrian UNESCO World Heritage area Hallstatt-Dachstein/Salzkammergut. Now, researchers who've studied ancient fecal samples (or paleofeces) from these mines have uncovered some surprising evidence: the presence of two fungal species used in the production of blue cheese and beer. The findings appear in the journal *Current Biology* on October 13.

"Genome-wide analysis indicates that both fungi were involved in food fermentation and provide the first molecular evidence for blue cheese and beer consumption during Iron Age Europe," says Frank Maixner of the Eurac Research Institute for Mummy Studies in Bolzano, Italy.

"These results shed substantial new light on the life of the prehistoric salt miners in Hallstatt and allow an understanding of ancient culinary practices in general on a whole new level," adds Kerstin Kowarik of the Museum of Natural History Vienna. "It is becoming increasingly clear that not only were prehistoric culinary practices sophisticated, but also that complex processed foodstuffs as well as the technique of fermentation have held a prominent role in our early food history."

Earlier studies already had shown the potential for studies of prehistoric paleofeces from salt mines to offer important insights into early human diet and health. In the new study, Maixner, Kowarik, and their colleagues added in-depth microscopic, metagenomic, and proteomic analyses—to explore the microbes, DNA, and proteins that were present in those poop samples.

These comprehensive studies allowed them to reconstruct the diet of the people who once lived there. They also could get information about the ancient microbes that inhabited their guts. Gut microbes are collectively known as the gut microbiome and are now recognized to have an important role in human health.

Their dietary survey identified bran and glumes of different cereals as one of the most prevalent plant fragments. They report that this highly fibrous, carbohydrate-rich diet was supplemented with proteins from broad beans and occasionally with fruits, nuts, or animal food products.

In keeping with their plant-heavy diet, the ancient miners up to the Baroque period also had gut microbiome structures more like those of modern non-Westernized individuals, whose diets are also mainly composed of unprocessed food, fresh fruits and vegetables. The findings suggest a more recent shift in the Western gut microbiome as eating habits and lifestyles changed.

When the researchers extended their microbial survey to include fungi, that's when they got their biggest surprise: an abundance in one of their Iron Age samples of *Penicillium roqueforti* and *Saccharomyces cerevisiae* DNA.

"The Hallstatt miners seem to have intentionally applied food fermentation technologies with microorganisms which are still nowadays used in the food industry," Maixner says.

The findings offer the first evidence that people were already producing blue cheese in Iron Age Europe nearly 2,700 years ago, he adds. In ongoing and future studies of the paleofeces from Hallstatt, they hope to learn more about the early production of fermented foods and the interplay between nutrition and the gut microbiome composition in different time periods.

More information: *Current Biology, Maixner et al.: "Paleofeces analyses indicate blue cheese and beer consumption by Iron Age Hallstatt salt miners and a non-Westernized gut microbiome structure in Europe until the Baroque period" www.cell.com/current-biology/f ... 0960-9822(21)01271-9 , DOI: 10.1016/j.cub.2021.09.031*

https://wb.md/3vlJ2QU

Even One Vaccinated Member Can Cut Family's COVID Risk

Chances are reduced even further with each additional vaccinated or otherwise immune family member

Marcia Frellick

The chances that unvaccinated family members will be infected or hospitalized with COVID-19 drop sharply if even one family member is vaccinated. The chances are reduced even further with each additional vaccinated or otherwise immune family member, according to new data.

Lead author Peter Nordström, MD, PhD, with the Unit of Geriatric Medicine, Umeå University, Umeå, Sweden, told *Medscape*

Medical News the message is important for public health: "When you vaccinate, you do not just protect yourself but also your relatives." The findings were published online on October 11 in *JAMA Internal Medicine.*

Researchers analyzed data from 1,789,728 individuals from 814,806 families from nationwide registries in Sweden. All individuals had acquired immunity either from previously being infected with SARS-CoV-2 or by being fullly vaccinated (ie, having received two doses of the Moderna, Pfizer, or Oxford/AstraZeneca vaccines). Persons were considered for inclusion until May 26, 2021.

Each person with immunity was matched in a 1:1 ratio to a person without immunity from a cohort of individuals with families that had from two to five members. Families with more than five members were excluded because of small sample sizes. Primarily nonimmune families in which there was one immune family member had a 45% to 61% lower risk of contracting COVID-19 (hazard ratio [HR], 0.39 – 0.55; 95% CI, 0.37 – 0.61; $P < .001$).

