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Mystery solved behind birth of Saturn's rings

A team of researchers has presented a new model for the origin of Saturn's rings based on results of computer simulations.

The results of the simulations are also applicable to rings of other giant planets and explain the compositional differences between the rings of Saturn and Uranus. The findings were published on October 6 in the online version of Icarus.

Figure 1: (left) Image of Saturn's rings taken by the Cassini spacecraft. Provided by NASA http://photojournal.jpl.nasa.gov/catalog/PIA06077). (right) Image of Uranus' rings taken by the Hubble Space Telescope. Provided by NASA. (http://photojournal.jpl.nasa.gov/catalog/PIA02963). **NASA**

The lead author of the paper is HYODO Ryuki (Kobe University, Graduate School of Science), and co-authors are Professor Sébastien Charnoz (Institute de Physique du Globe/Université Paris Diderot), Professor OHTSUKI Keiji (Kobe University, Graduate School of Science), and Project Associate Professor GENDA Hidenori (Earth-Life Science Institute, Tokyo Institute of Technology).

The giant planets in our solar system have very diverse rings. Observations show that Saturn's rings are made of more than 95% icy particles, while the rings of Uranus and Neptune are darker and may have higher rock content. Since the rings of Saturn were first observed in the 17th century, investigation of the rings has expanded from earth-based telescopes to spacecraft such as Voyagers and Cassini. However, the origin of the rings was still unclear and the mechanisms that lead to the diverse ring systems were unknown.

The present study focused on the period called the Late Heavy Bombardment that is believed to have occurred 4 billion years ago in our solar system, when the giant planets underwent orbital migration. It is thought that several thousand Pluto-sized (one fifth of Earth's size) objects from the Kuiper belt existed in the outer solar system beyond Neptune. First the researchers calculated the probability that these large objects passed close enough to the giant planets to be destroyed by their tidal force during the Late Heavy Bombardment. Results showed that Saturn, Uranus and Neptune experienced close encounters with these large celestial objects multiple times.

Next the group used computer simulations to investigate disruption of these Kuiper belt objects by tidal force when they passed the vicinity of the giant planets (see Figure 2a). The results of the simulations varied depending on the initial conditions, such as the rotation of the passing objects and their minimum approach distance to the planet. However they discovered that in many cases fragments comprising 0.1-10% of the initial mass of the passing objects were captured into orbits around the planet (see Figures 2a, b). The combined mass of these captured fragments was found to be sufficient to explain the mass of the current rings around Saturn and Uranus. In other words, these planetary rings were formed when sufficiently large objects passed very close to giants and were destroyed.

The researchers also simulated the long-term evolution of the captured fragments using supercomputers at the National Astronomical Observatory of Japan. From these simulations they found that captured fragments with an initial size of several kilometers are expected to undergo high-speed collisions repeatedly and are gradually shattered into small pieces. Such collisions between fragments are also expected to circularize their orbits and lead to the formation of the rings observed today (see Figures 2b, c).

This model can also explain the compositional difference between the rings of Saturn and Uranus. Compared to Saturn, Uranus (and also Neptune) has higher density (the mean density of Uranus is 1.27g cm-

3, and 1.6/g/ cm-3 for Neptune, while that of Saturn is 0.69g/ cm-3). This means that in the cases of Uranus (and Neptune), objects can pass within close vicinity of the planet, where they experience extremely strong tidal forces. (Saturn has a lesser density and a large diameter-to-mass ratio, so if objects pass very close they will collide with the planet itself). As a result, if Kuiper belt objects have layered structures such as a rocky core with an icy mantle and pass within close vicinity of Uranus or Neptune, in addition to the icy mantle, even the rocky core will be destroyed and captured, forming rings that include rocky composition. However if they pass by Saturn, only the icy mantle will be destroyed, forming icy rings. This explains the different ring compositions.

These findings illustrate that the rings of giant planets are natural by-products of the formation process of the planets in our solar system. This implies that giant planets discovered around other stars likely have rings formed by a similar process. Discovery of a ring system around an exoplanet has been recently reported, and further discoveries of rings and satellites around exoplanets will advance our understanding of their origin.

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New theory explains how the moon got there

Accounts for flaws in current 'giant impact' hypothesis

Earth's Moon is an unusual object in our solar system, and now there's a new theory to explain how it got where it is, which puts some twists on the current "giant impact" theory. The work is published Oct. 31 in the journal Nature.

The Moon is relatively big compared to the planet it orbits, and it's made of almost the same stuff, minus some more volatile compounds that evaporated long ago. That makes it distinct from every other major object in the Solar System, said Sarah Stewart, professor of earth and planetary sciences at the University of California, Davis and senior author on the paper.

"Every other body in the solar system has different chemistry," she said.

The textbook theory of lunar formation goes like this. Late in the formation of the solar system came the "giant impact" phase, when hot planet-size objects collided with each other. A Mars-sized object named what would become Earth, throwing off a mass of material from which the Moon condensed. This impact set the angular momentum for the Earth-Moon system, and gave the early Earth a five-hour day. Over millennia, the Moon has receded from the Earth and the rotation has skewed to our current 24-hour day.

Scientists have figured this out by looking at the Moon's current orbit, working out how orgally angular momentum of the Earth-Moon system has been transferred by the tidal forces between the two bodies, and working backwards.

But there are a couple of problems with the textbook theory. One is the Moon's surprisingly Earth-like composition. Another is that if the Moon coalesced from a disk of material existing around Earth's equator, it should be in orbit over the equator. But the Moon's current orbit is tilted five degrees off the equator, meaning some more energy must have been put in to move it.

An alternative to explain it all

Stewart, her former postdoctoral fellow Matija Ćuk (now a scientist at the SETI Institute in Mountain View, Calif.), with Douglas Hamilton at the University of Maryland and Simon Lock, Harvard University, have come up with an alternative model.

In 2012, Ćuk and Stewart proposed that some of the angular momentum of the Earth-Moon system could have been transferred to the Earth-Sun system. That allows for a more energetic collision at the beginning of the process.

In the new model, a high energy collision left a mass of vaporized and melten material from which the Earth and Moon formed. The Earth was set spinning with a two-hour day, its axis pointing towards the Sun.

Because the collision could have been more energetic than in the current theory, the material from Earth and the impactor would have mixed together, and both Earth and Moon condensed from the same material and therefore have a similar composition.
As angular momentum was dissipated through tidal forces, the Moon receded from the Earth until it reached a point called the "Laplace plane transition," where the forces from the Earth on the Moon became less important than gravitational forces from the Sun. This caused some of the angular momentum of the Earth-Moon system to transfer to the Earth-Sun system.
This made no major difference to the Earth's orbit around the Sun, but it did flip Earth upright. At this point, the models built by the team show the Moon orbiting Earth at a high angle, or inclination, to the equator.
Over a few tens of million years, the Moon continued to slowly move away from Earth until it reached a second transition point, the Cassini transition, at which point the inclination of the Moon – the angle between the Moon's orbit and Earth's equator – dropped to about five degrees, putting the Moon more or less in its current orbit.
The new theory elegantly explains the Moon's orbit and composition based on a single, giant impact at the beginning, Stewart said. No extra intervening steps are required to nudge things along.
"One giant impact sets off the sequance of events," she said.

http://bit.ly/2PQN8d

Raising 'good cholesterol' not as effective as lowering 'bad cholesterol'

Low, very high HDL levels associated with death; HDL not independent heart disease risk factor

Low and very high levels of HDL, or "good cholesterol" are associated with a higher risk of dying from heart disease, cancer and other causes, according to a study relay in the Journal of the American College of Cardiology. The findings from the first of its kind study suggest that a low level of good cholesterol may not be a heart disease risk factor on its own and that raising HDL does not likely reduce a person's risk of heart disease.
To reduce risk of suffering a cardiac episode, many patients are treated to lower their LDL, or "bad cholesterol," with statin--a medication used to block the enzyme needed in the body to produce cholesterol. However, some people don't respond to this treatment, so researchers have been studying HDL and whether raising levels of "good cholesterol" could have the same benefits as lowering "bad cholesterol."
Researchers studied over 631,000 individuals without prior cardiovascular conditions through the CANHEART cohort, a research database that links together multiple individual-level population-based datasets on sociodemographics, cardiac risk factors and comorbidities, medications, etc., in Ontario, Canada. Patients were between 40 and 105 years old, with an average age of 57.2, and lived in Ontario for at least two years as of January 1, 2008. This was the first study to evaluate the association between HDL and death in individuals living in the same environment and exposed to the same health care system.
The study cohort was divided into groups based on their HDL to allow researchers to examine the relationship between HDL levels and mortality. Researchers compared the HDL levels of people with healthier lifestyles to those with less healthy habits. The lowest levels of HDL were seen in people who were socioeconomically disadvantaged and who had less healthy lifestyle behaviors, more cardiac risk factors and more medical comorbidities.
However, even when adjusting for lifestyle factors, lower HDL levels were still associated with increased risk of both cardiovascular death and non-cardiovascular related death, such as death from cancer. Individuals with very high HDL levels had an increased risk of non-cardiovascular related death.
Researchers said their findings are similar to other studies showing low HDL levels are associated with a higher risk of cardiovascular

disease death, but this study is among the first to show a similar relationship between HDL and cancer death and other causes of death. Researchers said they are unsure why very high levels of HDL increased levels of non-cardiovascular related death, but other studies have suggested this could be related to increased alcohol intake.

In conclusion, researchers said this study casts doubt on HDL being used as an independent risk factor for cardiovascular disease or for raising HDL levels to be used by itself as an intervention to reduce the risk of dying from heart disease.

"The link between good cholesterol and heart disease is complex, but it seems certain that there is a connection between people with low good cholesterol levels and other well-known risk factors for heart disease such as poor diet and exercise habits and other medical conditions," said Dennis T. Ko, M.D., M.Sc., lead author of the study and an associate professor at the Institute for Clinical Evaluative Sciences in Toronto. "Focusing on raising HDL is likely not going to help these patients, but these findings show that one of the best interventions in treating and preventing heart disease continues to be lifestyle changes."

Limitations of the study include that researchers were unable to examine some potentially important aspects of HDL such as the relationship of particle sizes, subclasses or function with cardiovascular or non-cardiovascular mortality because these data are not available at the population level. Also, they did not have smoking status or alcohol use data for the entire population studied, but were able to supplement that data from an additional survey.

None of the authors of the study have disclosures to report.

http://bit.ly/2fMCAOQ

Twelve DNA areas 'linked with the age at which we have our first child and family size'

12 specific areas of DNA robustly related with age at which first child is borne and total number of children

Researchers have identified 12 specific areas of the DNA sequence that are robustly related with the age at which we have our first child, and the total number of children we have during the course of our life.

The study, led by the University of Oxford, working together with the Universities of Groningen, The Netherlands and Uppsala, Sweden, includes an analysis of 62 datasets with information from 238,064 men and women for age at first birth, and almost 330,000 men and women for the number of children. Until now, reproductive behaviour was thought to be mainly linked to personal choices or social circumstances and environmental factors. However, this new research shows that genetic variants can be isolated and that there is also a biological basis for reproductive behaviour. The paper is co-authored by over 250 sociologists, biologists, and geneticists from institutions worldwide, and has been published in the journal, Nature Genetics.

Lead author Professor Melinda Mills, from the Department of Sociology and Nuffield College at the University of Oxford, comments: 'For the first time, we now know where to find the DNA areas linked to reproductive behaviour. For example, we found that women with DNA variants for postponing parenthood also have bits of DNA code associated with later onset of menstruation and later menopause. One day it may be possible to use this information so doctors can answer the important question: "How late can you wait?" based on the DNA variants. It is important to put this into perspective, however, as having a child still strongly depends on many social and environmental factors that will always play a bigger role in whether or when we have babies.'

The study shows that DNA variants linked with the age at which people have their firstborn are also associated with other characteristics reflecting reproduction and sexual development, such as the age at which girls have their first period, when the voice breaks in boys, and at what stage women experience their menopause.

First author Nicola Barban, from the Department of Sociology and Nuffield College at the University of Oxford, comments: 'Our genes

do not determine our behaviour, but for the first time, we have identified parts of the DNA code that influence it. This is another small piece to understanding this very large jigsaw puzzle.'

The researchers calculated that variants in the 12 areas of the DNA together predict less than 1% of the timing at which men and women have their first child and of the number of children they have in the course of their lifetime. The paper says that while these numbers seem 'extremely small', their modelling shows that in some cases when the variants are combined, they can be used to predict the probability of women remaining childless. Importantly, by examining the function of the 12 DNA regions and the genes in these regions in detail, the researchers have identified 24 genes that are likely to be responsible for the effects of the 12 DNA variants on reproductive behaviour. Some of these genes were already known to influence infertility, while others have not yet been studied. According to study co-authors Professor Harold Snieder from the University of Groningen and Associate Professor Marcel den Hoed from Uppsala University, 'an improved understanding of the function of these genes may provide new insights for infertility treatments'.

The paper, 'Genome-wide analysis identifies 12 loci influencing human reproductive behavior' is published in the scientific journal, Nature Genetics. It is strictly embargoed until Monday, 31 October 2016 at 1600 London time / 1200 US Eastern time. Once live, it will appear at http://dx.doi.org/10.1038/ng.3698

What is 'human reproductive behaviour'? How was it measured?

Human reproductive behaviour is defined by two measures: age at first birth (AFB) and number of children ever born (NEB). AFB is the self-reported age when subjects had their first child. In most cases, people were directly asked a question such as: "How old were you when you had your first child?" Alternatively, researchers calculated the measure based on several survey questions (e.g., date of birth of the individual and the date of birth of their first child). Number of children ever born (NEB) is the self-reported number of children that an individual has. It was often asked directly such as "How many children do you have?" They also calculated it based on several survey questions (for example, pregnancy histories and outcomes, number of deliveries). NEB has emerged as the gold standard to measure lifetime reproductive success indicating 'biological fitness'.

Why the findings are timely given trends in modern society?

In many industrialized societies, first-time parents are considerably older than decades before, which in turn has consequences for the number of children they can have and their reproductive health. Since the 1970s, there has been a rapid postponement by around 4-6 years in the age at first birth from women having their first child at around 24 years in 1970 to 29 years in 2012 in many industrialized societies. There has not only been postponement, but also significant increases in the levels of childlessness, with around 20-25% of women born from 1965-69 in Southern and Western European countries having no children. The biological ability to conceive a child starts to steeply decline for some women as of age 25, with almost 50% of women being sterile by the age of 40.5 This means that a growing number of women start to have their first and subsequent children exactly at the time that their ability to conceive starts to decrease. Birth postponement and a lower number of children has been largely attributed to social, economic and cultural environmental factors (i.e., individual and partner characteristics, socioeconomic status), with virtually no attention paid to the genetic or biological underpinnings of this behaviour.

How the researchers studied the genome

They searched across the entire human genome, examining each genetic locus (or region) one by one to see if there is a relationship (or what we call an association) between our outcomes (AFB, NEB) and a particular genetic locus. These genetic loci contain so-called SNPs (pronounced SNIPs), which refers to single-nucleotide polymorphisms, or in other words, the DNA variants that distinguish us from each other. In the largest GWAS on human reproduction to date, they combined results from 62 different studies into what is referred to as a meta-analysis with a total sample size of N=251,151 for AFB and N=343,072 for NEB.

They also performed separate meta-analyses for women (AFB, N=189,656; NEB, N=225,230) and men (AFB, N=48,408; NEB, N=103,909). They went beyond simply finding the location of the genetic loci to determine whether they had any biological function or relevance. They identified 12 independent loci (10 of which were not previously anticipated to influence reproductive behaviour) that were significantly associated with AFB and/or NEB.

The main finding

They found that all 12 genetic loci combined can explain around 1 % of the variability in the average age at which someone has their first baby. They can also predict around 0.2% of the variability of the number of children we will have in the course of our lifetime using a combined polygenic score. Although it may seem low, the results showed that a 1 standard deviation increase of the NEB

polygenic score is associated with a 9% decrease in the probability for women to remain childless (with no significant effect found for men).

Could these results help predict exact timing of first child and number of children people will have?

No - not at all. As described previously, since each individual SNP or genetic variant has such a small effect, prediction of AFB or NEB using genetic results alone is not possible. Even if they combine the genetic variants together into an index or what is termed a 'polygenic score' using all approximately 9 million SNPs in our data, they can still only predict 0.9% and 0.2% of the variation in AFB and NEB across individuals. As more and more genetic data becomes available, they anticipate that it will be possible to predict at most 15 to 20% of the variance in AFB and NEB, which would resemble more recent whole-genome results.

Do the genetic variants identified have relevance for fertility treatments?

A variable that predicts around 1% of the variation in human reproductive behaviour is large enough to be relevant and useful for experts in many disciplines. In the longer term, this study offers a better understanding of the genetic architecture of human reproductive behaviour. It likewise has the potential to enable the discovery of predictors of infertility, which would in turn greatly improve family planning but also increase the effectiveness of costly and invasive ART treatments as well as allow couples to realize their fertility intentions. Some of the lead SNPs or genetic loci are related to critical fertility related processes such as: follicle stimulating hormone, estrogen, growth in ovaries, spermatid differentiation, male germ cell development and diseases associated with female infertility (endometriosis, PCOS).

http://bit.ly/2fo2jdU

Understanding mind-wandering could shed light on mental illness: UBC research

If you think the mind grinds to a halt when you're doing nothing, think again.

A University of British Columbia-led review of mind-wandering research, published in the November issue of Nature Reviews Neuroscience, proposes a new framework for understanding how thoughts flow, even at rest.

The authors argue that their new framework could help better understand the stream of consciousness of patients diagnosed with mental illnesses like depression, anxiety and attention deficit hyperactivity disorder (ADHD).

"Mind-wandering is typically characterized as thoughts that stray from what you're doing," said Kalina Christoff, the review's lead author and a professor in UBC's department of psychology. "But we believe this definition is limited in that it doesn't capture the dynamics of thought. Sometimes the mind moves freely from one idea to another, but at other times it keeps coming back to the same idea, drawn by some worry or emotion. Understanding what makes thought free and what makes it constrained is crucial because it can help us understand how thoughts move in the minds of those diagnosed with mental illness."