The risk reduction increased to 75% to 86% when two family members were immune (HR, 0.14 – 0.25; 95% CI, 0.11 – 0.27; $P < .001$). It increased to 91% to 94% when three family members were immune (HR, 0.06 – 0.09; 95% CI, 0.04 – 0.10; $P < .001$) and to 97% with four immune family members (HR, 0.03; 95% CI, 0.02 – 0.05; $P < .001$).

"The results were similar for the outcome of COVID-19 infection that was severe enough to warrant a hospital stay," the authors write. They list as an example that in three-member families in which two members were immune, the remaining nonimmune family member had an 80% lower risk for hospitalization (HR, 0.20; 95% CI, 0.10 – 0.43; $P < .001$).

Global Implications

Nordström said the team used the family setting because it was more easily identifiable as a cohort with the national registries and because COVID-19 is spread among people in close contact with each other. The findings have implications for other groups that spend large amounts of time together and for herd immunity, he said.

The findings may be particularly welcome in regions of the world where vaccination rates are very low. The authors note that most of the global population has not yet been vaccinated and that "it is anticipated that most of the population in low-income countries will be unable to receive a vaccine in 2021, with current vaccination rates suggesting that completely inoculating 70% to 85% of the global population may take up to 5 years."

Jill Foster, MD, a pediatric infectious disease specialist at the University of Minnesota Medical School, Minneapolis, Minnesota, told *Medscape Medical News* she agrees that the news could encourage countries that have very low vaccination rates.

This study may help motivate areas with few resources to start small, she said: "Even one is better than zero."

She added that this news could also help ease the minds of families that have immunocompromised members or in which there are children who are too young to be vaccinated.

With these data, she said, people can see there's something they can do to help protect a family member.

Foster said that although it's intuitive to think that the more vaccinated people there are in a family, the safer people are, "it's really nice to see the data coming out of such a large dataset."

The authors acknowledge that a limitation of the study is that at the time the study was conducted, the Delta variant was uncommon in Sweden. It is therefore unclear whether the findings regarding immunity are still relevant in Sweden and elsewhere now that the Delta strain is dominant.

The authors report no relevant financial relationships. Foster has received grant support

from Moderna.

JAMA Intern Med. Published online October 11, 2021. Full text

https://bit.ly/2XkdkH8

Scientists Use Photosynthesis to Power an Animal's Brain

Injecting oxygen-generating algae into tadpoles allows brain activity to continue in the absence of oxygen, researchers find.

Abby Olena

Unlike plants, animals can't carry out photosynthesis to generate our own oxygen, yet our brains rely on oxygen to make the massive amounts of energy needed to function. In a study published today (October 13) in *iScience*, researchers found a way to harness photosynthesis to supply neurons with oxygen: they injected either cyanobacteria or green algae into *Xenopus laevis* tadpoles and deprived the animals of oxygen, causing brain activity to cease. Exposing the animals to light, which allowed the microbes to make oxygen from CO_2, restored neural activity.

"The authors employ an elegant and easily reproducible experimental approach to examine the effects of activation of photosynthetic organisms as a way to directly increase oxygen levels in the brain," Diana Martinez, a neuroscientist at Rowan University in New Jersey who was not involved in the study, writes in an email to *The Scientist.* The work is a proof of principle, she adds, and "an important first step in using natural resources to address pathological impairments" that deplete oxygen in the brain, such as heart attack and stroke.

Neuroscientist Hans Straka of Ludwig Maximilian University of Munich (LMU) and his group are interested in oxygen consumption in the brain and use a well-established technique in which they remove the head of a tadpole and keep it alive and functional for a couple of days in a liquid environment that supplies both oxygen and nutrients. Over lunch, Straka and LMU plant biologist Jörg Nickelsen got to talking about how they might work together on a project. Their solution: investigate whether it would be possible to have photosynthetic microorganisms supply the brain with oxygen.

Nickelsen's then-postdoc Myra Chávez Rosas, who is now at the University of Bern in Switzerland, grew green algae (*Chlamydomonas reinhardtii*) and cyanobacteria (*Synechocystis* sp. PCC6803), which both produce oxygen upon illumination. Graduate student Suzan Özugur, who has since graduated from Straka's lab, then injected a slurry of either algae or cyanobacteria into the hearts of tadpoles just after their forelimbs emerged. Their hearts pumped the microbes throughout the animals' vessels, including into the vasculature of the brain.