In the review, the authors propose that thoughts flow freely when the mind is in its default state--mind-wandering. Yet two types of constraints--one automatic and the other deliberate--can curtail this spontaneous movement of thoughts. Reviewing neuroscience literature from more than 200 journals, the authors give an account of how the flow of thoughts is grounded in the interaction between different brain networks-- a framework that promises to guide future research in neuroscience.

This new perspective on mind-wandering could help psychologists gain a more in-depth understanding of mental illnesses, said review co-author Zachary Irving, postdoctoral scholar at the University of California, Berkeley, who has ADHD.

"Everyone's mind has a natural ebb and flow of thought, but our framework reconceptualizes disorders like ADHD, depression and anxiety as extensions of that normal variation in thinking," said Irving.

"This framework suggests, in a sense, that we all have someone with anxiety and ADHD in our minds. The anxious mind helps us focus on what's personally important; the ADHD mind allows us to think freely and creatively."

Within this framework, spontaneous thought processes-- including mind-wandering, but also creative thinking and dreaming-- arise when

thoughts are relatively free from deliberate and automatic constraints. Mind-wandering is not far from creative thinking.

"We propose that mind-wandering isn't an odd quirk of the mind," said Christoff. "Rather, it's something that the mind does when it enters into a spontaneous mode. Without this spontaneous mode, we couldn't do things like dream or think creatively."

The review, "Mind-wandering as spontaneous thought: a dynamic framework," was co-authored by UBC PhD candidate Kieran Fox, Nathan Spreng of Cornell University and Jessica Andrews-Hanna of the University of Colorado Boulder.

http://bit.ly/2fDODyO

UCI study finds acupuncture lowers hypertension by activating natural opioids

Regular electroacupunture treatment can lower hypertension by increasing the release of a kind of opioid

Irvine, Calif. - Researchers with the UCI Susan Samueli Center for Integrative Medicine have found that regular electroacupunture treatment can lower hypertension by increasing the release of a kind of opioid in the brainstem region that controls blood pressure.

The UCI study shows that repetitive electroacupuncture evokes a long-lasting action in lowering blood pressure in hypertension. **Chris Nugent / UCI**

In tests on rats, UCI cardiology researcher Zhi-Ling Guo and colleagues noted that reduced blood pressure lasted for at least three days after electroacupuncture by increasing the gene expression of enkephalins, which one of the three major opioid peptides produced by the body. Their study, which appears in the Nature's Scientific Reports, presents the first evidence of the molecular activity behind electroacupunture's hypertension-lowering benefits.

Last year, the UCI team reported patients treated with acupuncture at certain wrist locations experienced drops in their blood pressure. The present study shows that repetitive electroacupuncture evokes a long-lasting action in lowering blood pressure in hypertension, suggesting that this therapy may be suitable for treating clinical hypertension.

Hypertension affects about one third of the adult population of the world, and its consequences, such as stroke and heart attacks, are enormous public health problems, and the potential advantages of acupuncture over conventional medical therapy include few, if any, of side effects.

The open access study is available at: http://www.nature.com/articles/srep35791. It was supported by NIH grants HL-072125, AT009347 and AHA 10POST4190125.

http://bit.ly/2flruzP

Low-oxygen environment leads to heart regeneration in mice, UTSW research shows

Cardiologists able to regenerate heart muscle by placing mice in an extremely low-oxygen environment

DALLAS - Normal, healthy heart muscle is well-supplied with oxygen-rich blood. But UT Southwestern Medical Center cardiologists have been able to regenerate heart muscle by placing mice in an extremely low-oxygen environment.

Researchers with the Hamon Center for Regenerative Science and Medicine gradually lowered the oxygen in the air breathed by mice until it was at 7 percent - about the concentration of oxygen at the top of Mt. Everest. After two weeks in the low-oxygen environment, the heart muscle cells - called cardiomyocytes - were dividing and growing. Under normal circumstances cardiomyocytes do not divide in adult mammals.

The findings, published in Nature, build upon years of work that began with the discovery that the hearts of newborn mammals have the ability to regenerate, similar to the way skin has the ability to repair itself after a cut. But this ability of heart muscle to regenerate is quickly lost in the following weeks as the animal ages and cardiomyocytes are bathed in the oxygen-rich environment of the beating heart, causing damage to the cells.

"The adult human heart is not capable of any meaningful repair following a heart attack, which is why heart attacks have such a devastating impact," said Dr. Hesham Sadek, Associate Professor of Internal Medicine and with the Hamon Center. "Though counterintuitive, we've shown that severely lowering oxygen exposure can sidestep damage to cells caused by oxygen and turn cell division back on, leading to heart regrowth."

In the current study, researchers lowered the oxygen level from the normal 21 percent to 7 percent over a period of weeks, then monitored the mass and function of the heart. They demonstrated that reduction in oxygen leads to both an increase in cardiomyocytes and improved heart function.

The researchers had tried a 10 percent oxygen environment, but there was no heart regrowth in the 10 percent oxygen environment. To avoid oxygen damage to cells, oxygen levels needed to be very low, a situation referred to as hypoxia.

"This work shows that hypoxia equivalent to the summit of Mt. Everest can actually reverse heart disease, and that is extraordinary," said Dr. Benjamin Levine, Professor of Internal Medicine who holds the Distinguished Professorship in Exercise Sciences, and who directs the Institute of Exercise and Environmental Medicine at Texas Health Presbyterian Hospital Dallas, a joint program of UT Southwestern and Texas Health Resources.

"In theory, creating a low-oxygen environment could lead to repair not only of heart muscle, but of other organs as well," said Dr. Sadek, who holds the J. Fred Schoellkopf, Jr. Chair in Cardiology. "Although exposure to this level of hypoxia can result in complications, it is tolerated in humans when performed in a controlled setting."

The latest findings build upon previous research by UT Southwestern scientists that includes:

A 2011 study in Science showing the ability of the neonatal mouse heart to regenerate

A 2014 study in Cell in 2014 showing that oxygen metabolism causes damage to DNA in heart cells, which shuts down the ability to regenerate

A 2015 study in Nature showing that a few heart cells which are in very low-oxygen pockets retain the ability to divide.

This work was supported by the National Institutes of Health, in addition to support from the Hamon Center for Regenerative Science and Medicine, whose goal is to understand the basic mechanisms for tissue and organ formation, and then to use that knowledge to regenerate, repair and replace tissues damaged by aging and injury. UT Southwestern established the Hamon Center for Regenerative Science and Medicine in 2014 with a $10 million endowment gift from the Hamon Charitable Foundation to further research into the relatively new field of regenerative medicine.

Other UT Southwestern researchers who contributed to the study are Dr. Yuji Nakada, Assistant Instructor of Internal Medicine; Dr. Diana Canseco, Instructor of Internal Medicine; SuWanee Thet, Research Associate; Dr. Salim Abdisalaam, postdoctoral researcher; and Dr. Wataru Kimura, Visiting Assistant Professor of Internal Medicine.

http://bit.ly/2f4f5zH

New discovery could help oral medicines work better

University of Minnesota and the Dow Chemical Company file patent on research

Minneapolis/St. Paul - A team of researchers from the University of Minnesota and The Dow Chemical Company have discovered a new method for customizing ingredients that help oral medications dissolve in the body and be absorbed into the bloodstream. The materials discovered in this study could allow life-saving drugs to work faster and more efficiently.

The University of Minnesota and Dow have filed a patent on the discovery that may also lower the cost to produce new medications.

The research study is now online and is published in the current issue of the American Chemical Society's ACS Central Science, a leading journal in the chemical sciences.

One of the biggest challenges for pharmaceutical companies when developing oral medications is to ensure that the body will fully absorb the drug molecules. Many therapeutic structures do not easily dissolve on the molecular level, which means they are less effective. In that case, the dose must be increased for patients, which may increase side effects.

"A way to explain the differences in solubility of medicines is to think of how sugar easily dissolves in water and is rapidly absorbed by your digestive system, whereas sand doesn't dissolve in water and if swallowed, would pass right through the digestive system," said Theresa Reineke, a chemistry professor in the University of Minnesota's College of Science and Engineering and lead researcher on the study.

Drug companies add substances, called excipients, to help the medicines dissolve in the stomach and intestinal fluid, but there have been few improvements in recent years to this decades-old technology. The process outlined in the study is a major breakthrough that revolutionizes the process of making drug structures more soluble in the body so that they are better absorbed.

Funded by Dow, researchers examined two medications--phenytoin, an anti-seizure drug, and nilutamide, a drug used to treat advanced-stage prostate cancer. The team used automated equipment at Dow to synthesize long-chain molecules. Their efficiency as excipients with these drugs were then tested with facilities at the University of Minnesota, including the Characterization Facility located in the University's College of Science and Engineering. One particular excipient discovered by this research allowed these insoluble drugs to fully dissolve in simulated intestinal fluid in a test tube. When they tested phenytoin with the new excipient in rat models, it promoted drug absorption three times better than the previous formulation.