The team found that upon illumination, oxygen concentration in the ventricles of injected animals went up. Untreated animals or those that received strains of algae or cyanobacteria that were mutated to not produce oxygen did not have an increase in oxygen concentration. When the researchers depleted oxygen from the water the animals swam in, neuronal activity, as measured by electrical recordings of representative nerves, stopped. But they were able to restart activity in the brain by shining light on animals who'd received injections of microorganisms. When they turned off the light, neuronal activity ceased again.

Although the experiment was a success, Martinez notes it's not clear whether the findings could be translated to treat conditions in which the brain is starved for oxygen. "The first issue is that *Xenopus laevis* tadpoles are transparent and light can easily pass through the skin to activate photosynthetic machinery to produce oxygen. Use in more complex animals would . . . be difficult, as light does not easily traverse the skin and may not reach the vasculature to activate the photosynthetic organisms," she writes. Additionally, while low oxygen can be a problem, excess oxygen can also exacerbate brain injuries. "Thus, the inability of oxygen

levels to be controlled properly through the use of these photosynthetic organisms would therefore be just as detrimental as the hypoxia itself." Trying the technique in brain organoids and slices first would give more insight into its physiological effects, she adds.

Straka acknowledges that the research is still at the early stages and that taking the strategy to the clinic is "very far away." In the near term, his team will focus on several questions, including the immunological effects of introducing the photosynthesizing microorganisms, and whether or not the sugars that the microbes produce can be used by the tadpoles' brains.

"Over the last decade, there are quite a few projects where people have been trying to set up artificial symbiotic associations with algae, in order to augment in some way or manipulate vertebrate physiology, which is really radical," says Ryan Kerney, a biologist who studies symbioses between algae and salamanders at Gettysburg College in Pennsylvania and did not participate in the new work. Approaches where microbes are artificially inserted into cells or into tissues to modify their function are largely unregulated and under-scrutinized in comparison to widely used genetic modification techniques such as CRISPR that target one gene, Kerney adds. The unknowns, as well as examples of pathogenic algae, make this strategy a bit risky, he notes. "But the potential implications are also just fascinating to speculate about: Can we get away from breathing as a way to keep our brains going?"

https://bit.ly/3jcdacu

Scientists Warn: Sunscreen That Includes Zinc Oxide Loses Effectiveness and Becomes Toxic After 2 Hours

Sunscreen that includes ZnO loses much effectiveness and becomes toxic after two hours of exposure to UV radiation

Sunscreen that includes zinc oxide, a common ingredient, loses much of its effectiveness and becomes toxic after two hours of exposure to ultraviolet radiation, according to a collaboration that included Oregon State University scientists.

The toxicity analysis involved zebrafish, which share a remarkable similarity to humans at the molecular, genetic and cellular levels, meaning many zebrafish studies are immediately relevant to people. Findings to be published tomorrow (October 14, 2021) in *Photochemical & Photobiological Sciences.*

The research team, which included College of Agriculture Sciences faculty Robyn Tanguay and Lisa Truong and graduate fellow Claudia Santillan, sought to answer important but largely neglected questions regarding the massive global sunscreen market, predicted by market data firm Statista to be worth more than $24 billion by the end of the decade.

The questions: How stable, safe, and effective are sunscreen ingredients in combination rather than as individual compounds – which is how they are considered for Food and Drug Administration approval – and what about the safety of any chemical products that result from reactions caused by exposure to sunlight?

"Sunscreens are important consumer products that help to reduce UV exposures and thus skin cancer, but we do not know if the use of some sunscreen formulations may have unintended toxicity because of interactions between some ingredients and UV light," said Tanguay, an OSU distinguished professor and an international expert in toxicology.

What the public thinks about sunscreen safety has caused manufacturers, often based on limited data, to use lots of some ingredients while limiting others, she said. For example, oxybenzone has effectively been discontinued because of concerns that it harms coral reefs.

"And sunscreens containing inorganic compounds like zinc oxide or titanium dioxide, that block UV rays, are being marketed more

and more heavily as safe alternatives to the organic small-molecule compounds that absorb the rays," Tanguay said.

Scientists including the University of Oregon's James Hutchinson and Aurora Ginzburg and the University of Leeds' Richard Blackburn made five mixtures containing the UV filters – the active ingredients in sunscreens – from different products available in the United States and Europe. They also made additional mixtures with the same ingredients, plus zinc oxide at the lower end of the commercially recommended amount.

The researchers then exposed the mixtures to ultraviolet radiation for two hours and used spectroscopy to check their photostability – i.e., what did sunlight do to the compounds in the mixtures and their UV-protective capabilities?