"While we were pleased with the results with these specific drugs, the most important thing is that we have developed a high throughput methodology for excipient development that could be used by many companies to create other life-saving medicines," Reineke said.

"It takes about $1 billion dollars and 10 to 15 years for a pharmaceutical company to develop a new drug, but then they sometimes find marketable formulations are limited by solubility," said Steven Guillaudeu, a lead R&D manager at Dow and co-author of the study. "The methodology our team has created could help drug companies advance their pipeline compounds by using a better method to improve solubility and therefore bioavailability. The approach could have a major impact on the multibillion-dollar industry."

The research discovery is one result of a five-year collaboration between Dow and the University of Minnesota for research partnerships to develop new chemical solutions, improve research facilities, and train the next generation of scientists.

"This discovery is a perfect example of what can happen when industry and academia come together," said Frank Bates, a Regents Professor in the University's Department of Chemical Engineering and Materials Science and co-author of the study. "This research has yielded something that could have a huge effect on human health and lower the cost of medications."

In addition to Reineke, Guillaudeu, and Bates, other researchers who were part of the team included current and former University of Minnesota students and post doctoral researchers Jeffrey Ting (lead author), Swapnil Tale, Anatolii A. Purchel, Seamus D. Jones, Lakmini Widanapathirana, Zachary P. Tolstyka, and former Dow researcher Li Guo.

To read the complete research study, entitled "High-throughput Excipient Discovery Enables Oral Delivery of Poorly Soluble Pharmaceuticals," visit the ACS Central Science website.

http://bit.ly/2fFyV6e

Diabetes study finds that cutting nerves to the kidneys improves insulin resistance

Cedars-Sinai researchers show kidneys and liver communicate to control glucose levels

Los Angeles - Incapacitating specific nerves to the kidneys improves the work of insulin on another organ, the liver, according to research from Cedars-Sinai recently published in the journal Diabetes.

The liver metabolizes and produces glucose (sugar) that is used by the body for energy. However, in people with diabetes insulin secreted by the pancreas fails to normalize glucose production in the liver. The mechanism that accounts for this failure has been a mystery, until now. The answer: The kidneys and the liver are communicating with each other to set glucose levels.

"To our surprise, we found that renal denervation -- cutting nerves to the kidneys -- dramatically improved the liver's sensitivity to insulin," said Malini Iyer, PhD, the lead author of the study conducted at the Bergman Laboratory in the Diabetes and Obesity Research Institute at Cedars-Sinai.

In the study, researchers cut the nerves to the kidneys of laboratory animals that had become insulin-resistant from being fed a high-fat diet. After the procedure their livers had a healthy response to insulin, effectively curing the animals of insulin resistance - a pre-diabetic condition. Kidney function remained normal following the procedure.

"For the first time, we have identified the role the kidneys play in regulating blood sugar," said Richard Bergman, PhD, director of the Cedars-Sinai Diabetes and Obesity Research Institute and the Alfred Jay Firestein Chair in Diabetes Research.

"The kidneys and the liver are signaling each other in order to set healthy levels of sugar in the body," said Bergman, the study's principal investigator. "When we didn't cut those lines of communication between the two organs, the liver overproduced glucose in the animals on a high-fat diet,"

Researchers say the next step is to pinpoint the most effective method for surgically silencing nerves in the kidneys of humans to begin investigating the procedure's potential for treating diabetic patients.

http://bit.ly/2fFDP3r

https://www.eurekalert.org/pub_releases/2016-11/enc-oep102816.php

One egg per day associated with 12 percent reduced risk of stroke

Protein and antioxidants found in eggs named as potential nutritional factors

Park Ridge, Ill. - On the heels of the 2015 Dietary Guidelines for Americans that placed no daily limit on dietary cholesterol and noted eggs are an affordable, accessible, nutrient-rich source of high quality protein, new research shows eggs are associated with a 12 percent reduction in the risk of stroke, the 5th leading cause of death in the United States.

The study is published in the Journal of the American College of Nutrition (1). Researchers report that consumption of up to one egg per day had no association with coronary heart disease (CHD) and a 12 percent reduction of stroke risk. These findings come from a systematic review and meta-analysis of studies dating back between 1982 and 2015, which evaluated relationships between egg intake and coronary heart disease (total of 276,000 subjects) and stroke (total of 308,000 subjects).

Principal Investigator on this study, Dr. Dominik Alexander of the EpidStat Institute, Ann Arbor, MI, notes that mechanistic work is needed to understand the connection between egg consumption and stroke risk. However, he theorizes that, "Eggs do have many positive nutritional attributes, including antioxidants, which have been shown to reduce oxidative stress and inflammation. They are also an excellent source of protein, which has been related to lower blood pressure." One large egg boasts 6 grams of high-quality protein and antioxidants lutein and zeaxanthin, found within the egg yolk, as well as vitamins E, D, and A.

Alexander's research lends further support to changes in the recently-released 2015 Dietary Guidelines for Americans, which have eliminated dietary cholesterol limits, and now include regular consumption of eggs among lean protein choices (2). It also builds on a 2015 meta-analysis in which dietary cholesterol was shown to have no association with cardiovascular diseases, including coronary artery disease and stroke (3). "This systematic review and meta-analysis underscores prior research, showing the lack of a relationship between eggs and heart disease and now suggests a possible beneficial effect of eating eggs on risk of stroke," Tia M. Rains, PhD, Interim Executive Director of the Egg Nutrition Center, the scientific research arm of the American Egg Board.

More information on the nutritional benefits of eggs can be found at The Egg Nutrition Center http://www.eggnutritioncenter.org/.

http://bit.ly/2fpKfQz

New drug helps clear amyloid plaques in Alzheimer's disease patients

New research suggests a long-sought amyloid-lowering drug for Alzheimer's disease (AD) may soon be on the horizon.

In a phase 1 clinical trial, a compound that blocks the enzyme BACE1, a major AD target, safely reduced toxic β-amyloid in 32 study participants with AD. Unlike other BACE1 inhibitors that cause severe side effects, the new drug proved safe, making it the first oral BACE1 inhibitor to advance to phase 3 trials, which are currently underway. β-amyloid (Aβ) is a sticky peptide that clumps into plaques, which damage the brain of individuals with AD. Blocking BACE1, which plays a key role in the production of Aβ, has emerged as a promising approach to rid the brain of amyloid buildup. However, the search for a brain-penetrant BACE1 inhibitor remains a challenge because of severe toxicity, which can lead to liver damage and further neurodegeneration. Matthew Kennedy and colleagues developed verubecestat, a potent and well-tolerated BACE1 inhibitor. A single dose of the drug markedly reduced levels of Aβ in the blood and cerebrospinal fluid of rats and monkeys. The animals showed no signs of toxicity even after extended treatment. In a phase 1 trial of healthy adults and patients with mild to moderate AD, single and multiple doses of verubecestat lowered Aβ levels without serious side effects. The promising results have helped launched phase 3 trials of the drug investigating its long-term outcomes in AD patients.

http://bit.ly/2fnMhTs

Plants 'see' underground by channelling light to their roots

A light-bulb moment? Plants seem to pipe sunlight directly down into underground roots to help them grow.

By Alice Klein

Light receptors in stems, leaves and flowers have long been known to regulate plant growth.

Roots also have these receptors, but it has been unclear how they sense light deep in dark soil. Hyo-Jun Lee at Seoul National University in South Korea and his colleagues used *Arabidopsis thaliana* – a small flowering plant from the mustard family – as a model to study this phenomenon.

Sensing light in the dark **Dr John Runions/Science Photo Library**

They found that the plant stem acts like a fibre-optic cable, conducting light down to receptors in the roots known as phytochromes. These trigger the production of a protein called HY5, which promotes healthy root growth.

When the plants were engineered to have phytochrome mutations, HY5 production declined. And when they had HY5 mutations, their roots became stunted and strangely angled.

Light versus chemicals

To check whether light was directly transmitted through the plant rather than it activating signalling chemicals that travelled to the roots, the researchers attached a light source to the stem of plants via an optical fibre. An underground detector at the end of the roots confirmed that light was transmitted through.

Moreover, when they treated *A. thaliana* specimens in the dark with common plant signalling chemicals such as sucrose, no significant increase in root growth was observed – suggesting that such chemicals were not driving growth.

Red light was found to move most efficiently through the plants. The long wavelengths of such light may be favourable because they can travel further than shorter blue and green wavelengths, says Lee.

However, the light's intensity would be too low for creatures in the soil to see it illuminating the roots, or for bacteria to use it for photosynthesis, he says.

Common function?

Most plants have phytochromes, suggesting that directly piping sunlight down the stem is a common mechanism used to optimise root growth, says Lee.

This makes sense, because light signalling would be faster than chemical signalling, says Mike Haydon at the University of Melbourne, Australia.

The study does not, however, provide definitive proof, he says. The researchers found that it took 2 hours from initial illumination for plants to activate their root phytochromes – longer than might be expected if the light is directly conducted.

In addition, the study only investigated a handful of signalling chemicals that could act as mobile intermediaries between light, the stem and the roots, says Haydon. "This doesn't really exclude the possibility of a mobile intermediate signal."