The scientists also looked at whether the UV radiation had caused any of the mixtures to become toxic to zebrafish, a widely used model organism that goes from egg to swimming in five days, and found that the UV-exposed mixture without zinc oxide did not cause any significant changes in the fish.

"There have been several studies that showed sunscreens can quickly react under UV exposure – the specifically intended setting for their use – so it's pretty surprising how little toxicity testing has been done on the photodegradation products," Truong said. "Our findings suggest that commercially available small-molecule-based formulas, which were the basis for the formulas we studied, can be combined in different ingredient ratios that minimize photodegradation."

But scientists saw big differences in photostability and phototoxicity when zinc oxide particles were added – either nanoparticles or the larger microparticles.

"With either size of particle, zinc oxide degraded the organic mixture and caused a greater than 80% loss in organic filter protection against ultraviolet-A rays, which make up 95% of the UV radiation that reaches the Earth," Santillan said. "Also, the zinc-oxide-induced photodegradation products caused significant increases in defects to the zebrafish we used to test toxicity. That suggests zinc oxide particles are leading to degradants whose introduction to aquatic ecosystems is environmentally hazardous."

Tanguay said she was surprised that all five small-molecule mixtures were generally photostable but not surprised that adding zinc oxide particles led to toxicity upon UV irradiation.

"As a team at Oregon State that specializes in studying nanoparticle toxicity, these results were not a shock," she said. "The findings would surprise many consumers who are misled by 'nano free' labels on mineral-based sunscreens that imply the sunscreens are safe just because they don't contain those smaller particles. Any size of metal oxide particle can have reactive surface sites, whether it is less than 100 nanometers or not. More important than size is the metal identity, its crystal structure and any surface coatings."

Reference: "Zinc oxide-induced changes to sunscreen ingredient efficacy and toxicity under UV irradiation" by Aurora L. Ginzburg, Richard S. Blackburn, Claudia Santillan, Lisa Truong, Robyn L. Tanguay and James E. Hutchison, 14 October 2021, Photochemical & Photobiological Sciences. DOI: 10.1007/s43630-021-00101-2

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https://bit.ly/3n3w9ar

We Accidentally Solved the Flu. Now What?

America has a choice to make.

By Jacob Stern

Perhaps the oddest consolation prize of America's crushing, protracted battle with the coronavirus is the knowledge that flu season, as we've long known it, does not have to exist.

It's easy to think of the flu as an immutable fact of winter life, more inconvenience than calamity. But each year, on average, it sickens roughly 30 million Americans and kills more than 30,000 (though the numbers vary widely season to season). The elderly, the poor,

and people of color are all overrepresented among the casualties. By some estimates, the disease's annual economic cost amounts to nearly $90 billion. We accept this, when we think about it at all, as the way things are.

Except that this past year, things were different: During the 2020–21 flu season, the United States recorded only about 2,000 cases, *17,000* times fewer than the 35 million it recorded the season before. That season, the flu killed 199 children; this past season, as far as we know, it killed one.

"We've looked for flu in communities and doctors' offices and hospitals, and we've gotten almost zero," says Emily Martin, a University of Michigan epidemiologist who's part of the CDC's flu-monitoring network. The same was true of other seasonal respiratory viruses last winter, says Saskia Popescu, an epidemiologist at George Mason University in Virginia, though some have since rebounded. RSV, parainfluenza, rhinovirus, adenovirus—for a while, they all but vanished.

For this, perversely, we can thank the pandemic. The coronavirus itself may have played some role—infection could produce a general immune response that would also confer protection against the flu—but most of the epidemiologists I spoke with instead emphasized the importance of the behavioral changes adopted to slow the spread of the coronavirus: masking, distancing, remote learning, working from home, limiting indoor social gatherings. Despite the inconsistency with which America deployed them, these measures helped tamp down the spread of the virus, but they completely crushed influenza, a less transmissible foe to which the population has considerable preexisting immunity. We set out to flatten the curve, and we ended up stamping out the flu.

This was one of the few blessings in an otherwise abysmal winter, in which COVID cases and deaths surged to their highest levels ever in the U.S. At least we didn't face the dreaded "twindemic."

But our triumph over the flu also poses a dilemma, as much ethical as epidemiological. We've demonstrated conclusively that saving nearly everyone who dies of the flu is within our power. To do nothing now—to return to the roughly 30,000-deaths-a-year status quo without even trying to save some of those lives—would seem irresponsible. So what *do* we do? Which measures do we maintain and which do we let go?