Journal reference: Science Signaling, *DOI: 10.1126/scisignal.aaf6530*

http://bit.ly/2fFLwGK

Study: Lack of brain shrinkage may help predict who develops dementia with Lewy bodies

Dementia with Lewy bodies is a progressive disease that causes hallucinations, decline in mental abilities, rigid muscles, slow movement and tremors.

ROCHESTER, Minn. -- With symptoms similar to Alzheimer's disease and Parkinson's disease, a correct diagnosis can be difficult.

A new study published today in the online issue of Neurology, a medical journal of the American Academy of Neurology, shows that a lack of shrinkage in the area of the brain called the hippocampus may be a sign that people with thinking and memory problems may develop dementia with Lewy bodies rather than Alzheimer's disease. Atrophy of the hippocampus, the area of the brain responsible for thinking and memory, is an early sign of Alzheimer's disease.

"Identifying people with mild cognitive impairment at risk for dementia with Lewy bodies is critical for early interventions," says the study's lead author Kejal Kantarci, M.D., a Mayo Clinic radiologist. "Early diagnosis helps target appropriate treatments, including what medications not to give. For example, as many as 50 percent of people with Lewy body disease have severe reactions to antipsychotic drugs."

Lewy bodies are protein deposits that develop in nerve cells in regions of the brain involved in thinking, memory and movement.

In the study, 160 people with mild cognitive impairment had brain MRI scans to measure hippocampus size. They also had yearly tests for an average of two years. During that time, 61 people, or 38 percent, developed Alzheimer's disease, and 20 people, or 13 percent, progressed to probable dementia with Lewy bodies.

Because Lewy body disease can be diagnosed only by an autopsy after death, it is called probable dementia with Lewy bodies. The researchers note that their results should be confirmed with studies that use autopsies for final diagnoses.

The people who had no shrinkage in the hippocampus were 5.8 times more likely to develop probable dementia with Lewy bodies than those who had hippocampal atrophy.

Seventeen of 20, or 85 percent, of people who developed dementia with Lewy bodies had a normal hippocampus volume; whereas, 37 of the 61, or 61 percent, of people who developed Alzheimer's disease had hippocampus atrophy.

The relationship of hippocampus volume and disease was stronger among people without memory issues. Dementia with Lewy bodies does not always affect memory. Affected thinking skills usually include attention, problem-solving and interpreting visual information.

The study was supported by the National Institutes of Health, the Mangurian Foundation, Robert H. and Clarice Smith and the Abigail Van Buren Alzheimer's Disease Research Program. In addition to Dr. Kantarci, Mayo Clinic study co-authors are:

Timothy Lesnick Tanis Ferman, Ph.D.
Scott Przybelski Bradley Boeve, M.D.
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http://bbc.in/2fbtMP5

Project aims to end 'ambiguity' of plant-based medicine

A team of scientists at Royal Botanical Gardens Kew has embarked on the mammoth task of creating a single database of the world's medicinal plant species.

By Mark Kinver Environment reporter, BBC News

Our knowledge of beneficial botany is dispersed across many sources, and is complicated with most species having a variety of different names.

The team at Kew says its work will help pharmacists and regulators, as well as relevant scientific research.

To date, the resource covers an estimated 18,000 different species.

"From those 18,000 species of plant, we have something like 90,000 different names that are used within the health community and by regulators," explained Bob Allkin from Kew's Medicinal Plant Name Services project (MPNS).

"They use many different names for the same plant; some of the names are ambiguous, and we have 230,000 scientific names for those plants."

What's in a name?

He described why there was a need to compile a single reference for the increasingly globalised plant-based medicinal market.

"Pharmacists have traditionally referred to products in great detail, about how it should be prepared. They would also suggest what plant, and what bit of the plant, it can be derived from, such as just the root or just the leaves," Dr Allkin told BBC News.

"However, from a botanical point of view, they have been rather loose about how they referred to the plants; they would have used common names, or they would have used pharmaceutical names.

"In both cases, those names are used differently in different places. Obviously, language is an issue but even within the English-speaking world, one common name can be used in different ways to mean different plants. This leads to ambiguity."

When you are dealing with medicine, ambiguity can result in unacceptable consequences.

In a high profile incident, more than 100 people in Belgium suffered kidney failure as a result of taking weight-loss pills. Unfortunately, a number of the casualties lost their lives as a result of taking the pills.

"The reason for this was because one substance was substituted for another because they had a similar name. This shows that there are very serious consequences to not being precise about what plants are being used," Dr Allkin warned.

"We are compiling all of the names of the plants as used in herbal medicinal products, as used in [various editions of] pharmacopeia and medical literature. They use a mix of common names, in different languages, they also use what are known as pharmaceutical names - which in many cases are also written in Latin - and they also use scientific names. They use a whole mix of things."

There are numerous pharmacopeia (books containing technical instructions to identify compound medicines) - such as the Chinese, Japanese, and European editions - as well as databases used by regulators, such as the US Food and Drug Administration.

Dr Allkin observed: "We then map those names as used by the regulators and health profession to Kew Garden's comprehensive and authoritative global plant taxonomies."

Identity parade

He said that in order for regulators to be able to accurately identify what plants are being used, it is necessary to use scientific names.

"That is the only way because those scientific names are referred to a physical reference in a herbarium store, such as the one at Kew, and those physical specimens tie down what that [scientific] name refers to, as well as its chemical components and DNA etc," he explained.

"The problem for people who are not botanists is that there are various obstacles to using the scientific names properly. In the past, botanists have provided wonderful online resources that are useful to other

botanists, but not necessarily intelligible to those working in the health sector."

However, this presents a problem of its own. Dr Allkin acknowledge that one of the challenges of using scientific nomenclature is that there are many more names than there are plants.

It is estimated that there are between 360,000 and 400,000 species of flowering plants in the world, yet there are 1.6 million scientific names for plants known to science.

"Each plant often has multiple scientific names; this is particularly true of useful plants like medicinal plants because they have been well studies and well described, therefore end up having lot of different or alternative names," Dr Allkin said.

"We know of one plant in the British pharmacopeia that has more than 500 scientific synonyms.

"One consequence of that is that it makes it very hard to find all the research that has been published about that plant, as research might have been published under any one of many names."

Dr Allkin said that if someone searched for details of previous research of a plant using just one of its names then you - on average - would find about 10% to 15% of the previous reach, meaning you would not find up to 85% of previous scientific work on the plant.

Another problem is that names keep changing - there are 10,000 changes to scientific nomenclature each year.

"This is because there are new plants being found, there are about 2,000 of those, and then there are about 4,000 cases each year when a plant is moved from one genus into another genus," he added.

"This is done because the molecular or chemical data that becomes available makes us realise that that particular species is much more closely related in another genus rather than the one it current belongs to.

"Our project is about making Kew's botanical expertise accessible to all."

http://bit.ly/2eoOnOj

A lot of blood, for no reason? Review shows that common, costly clot test has few benefits

Curbing genetic testing for clot-prone patients is just one example of how to improve spending of health care dollars through better ordering of tests

Ann Arbor, Mich. -- A half billion dollars - at least -- gets spent each year on blood tests to see which hospital patients have a genetic quirk that makes their blood more likely to form dangerous clots.

And most of that spending probably isn't necessary, according to a new paper by a University of Michigan Medical School team.

Writing in the Journal of Hospital Medicine, they review what's known about testing for the trait called inherited thrombophilia, and call for a drastic cut in the test's use by doctors across America.

After all, they write, hospitalized people who have already had such dangerous clots, called venous thromboembolisms or VTEs, don't need a positive genetic test to justify taking medication and making other changes to prevent future ones.

And there's no evidence that medication to prevent clots will help hospital patients who haven't yet had a VTE. Testing their DNA for inherited thrombophilia won't change that.

In other words, the authors say, ordering inherited thromboembolism testing on inpatients is something doctors do for little or no reason. And according to the team's analysis of data pulled from medical records, they do it hundreds of thousands of times a year in Medicare patients alone. Often, it appears, the test gets ordered to satisfy curiosity about why a patient had a VTE, to see if they're among the seven percent of Americans with a genetic mutation that makes blood more prone to clot.

There are several tests for several traits, so patients often get them in combination - what's called a "hypercoagulable workup." But if doctors are following guidelines grounded in evidence, the test result should rarely change a patient's care.

So, except in very specific cases where such clots are highly likely - such as women with a family history of clots who are pregnant or getting hormone replacement therapy - there's probably not much reason to do the test at all.

Resisting temptation

"More testing is not always better," says Christopher Petrilli, M.D., an assistant professor of internal medicine at U-M and co-first author of the new paper. "Testing for this disorder is almost never beneficial, and in fact can even be harmful because it can cause undue psychological distress for the patient, and unnecessary expense for the healthcare system," he adds. "Physicians and patients should resist the temptation to perform costly search for an underlying genetic cause of venous thrombosis," says co-first author Lauren Heidemann, M.D., also an assistant professor of medicine.

Petrilli and Heidemann - both hospitalists who specialize in treating patients in the U-M Health System's University Hospital -- have set out to address such "no reason" testing at UMHS and beyond.

They've co-founded a local chapter of the group Providers for Responsible Ordering, which aims to help physicians, nurse practitioners and physician assistants reduce over-testing and use health care resources appropriately.

They've also led the effort to make UMHS one of more than 40 founding members of the High Value Practice Academic Research Alliance, which is working to bring institutions together to help one another implement strategies that make better use of resources.

The current climate of public attention on new genetic testing options and personalized medicine could make this difficult in some cases, they note in the paper. Ideally, genetic tests to find out whether someone carries a certain genetic trait should be used when there's clear information about the risks, benefits and costs of that test.

"With national health care spending reaching an unsustainable level, we as physicians need to be vigilant about becoming stewards of health care resources," says Heidemann.

Reviewing the evidence

For the paper, Petrilli, Heidemann and their colleagues reviewed the full scope of literature and established guidelines on inherited thrombophilia testing. They illustrated the situation by applying this information to a hypothetical case of a young patient with a VTE but no family history who suffers a pulmonary embolism - a dangerous health emergency where clots form in the lower extremities and travel to the lungs, potentially cutting off oxygen to the body unless treatment starts quickly.

They note the conclusions about VTE prevention and treatment that have been reached by several medical bodies - including an American College of Chest Physicians guideline recommending against giving clot-prevention medication to people with the genetic trait but no VTE history.

A group that looks at genetic testing, the Evaluation of Genomic Applications in Practice and Prevention (EGAPP) Working Group, concluded that tests for inherited thrombophilia were likely not cost-effective.

In addition to Petrilli and Heidemann, the research team included senior author Vineet Chopra, M.D., M.Sc., a hospitalist and assistant professor of general medicine, as well as assistant professor Megan Mack, M.D. and UMHS financial analyst Paul Durance, Ph.D. Petrilli, Heidemann and Chopra are members of the U-M Institute for Healthcare Policy and Innovation.

The new paper is part of the Journal of Hospital Medicine's series called Choosing Wisely: Things We Do for No Reason. It's published in the November 2016 issue. Reference: J. Hosp. Med., 11: 801-804. doi:10.1002/jhm.2616

http://bit.ly/2fd6JDs

Buildup of 'toxic fat' metabolite could increase diabetes risk

Research could help explain why some obese people are more prone to diabetes than others

For years, scientists have known that someone who is thin could still end up with diabetes. Yet an obese person may be surprisingly healthy. Now, new research led by scientists at the University of Utah College of Health, and carried out with an international team of scientsts, points to an answer to that riddle: accumulation of a toxic class of fat

metabolites, known as ceramides, may make people more prone to type 2 diabetes.

Among patients in Singapore receiving gastric bypass surgery, ceramide levels predicted who had diabetes better than obesity did. Even though all of the patients were obese, those who did not have type 2 diabetes had less ceramide in their adipose tissue than those who were diagnosed with the condition.

"Ceramides impact the way the body handles nutrients," says the study's senior author Scott Summers, Ph.D., also chairman of the University of Utah Department of Nutrition and Integrative Physiology. "They impair the way the body responds to insulin, and also how it burns calories."

In the study, published on Nov. 3 in Cell Metabolism online, the researchers also show that a buildup of ceramides prevents the normal function of fat (adipose) tissue in mice.

When people overeat, they produce an excess of fatty acids. Those can be stored in the body as triglycerides or burned for energy. However in some people, fatty acids are turned into ceramides.

"It's like a tipping point," Summers said.

At that point, when ceramides accrue, the adipose tissue stops working appropriately, and fat spills out into the vasculature or heart and does damage to other peripheral tissues. Until now, scientists didn't know how ceramides were damaging the body.

The three-year project found that adding excess ceramides to human fat cells, or mice, caused them to become unresponsive to insulin and develop impairments in their ability to burn calories. The mice were also more susceptible to diabetes as well as fatty liver disease.

Conversely, they also found that mice with fewer ceramides in their adipose tissue were protected from insulin resistance, a first sign of diabetes. Using genetic engineering, researchers had deleted the gene that converts saturated fats into ceramides.

The findings indicate that high ceramides levels may increase diabetes risk and low levels could protect against the disease.

The scientists think this could mean that some people are more likely to convert calories into ceramides than others. "That suggests some skinny people will get diabetes or fatty liver disease if something such as genetics triggers ceramide accumulation," said Bhagirath Chaurasia, Ph.D., assistant professor at the University of Utah and the lead author of the study.

As a result of the new research, the scientists are now searching for genetic mutations that lead to people's predisposition to accumulating ceramides, developing obesity and type 2 diabetes.

Summers notes that some Asian countries have a higher diabetes rate than the United States even though the obesity rate is relatively low. "Some people are just not made to deal with dietary fat," says Summers. "It's not just how much you eat, because some people can eat a lot and they just store all the fat effectively and remain healthy."

Adipose tissue exists as three types. White adipose tissue is considered the "bad" kind, because it predominately stores fat. Brown adipose tissue burns fat to generate heat. Beige adipose tissue is a variety of white fat that can change to brown when the body needs to produce heat or create energy.

Based on their research, the scientists propose that as ceramides build up, the tissue loses the characteristics of brown fat, effectively becoming more white. This sets off a sequence of events that can lead to disease.

Summers previously published research in 2007 proving that the inhibition of ceramide synthesis in rodents prevented the development of fatty liver disease and diabetes. He is now working to develop drugs to target that issue.

"By blocking ceramide production, we might be able to prevent the development of type 2 diabetes or other metabolic conditions, at least in some people," Chaurasia said. Knowing how problematic ceramide accumulation is inside adipose tissue will help researchers focus on that specific problem.

Citation: Adipocyte Ceramides Regulate Subcutaneous Adipose Browning, Inflammation, and Metabolism; Cell Metabolism online Nov. 3, 2016

Funding: National Medical Research Council, Singapore; Victorian State Government OIS scheme, Australia; University of Utah Diabetes and Metabolism Center; University of Utah College of Health.
Collaboratoring Institutions: University of Utah College of Health; Baker IDI Heart and Diabetes Institute, Australia; Singapore Bioimaging Consortium; Duke-NUS Graduate Medical School, Singapore; National University of Singapore; Tata Institute of Fundamental Research, India; University of Brunei Darussalam; Yong Loo Lin School of Medicine; University of Michigan; RIKEN Brain Science Institute, Japan.

http://bit.ly/2fpQkyE

Ebola adapted to better infect humans during 2013-2016 epidemic

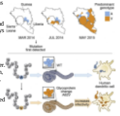
Two teams report mutations in virus from the 2013-2016 Ebola virus epidemic increased its ability to infect human cells

Researchers have identified mutations in Ebola virus that emerged during the 2013-2016 Ebola virus epidemic in West Africa that increased the ability of the virus to infect human cells, two independent teams of researchers are reporting November 3 in Cell.

"Ebola virus is thought to circulate in an unknown animal reservoir and to only rarely cross over into people. When the virus does cross over, the effect has been devastating to those people who are infected. Until recently, the human disease outbreaks have been short lived, and the virus has had little opportunity to adapt genetically to the human host," says Jeremy Luban, a co-author of one of the papers and Professor at the University of Massachusetts Medical School.

By the end of the Ebola virus disease epidemic in 2016, more than 28,000 people had been infected with the virus, and more than 11,000 people died from Ebola virus disease. To investigate whether the virus might have changed genetically in response to infection of such large numbers of people, the research teams used publicly available Ebola virus genomic sequences to track virus mutations. The teams found that mutations of the gene that encodes the Ebola virus glycoprotein increased the virus' ability to infect cells of humans and other primates. By increasing infectivity in human cells, it is possible that these mutations increased Ebola virus spread during the outbreak.

"If you introduce a virus into a new host, like humans, it may need to adapt to better infect and spread in that host," says Jonathan Ball, a virologist at the University of Nottingham and co-author of the other paper. One particular mutation, studied by both groups, emerged early in the outbreak just as case numbers vastly increased and soon became the dominant virus type circulating in the outbreak.



This figure depicts the finding that an Ebola glycoprotein mutant that arose early during the West African epidemic increases infectivity of human cells and may have contributed to increased mortality. **Luban et al./Cell 2016**

The Ebola virus mutations did not increase the ability of Ebola virus to infect cells from other mammalian species, including fruit bats, the presumed natural host of Ebola virus. "We found that, as Ebola virus was spreading from human to human, it apparently didn't have to worry about maintaining its infectivity in bats," Ball says.

The research teams are continuing their work to learn more about how these specific mutations made the Ebola virus more infectious for human cells. "It's important to understand how these viruses evolve during outbreaks," says Luban. "By doing so, we will be better prepared should these viruses spill over to humans in the future."

Cell, Diehl, William, Kyusik, Kim, McCauley, Sean, Donnard, Elisa, Kucukural, Alper, McDonel, Patrick, Garber, Manuel, Luban, Jeremy, et al.: "Ebola virus glycoprotein with increased infectivity dominated the 2013-2016 epidemic"
http://www.cell.com/cell/fulltext/S0092-8674(16)31397-6 / 10.1016/j.cell.2016.10.014

Cell, Urbanowicz, Richard, McClure, Patrick, Ball, Jonathan, et al: "Human adaptation of Ebola virus during the West African outbreak." http://www.cell.com/cell/fulltext/S0092-8674(16)31396-4 / 10.1016/j.cell.2016.10.013

http://bit.ly/2f6a3CU

A secret ingredient to help heal spinal cord injuries?