One thing we're *not* going to do is go into lockdown every year (or even go into what passed for lockdown in the United States, which in reality was not). This, the public-health experts I spoke with for this story all agreed, would be neither feasible nor desirable. Broad restrictions on travel and large indoor gatherings, they said, also seem like nonstarters (though Seema Lakdawala, a flu-transmission expert at the University of Pittsburgh, suggested that companies might consider rescheduling their annual holiday party for the summer and moving it outdoors). Even more moderate capacity limitations, though beneficial from a health perspective, Popescu told me, are "tricky for business."

Still, perhaps other, targeted versions of the restrictions deployed during the pandemic could work. Linsey Marr, an environmental engineer at Virginia Tech, proposed a sort of "circuit breaker" system, in which schools and workplaces could go remote for a week or two to slow flu transmission during severe local outbreaks. Before shutdowns kick in, people could keep a close eye on flu cases in their area—just as many have monitored COVID numbers over the past two years—and make their own personal risk assessments. For one person, Lakdawala imagines, that might mean being more efficient in a crowded grocery store; for another, masking at a movie theater. (That said, people tend to be less than perfect at gauging the danger of different situations.)

Masks, in theory, are one of the simplest pandemic-times interventions to hold on to. They are "the low-hanging fruit," says

the Emory University immunologist Anice Lowen, because, unlike shutdowns or restrictions on indoor gatherings, they don't disrupt our daily routines. In an ideal world, several epidemiologists told me, people would mask in crowded indoor spaces during flu season—if not all the time, then at least when case counts are on the rise. If that became the norm, Marr told me, "we would see huge reductions in colds and flus. No question."

Ours, of course, is not an ideal world, and masking is unlikely to become an uncontroversial American norm anytime soon. Demand too much, warns Angela Rasmussen, a virologist at the Vaccine and Infectious Disease Organization, in Saskatchewan, Canada, and you risk inciting backlash. Even if health officials ask people to mask only during local surges, she worries, "you're going to have a lot of people who are like, 'Well, we saw this coming. First you mandated masks for COVID; now you're mandating masks all the time. It's all about control! What about my freedom?'"

At the very least, both Marr and Rasmussen would like to see the CDC recommend that people wear masks when symptomatic and provide information about how masking in crowded indoor spaces can lower the risk of infection. For now, the CDC isn't prepared to endorse any new antiflu interventions. David Wentworth, the virology, surveillance, and diagnosis chief within the agency's influenza division, agrees that pandemic precautions played a major role in reducing flu transmission over the past year. But he told me that the agency needs to see more data on which measures were most effective before it officially recommends any of them. "It sounds like we're doing nothing, but really we want to understand what factors have the big impact before you start making those kinds of recommendations," he said. "It's not that we don't care about the tens of thousands of people who are impacted by flu."

The agency's most up-to-date information on masks and the flu is labeled "Interim Guidance" … as it has been since it was published in 2004. It stresses, as several of the experts I spoke with did, that no one intervention can provide total protection, and it even mentions social distancing and school closures as possible "community measures." But outside of a health-care setting, it recommends masks only for people who either are diagnosed with the flu by a doctor or have a fever and respiratory symptoms during a known local outbreak—and even then, it stops short of an actual prescription. Those people should try to stay home, it says, but if they can't, "consideration should be given" to masking in public spaces.

Like everyone else I spoke with, Wentworth strongly recommended flu shots, which he called "the most important tool" at our disposal for fighting influenza. And while most years' flu shots are considerably less effective than the best-performing COVID vaccines, several of the experts I spoke with said that not-so-far-off advances in immunization technology could narrow the gap before long.

Certainly, methods for knocking out the flu need not be limited to successful pandemic interventions. Many experts advocated for changes they said were long overdue even before the pandemic began, chief among them paid sick leave, which every wealthy country in the world except the U.S guarantees. As a result, nearly a quarter of the American labor force must report to work when ill. Among the bottom quartile of earners, that proportion is more than half. And while many employers have introduced more accommodating policies during the pandemic, there's no guarantee they'll outlast it. In schools, perfect-attendance awards encourage a similar dynamic, even if well intentioned, says Sarah Cobey, an evolutionary biologist at the University of Chicago.

Giving workers and students the ability to stay home when sick would go a long way toward reducing the flu's spread. But policy changes alone won't unravel the problem overnight. "There's a real

culture … that if you're not on your deathbed or you're not going to the hospital, that you're fine to go to work," Rasmussen told me. "If you're sick, you should stay home. It seems like a no-brainer, but people are actually really resistant to that."