Researchers have identified a protein in zebrafish that facilitates healing of major spinal cord injuries.

While mammals lack the ability to regenerate nervous system tissue after spinal cord injury, zebrafish can regenerate such tissue.

Yet, the mechanisms behind this recovery have remained elusive.

***Adult zebrafish are capable of regenerating their spinal cords after complete transection injury. Expression of the connective tissue growth factor a (ctgfa) gene in tissue that is bridging the two severed ends stimulates spinal cord regeneration. Glial cells are indicated in red, neuronal cells in green, and ependymal cells in blue. Zebrafish provide a model to inform methodologies for spinal cord regeneration in humans.* M. Mokalled and K. Poss**

Scientists have thought clues may exist in glial cells, which, in mammals, cause scarring that interferes with spinal cord repair; in zebrafish, however, these same cells help create a bridge across severed spinal cord tissue and facilitate regeneration.

To gain more insights into this capacity in zebrafish, Mayssa Mokalled and colleagues analyzed their gene expression following spinal cord injury, identifying seven genes of interest. Of these, connective tissue growth factor a (ctgfa), was found to be expressed during a key period of healing, as glial cells were actively building bridges across damaged tissue.

Zebrafish in which ctgfa was knocked out exhibited glial cells that often failed to extend into the lesions, and the fish were unable to recover from spinal injury. In contrast, overexpression of ctgfa resulted in increased bridging, axon regeneration, and overall healing compared to controls.

When the researchers applied a human form of CTGF protein to lesions in zebrafish, similar recovery of spinal cord function was observed, hinting that other factors within zebrafish spinal tissue may explain the healing differences between mammals and zebrafish; Philip Williams and Zhigang He explore some possible explanations for these differences in a related Perspective.

http://bit.ly/2fpUjuY

Psychologists identify key characteristics of earworms

Study helps explain why tunes get stuck in our heads

WASHINGTON - If you've found yourself singing along to Lady Gaga's "Bad Romance" hours after you switched the radio off, you are not alone. Certain songs do tend to stick in our heads more than others for some very specific reasons, according to research published by the American Psychological Association.

These songs, often called earworms, are usually faster, with a fairly generic and easy-to-remember melody but with some particular intervals, such as leaps or repetitions that set them apart from the average pop song, according to the first large-scale study of earworms. The article appears online in the APA journal Psychology of Aesthetics, Creativity and the Arts.

In addition to "Bad Romance," examples of common earworms named in the study include "Don't Stop Believing" by Journey and, perhaps not surprisingly, "Can't Get You Out Of My Head" by Kylie Minogue.

"These musically sticky songs seem to have quite a fast tempo along with a common melodic shape and unusual intervals or repetitions like we can hear in the opening riff of 'Smoke On The Water' by Deep Purple or in the chorus of 'Bad Romance,'" said the study's lead author, Kelly Jakubowski, PhD, of Durham University. She conducted the study while at Goldsmiths, University of London.

Earworms are also more likely to get more radio time and be featured at the top of the charts, which is not surprising. However, there has previously been limited evidence about what makes such songs catchy regardless of popularity or how often people may have heard them.

"Our findings show that you can, to some extent, predict which songs are going to get stuck in people's heads based on the song's melodic content. This could help aspiring song-writers or advertisers write a jingle everyone will remember for days or months afterwards," said Jakubowski.

The study found that the tunes most likely to get stuck in people's heads were those with more common global melodic contours, meaning they have overall melodic shapes commonly found in Western pop music. For example, one of the most common contour patterns is heard in "Twinkle, Twinkle Little Star," where the first phrase rises in pitch and the second falls. Numerous other nursery tunes follow the same pattern, making them easy for young children to remember, according to the authors. The opening riff of "Moves Like Jagger" by Maroon 5, one of the top named earworm tunes in the study, also follows this common contour pattern of rising then falling in pitch.

In addition to a common melodic shape, the other crucial ingredient in the earworm formula is an unusual interval structure in the song, such as some unexpected leaps or more repeated notes than you would expect to hear in the average pop song, according to the study. The instrumental interlude of "My Sharona" by the Knack and "In The Mood" by Glen Miller both have this unusual interval structure.

The researchers asked 3,000 people to name their most frequent earworm tunes and compared these to tunes that had never been named as earworms in the database but were a match in terms of popularity and how recently they had been in the United Kingdom music charts. The melodic features of the earworm and non-earworm tunes were then analyzed and compared. Songs were limited to popular genres, such as pop, rock, rap and rhythm and blues. The data for the study were collected from 2010 to 2013.

Studies of earworms can help to understand how brain networks, which are involved in perception, emotions, memory and spontaneous thoughts, behave in different people, the authors said.

Jakubowski offered tips for how to get rid of an earworm:

Engage with the song. Many people report that actually listening to the earworm song all the way through can help to eliminate having it stuck on a loop.

Distract yourself by thinking of or listening to a different song.

Try not to think about it and let it fade away naturally on its own.

Most frequently named earworms in study:

"Bad Romance" by Lady Gaga
"Can't Get You Out Of My Head" by Kylie Minogue
"Don't Stop Believing" by Journey
"Somebody That I Used To Know" by Gotye
"Moves Like Jagger" by Maroon 5
"California Gurls" by Katy Perry
"Bohemian Rhapsody" by Queen
"Alejandro" by Lady Gaga
"Poker Face" by Lady Gaga

Article: "Dissecting an earworm: Melodic features and song popularity predict involuntary musical imagery," by Kelly Jakubowski, PhD, Goldsmiths, University of London; Sebastian Finkel, MS, University of Tübingen; Lauren Stewart, PhD, Goldsmiths, University of London and Aarhus University and The Royal Academy of Music Aarhus/Aalborg, Denmark; and Daniel Müllensiefen, PhD, Goldsmiths, University of London. Psychology of Aesthetics, Creativity and the Arts, published online Nov. 3, 2016.

Full text of the article is available from the APA Public Affairs Office and at http://www.apa.org/pubs/journals/releases/aca-aca0000090.pdf.

http://bit.ly/2eqBEuv

Breast-friendly, radiation-free alternative to mammogram in the making

New method identifies cancerous tumors by blood vessels structure

Each year around a million women in the Netherlands undergo mammograms for early detection of possible breast cancer. It's an unpleasant procedure that uses X-rays. Researchers at TU Eindhoven are working on a 'breast-friendly' method, without radiation, that is more accurate and generates 3D rather than 2D images. They published their proof of concept earlier this month in the online journal Scientific Reports.

In the regular screening method the breast is squeezed tight between two plates in order to produce one or more good X-ray photos. Apart from being unpleasant, it is not without risk. The X-rays used can themselves be a contributor to the onset of cancer. Moreover, it is often unclear whether the anomaly found is malignant lesion or not. More than two-thirds of the cases where something worrying can be seen on the X-ray photos is a false-positive: after biopsies, they are not found to be cancer. This is why science is seeking alternatives.

Researchers at TU Eindhoven have now cleared a major scientific hurdle towards a new technology in which the patient lies on a table and the breast hangs freely in a bowl. Using special echography (inaudible sound waves) a 3D image is made of the breast. Any cancer is clearly identifiable on the generated images; the researchers therefore expect there to be many fewer false-positive results.

The new technology builds on the patient-friendly prostate cancer detection method developed at TU/e whereby the doctor injects the patient with harmless microbubbles. An echoscanner allows these bubbles to be precisely monitored as they flow through the blood vessels of the prostate. Since cancer growth is associated with the formation of chaotic microvessels, the presence and location of cancer become visible. This method works well for the prostate and this is now being widely tested in hospitals in the Netherlands, China and, soon, Germany. For breast cancer the method had not yet been suitable because the breast shows excessive movement and size for accurate imaging by standard echography.

Researchers Libertario Demi, Ruud van Sloun and Massimo Mischi have now developed a variant of the echography method that is suitable for breast investigation. The method is known as Dynamic Contrast Specific Ultrasound Tomography. Echography with microbubbles uses the fact that the bubbles will vibrate in the blood at the same frequency as the sound produced by the echoscanner, as well as at twice that frequency; the so-called second harmonic. By capturing the vibration, you know where the bubbles are located. But body tissue also generates harmonics, and that disturbs the observation.

For the new method the researchers are using a phenomenon that Mischi happened upon by chance and later investigated its properties together with Demi. They saw that the second harmonic was a little delayed by the gas bubbles. The researchers have now developed a new visualization method. The more bubbles are encountered by the sound on its route, the bigger the delay compared to the original sound. By measuring this delay, the researchers can thus localize the air bubbles and do so without any disturbance because the harmonic generated by the body tissue is not delayed, and is therefore discernible. This difference, however, can only be seen if the sound is captured on the other side. So this method is perfectly suited to organs that can be approached from two sides, like the breast.