Whether because of that culture or because they don't realize they're contagious, some sick people will still come in to work. That, experts told me, is where overhauled ventilation can help us. For all the advances we've made in preventing diseases transmitted via water or insects, my colleague Sarah Zhang has written, we have overlooked air. Until the advent of sewer systems and water treatment, Marr said, people accepted deadly waterborne diseases as a basic fact of life. These days, the idea of drinking dirty water strikes most as repulsive, even as we resign ourselves to breathing filthy air and contracting seasonal respiratory viruses. But now, Marr said, "we've seen we don't have to live that way." By better ventilating our buildings—which to this point have largely been optimized for energy efficiency, not air quality—she said, we could do for air what we have done for water.

That is at least a little ways off, though. To fight the flu *right now*, flu shots and nonpharmaceutical interventions are all we've got. If we're going to save people, that's how. We're unlikely to consistently replicate the nonexistent flu season we just had, but the experts I spoke with said that even the more modest precautions could reduce mortality by 25, 50, even 75 percent, which translates to tens of thousands of lives saved. Those figures, they stressed, are highly speculative. So far, the 2021–22 season is off to a good start, though some experts worry that the flu will be back with a vengeance before long.

Whatever happens, there can be no more illusions of inevitability. The flu, it turns out, has always been a choice. Now we have the opportunity to do something about it—and the burden of knowing we can.

https://bit.ly/3jcj4KM

Meteorite crash-lands in woman's bed in Canada

She awoke to find the space rock next to her head.

By Mindy Weisberger

A woman in Canada narrowly missed being struck by a meteorite that crashed through her roof and landed on her pillow. Ruth Hamilton, a resident of Golden, British Columbia, was asleep in her bed on the night of Oct. 3 when she was jolted awake by an explosive bang, as something plummeted through the roof and showered her with debris, Hamilton told Victoria News on Oct. 8.

She jumped out of bed and turned on the light, discovering a rock lying nestled between her pillows, right next to the spot where her head had been moments earlier. The object was about the size of a fist and weighed about 2.8 pounds (1.3 kilograms), The New York Times reported on Thursday (Oct. 14).

Hamilton promptly called 911; a police officer arrived on the scene and investigated the debris, then checked with a local construction company to see if they had set off any explosions at a highway site in the nearby Kicking Horse Canyon, Victoria News reported.

A construction company representative said that no blasting had occurred that night, but they mentioned seeing "a bright light in the sky that had exploded and caused some booms," Hamilton told Victoria News. Hamilton then realized that the object on her pillow — a greyish, melon-size boulder — was likely a rock from space, according to the Canadian Broadcasting Company (CBC).

Each year, thousands of fast-moving space rocks survive their fiery passage through Earth's atmosphere to strike the planet's surface as meteorites, though most of these cosmic projectiles go unnoticed and undiscovered, according to Live Science's sister site Space.com. And very few people in recorded history are as close to a meteorite

at the moment of impact as Hamilton was.

One famous example is Ann Hodges of Sylacauga, Alabama, who was struck by a falling meteorite on Nov. 30, 1954. Like Hamilton, Hodges was also asleep in her home when the meteorite came calling. But whereas Hamilton escaped her event unscathed, Hodges wasn't so lucky. Hodges' meteorite was about the size of a softball and weighed about 8.5 pounds (3.8 kg), and it struck her after rebounding off a radio console, causing a sizable bruise on her side, Space.com reported in 2019.

Though Hamilton was uninjured by her close call, the experience still left her shaken, she told the CBC.

"You're sound asleep, safe, you think, in your bed, and you can get taken out by a meteorite, apparently," Hamilton said. She plans to send the meteorite to scientists in the Department of Physics and Astronomy at Western University in London, Ontario, for analysis, but she would like to keep the rock once the researchers' investigation is done, the CBC reported.

https://bit.ly/3BVkfWq

Gulf Stream and Kuroshio Current found to be synchronized on decadal time scale

Both heavily influence weather conditions in the northern hemisphere

by Bob Yirka , Phys.org

A team of researchers with members affiliated with a large number of institutions across Japan has found that the Gulf stream and Kuroshio are synchronized on a decadal time scale. In their paper published in the journal *Science*, the group describes their study of decades of weather satellite data and the link between the two ocean currents. Paola Cessi, with the Scripps Institution of Oceanography at the University of California, has published a Perspective piece on the work done by the team in Japan in the same journal issue.

The Gulf Stream is an ocean current that begins in the Gulf of Mexico and extends past the southern tip of Florida. It then follows the eastern U.S coastline before colliding with currents in the North Atlantic Ocean.

Kuroshio is a similar type of current that flows from south of Japan in the East China Sea until it collides with Oyashio, a more northerly current. Prior research has shown that both heavily influence weather conditions in the northern hemisphere; for example, large storms typically arise at the points where they meet colder currents. In this new effort, the researchers have found that the two currents are synchronized over a decadal time scale.

To learn more about a possible connection between the two currents, the researchers collected and studied a massive amount of weather data and created models to show how the two systems might impact one another.

They found that the westerly jets carried energy from the two currents all the way around the globe. As heat from Kuroshio was carried into the atmosphere, for example, where it met Oyashio, storms were generated that moved from west to east—all the way across the northern parts of the Pacific Ocean. The Jet Stream then carried that energy across the continental U.S. and all the way to the Atlantic.

There, it collided with heat carried into the atmosphere by the Gulf stream as it collided with the Labrador Current. The vast distances involved meant it took a long time for energy from one of the currents to have an impact on the other. But the end result was some degree of synchronization of the two currents, a finding that could improve weather forecasting in the northern hemisphere in the future.

More information: *Tsubasa Kohyama et al, The Gulf Stream and Kuroshio Current are synchronized, Science (2021).* *DOI: 10.1126/science.abh3295*

Paola Cessi, Gulf Stream and Kuroshio synchronization, Science (2021). *DOI: 10.1126/science.abl9133*

https://wb.md/3n637Hc

Lumbar Epidural Steroid Jab Lowers Bone Formation in Older Women

Levels of bone formation biomarkers decreased among postmenopausal women who received an epidural steroid injection in the lumbar spine to treat back and leg pain

Marlene Busko

Among postmenopausal women who received an epidural steroid injection (ESI) in the lumbar spine to treat back and leg pain arising from a compressed nerve in the spine, levels of bone formation biomarkers were decreased. The decrease in levels persisted more than 12 weeks, results from a new study show.

In addition, serum cortisol levels decreased by 50% at week 1 after the ESI, indicating systemic absorption of the steroid.

"The extent and duration of these effects suggest that patients who receive multiple [ESIs in the lumbar spine] may be at particular risk for harmful skeletal consequences," Shannon Clare reported in an oral presentation at the American Society of Bone and Mineral Research (ASBMR 2021) Annual Meeting.

Further studies are needed of the relationship between these short-term changes in bone turnover and bone loss and the risk for fracture among the burgeoning population treated with ESIs, added Clare, of the Hospital for Special Surgery, New York City.

The researchers examined changes in serum levels of bone formation and resorption markers and other analytes in 24 women who received a lumbar ESI for radicular back pain and in eight other women from the hospital population who served as control persons.

Among the women who received ESI, 1 week after the injection, serum levels of two bone formation biomarkers — total procollagen type 1 N-terminal propeptide (P1NP) and osteocalcin — were about 27% lower than at baseline. The suppression persisted beyond 12 weeks. Serum levels of the bone resorption biomarker C-terminal telopeptide of type I collagen (CTX) did not differ significantly after ESI.

"Our results are notable because we found that the duration of suppression of bone formation extended beyond 12 weeks, a far longer duration than seen previously with intra-articular injections" of glucocorticoids, said Clare and senior author Emily M. Stein, MD, director of research for the Metabolic Bone Service and an endocrinologist at the Hospital for Special Surgery and is associate professor of medicine at Weill Cornell Medical College, New York City.

The findings suggest that patients should not receive multiple doses within a 12-week period, they told *Medscape Medical News* in a joint email response. Women are not typically screened for osteopenia or osteoporosis before ESI, they continued. However, "our results suggest that physicians should consider screening women for osteoporosis who receive ESI, particularly those who are treated with multiple doses," said Clare and Stein. "Steroid exposure should be minimized as much as possible by having patients space injections as far as they can tolerate."

Systemic Absorption, Negative Impact on Bone Turnover Markers

"The hypothesis that [ESIs] interfere with the vertebral osseous microenvironment and increase the risk of vertebral fractures has been supported with evidence in the literature," Mohamad Bydon, MD, professor of neurosurgery, orthopedic surgery, and health services research at the Mayo Clinic, Rochester, Minnesota, told *Medscape Medical News* in an email.

Prior studies have demonstrated a decrease in bone mineral density (BMD) and an increase in vertebral fractures following ESI, added Bydon, senior author of a 2018 review of the effect of ESI on BMD and vertebral fracture risk that was published in *Pain Medicine.* He

was not involved with the current study.

"The article by Clare et al. provides evidence on the systemic absorption of glucocorticoids by demonstrating a drop in serum cortisol following ESI," he noted. "The measurement of bone metabolism biomarkers offers molecular confirmation of clinical and radiological observations of previous studies" showing that ESI affects the vertebrae.

More Than Nine Million ESIs Each Year

Each year, more than nine million ESIs are administered to patients in the United States to relieve radicular back and leg pain that may be caused by a herniated disc or spinal stenosis (a gradual narrowing of the open spaces in the spinal column, which is common in older adults), the researchers explained.

Some patients experience sufficient pain relief with ESIs. Others may not be eligible for surgery and may receive multiple ESIs annually for many years because they provide pain relief.

It is well established that oral and intravenous glucocorticoids profoundly suppress bone formation and transiently increase bone resorption, causing substantial bone loss and increased fracture risk within 3 months of administration, Clare explained in the session.

Long-term use of high-dose inhaled glucocorticoids has been associated with bone loss and fractures. However, the effect of ESIs on bone has been less well studied.

The researchers hypothesized that ESIs are systemically absorbed and cause suppression of bone formation without a compensatory decrease in bone resorption.

They enrolled 24 patients who had undergone lumbar ESIs and eight control patients. The mean age of the patients in the two groups was 63 years and 68 years, respectively. Most patients were White (88% and 100%, respectively). The mean body mass index was 27 kg/m^2 and 28 kg/m^2, respectively. On average, the patients had entered menopause 12 and 16 years earlier, respectively.

In the group that received steroid injections, almost two thirds (15 patients, 63%) received triamcinolone. The rest received dexamethasone (six patients, 25%) or betamethasone (three patients, 12%) at doses that were equivalent to 80 mg triamcinolone.

The patients' baseline serum levels of 25-hydroxy vitamin D, parathyroid hormone, cortisol, P1NP, osteocalcin, and CTX were within the reference ranges and were similar in the two groups.

The researchers also determined serum levels of cortisol (to assess suppression of endogenous glucocorticoids), osteocalcin, P1NP, and CTX in the patients and control persons at 1, 4, 12, 26, and 52 weeks after patients had received the ESI.

The researchers acknowledge that the small sample is a study limitation. In addition, the first serum samples were taken 1 week after the injection, and so any earlier changes in analyte levels were not captured. The patients also received different types of steroids, although the doses were similar when converted to triamcinolone equivalents.

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https://wb.md/3n2leOq

Gut Bacteria May Fuel Prostate Cancer Treatment Resistance

Gut bacteria start producing androgens that seem to support the growth of prostate cancer and its resistance to treatment

Emily Willingham

A mainstay of treatment for prostate cancer is to deprive it of androgens, the hormones that make it grow. The testes are the main source of these hormones, so treatment can consist of either surgical removal of these organs or use of drugs to block their hormone production.

Over time, some prostate cancers become resistant to these

treatments and begin to expand again. As with many cancers that show these behaviors, finding exactly what makes them resistant can be tricky.

A culprit may be bacteria that live in the gut. Researchers found that in castrated mice and in people having androgen deprivation therapy, some of these gut bacteria start producing androgens that are easily taken into the bloodstream. According to these new findings, published in the journal *Science* , the androgens seem to support the growth of prostate cancer and its resistance to treatment. This study is the first to show that bacteria can produce testosterone, although the investigators are not yet sure what triggers them to start doing that. Androgen deprivation treatment may also lead to more of these hormone-producing microbes in the gut, the results suggest. Fecal bacterial of people with treatment-resistant prostate cancer also showed a link to lower life expectancy.

Fecal transplants from mice with treatment-resistant prostate cancer could trigger resistance in animals with disease susceptible to these hormones. When these mice received fecal transplants from humans with resistant cancer, the effect was the same: a shift to treatment resistance.

But the converse also was true: Fecal transplants from mice or humans with hormone-susceptible cancer contributed to limiting tumor growth.

The findings may suggest new therapeutic targets: the microbes living in the gut. In mouse studies, the researchers found that when they wiped out these bacteria, the cancer was much slower to progress to treatment resistance. Authors of a commentary accompanying the study say there are other places to look for bacteria that might be making these hormones, too, including the urinary tract or even in the tumor itself.

Sources *Science: "Commensal bacteria promote endocrine resistance in prostate cancer through androgen biosynthesis," "Gut bacteria enable prostate cancer growth."*