The researchers are currently putting together an international, strong medical team to start performing preclinical studies. Application in practice is certainly ten or so years away, Mischi expects. Moreover, he forecasts that the technology that has been developed will probably not operate on a standalone basis but in combination with other methods, which will create a better visualization. One of the candidates for this elastography, a variant of echography whereby the difference in the rigidity of the tumor and healthy tissue can be used to detect cancer.

The scientific article can be read on the website of Scientific Reports: *http://www.nature.com/articles/srep34458*

http://bit.ly/2eB6Z0M

Hip fracture patients fare best during recovery in high-occupancy nursing homes with higher level physician staffing

Penn Medicine study could help guide decisions on resource allocation by health systems and payers

PHILADELPHIA - Hip fractures are a common and disabling condition that occurs more than 300,000 times each year in the United States in

those 65 and older--1.6 million times worldwide. A new study from Penn Medicine, which compared outcome variations in acute and post-acute care facilities, suggests that for older adults hospitalized with hip fracture, the quality of the post-acute care they receive has a greater impact on long-term recovery than the care they received at the hospital. This study was published today online ahead of print in Medical Care, a journal of the American Public Health Association.

In an analysis of over 42,000 Medicare patients, researchers found that the impact of post-acute care - care received in a nursing homes, rehabilitation facilities, at-home care, etc. - on outcomes, including mortality and mobility, was three to eight times greater than the impact of hospital factors. Overall, nursing home factors explained three times more variation in a patient's probability of dying at 30 days than hospital factors, seven times more variation in the probability of dying at 180 days, and eight times more variation in the probability of dying or being newly unable to walk at 180 days.

"These results highlight the major impact that post-acute care has on basic outcomes such as survival and walking ability among this patient population," said the study's lead author Mark D. Neuman, MD, MSc, an assistant professor of Anesthesiology and Critical Care in the Perelman School of Medicine at the University of Pennsylvania, and director of the Penn Center for Perioperative Outcomes Research and Transformation (PCORI).

Researchers performed a retrospective cohort study using Medicare data of older adult, hip fracture patients who were previously nursing home residents between 2005 and 2009. Of the 42,000 patients, 75 percent were women, 92 percent white and all patients were over 80 years old. While patient characteristics represented the principal determinants of outcomes after hip fractures, selected hospital and nursing home characteristics were associated with short-and long-term outcomes. Hospital characteristics - nurse-to-bed ratio, mean hospital nurse skill mix, and hospital for-profit status, for example - were not consistently associated with outcomes, while multiple nursing home characteristics - bed count, chain membership, and performance on selected quality measures - did predict outcomes.

For instance, patients treated at a nursing home with low occupancy, more than 150 beds versus a facility with less than 100 beds, and with historically high mortality rates, were more likely to die or have a new inability to walk after 30 days. Nursing home market concentration - a higher number of nursing homes in a specific region - and ownership by a multi-facility organization were also modestly associated with 30-day mortality. More, facilities that used more full-time physician extenders - physician assistants and nurse practitioners - and those with a full-time Director of Nursing were modestly associated with 180-day mortality. Nursing homes located within a hospital was also associated with 180-day mortality.

From a policy standpoint, this paper is important because it informs policymakers on which care setting contributes most to outcomes. Post-acute care represents a large and growing source of health care spending in the United States, the authors said.

Medicare costs exceeded $62 billion in 2012, with evidence that spending on post-acute care now outpaces spending on patients hospitalized for common conditions. The authors added, as payment models move more and more towards bundled payments for acute and post-acute care, studies such as this can help guide decisions about how best to allocate resources by health systems and payers.

"For patients, it sends the simple message that post-acute care, for instance, at a nursing home, may have a major impact on recovery in the long term," Neuman said.

The next phase of this research should explore the impact on these factors on outcomes for older adults hospitalized for conditions other than hip fractures, as well as the processes within facilities that may help explain the variations in the outcomes observed in this study, the authors wrote.

Additional authors on the study include senior author Rachel M. Werner, Jeffrey H. Silber, and Molly A. Passarella. This study was supported by the National Institutes on Aging (K08AG043548 and K24AG047908).

http://bit.ly/2f6aixJ

Rubella virus persists after vaccination in some patients with rare immune disorders

CHOP study: Rubella vaccine generally safe and effective, but patients with certain immune diseases may be at risk

Some patients with rare primary immunodeficiency disorders may be at risk for infection by rubella virus, and possibly serious skin inflammation, after receiving the rubella vaccine, usually administered as part of the measles-mumps-rubella (MMR) vaccine. Although the vaccine for rubella (German measles) has an established record of safety and effectiveness in the general population, patients with severe deficiencies in their immune defenses may be susceptible to side effects from the vaccine.

"Up to now, the risk of adverse effects from rubella vaccine has been a theoretical concern for many immune deficient patients," said study leader Kathleen E. Sullivan, MD, PhD, chief of the Division of Allergy and Immunology at Children's Hospital of Philadelphia (CHOP). "The vaccine's package insert states that it shouldn't be given to immune-deficient individuals. Our new study found genuine evidence of harm in a subset of patients with these rare disorders."

Her study appears in the November 2016 issue of the Journal of Allergy and Clinical Immunology, where it is highlighted as an "Editor's Choice" article.

Primary immunodeficiency diseases (PIDD) are a diverse group of rare, chronic disorders with genetic origins, characterized by malfunctions in the body's immune system. Most patients have recurrent infections, along with other health problems. Some PIDD patients have cutaneous granulomas--inflammatory skin lesions that may progress to life-threatening ulcers.

In previous, smaller case reports, researchers had found vaccine-related rubella virus in granulomas of PIDD patients. In the current study, Sullivan and colleagues analyzed data from a larger group of 14 patients with different PIDDs who had cutaneous granulomas. Twelve of those patients were from the USIDNET, a national registry of American PIDD patients, and two other patients were from European outreach. Four patients were adults, the others children. Three of the 11 children died from severe infections. Of the 14 patients, 7 had evidence of rubella virus antigen in their granulomas.

The team's findings suggest that because PIDDs compromise a patient's immune system, patients are unable to clear out the weakened rubella virus contained in the vaccine. That virus persists in their bodies, damaging skin cells and even leading to ulcers.

"This research reinforces the warning already found in rubella vaccine package inserts," said Sullivan. "It gives additional guidance to physicians and families as to who should be restricted from the MMR vaccine. All of the patients with this complication had pretty severe immune compromise of their T cells--the cells responsible for clearing viral infections."

The Centers for Disease Control and Prevention (CDC) and The Children's Hospital of Philadelphia supported this study.

"Rubella persistence in epidermal keratinocytes and granuloma M2 macrophages in patients with primary immunodeficiencies," The Journal of Allergy and Clinical Immunology, published online Sept. 6, 2016, in print Nov. 2016. http://doi.org/10.1016/j.jaci.2016.06.030

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Study challenges model of Alzheimer's disease progression

Alzheimer's disease is a neurodegenerative disorder for which, despite years of research, there are no effective treatments or cures.

However, recent breakthroughs in molecular genetics have shown that the disease may spread, like an infection, across closely connected areas of the brain. These findings underscore the need for research aimed at tracking its spread to the earliest points of origin in the brain, so therapies that target those areas can be developed.

An international collaboration between Nathan Spreng, Cornell assistant professor of human development and the Rebecca Q. and James C. Morgan Sesquicentennial Faculty Fellow in the College of Human Ecology, and Taylor Schmitz of the University of Cambridge's

Cognitive Brain Sciences Unit, sheds light on the basal forebrain region, where the degeneration of neural tissue caused by Alzheimer's disease appears even before cognitive and behavioral symptoms of the disease emerge.

Their paper, "Basal forebrain degeneration precedes and predicts the cortical spread of Alzheimer's pathology," is published Nov. 4 in Nature Communications. Data used for their work were obtained from the Alzheimer's Disease Neuroimaging Initiative database.

The basal forebrain contains very large and densely connected neurons that are particularly vulnerable to the disease. Schmitz and Spreng show that, as Alzheimer's progresses, degeneration of the basal forebrain predicts subsequent degeneration in temporal lobe areas of the brain involved in memory. This pattern is consistent with other research showing that Alzheimer's indeed spreads across brain regions over time, but the study challenges a widely held belief that the disease originates in the temporal lobe.

"We're hoping that this work pushes a bit of a reorganization of the field itself, to reappraise where the disease originates," Spreng said. "That could open up new avenues for intervention; certainly it would for detection."

Their report is the product of a two-year study of a large sample of age-matched older adults. Within this sample, one group was cognitively normal, according to standard tests, while others were characterized by different levels of cognitive impairment:

individuals with mild cognitive impairment (MCI) who did not progress to Alzheimer's disease;

MCI individuals who progressed to Alzheimer's after one year; and

individuals classified as having Alzheimer's throughout the duration of the study.

Through analysis of high-resolution anatomical magnetic resonance imaging of brain volumes, taken three times over the two-year study period, the researchers were able to determine that individuals with MCI or Alzheimer's showed greater losses in gray matter volume in both the basal forebrain and temporal lobe, compared with cognitively normal controls. Intriguingly, they showed that over the two-year period, degeneration of neural tissue in the basal forebrain predicted subsequent tissue degeneration in the temporal lobe, but not the other way around.

A sampling of spinal fluid from healthy adults can detect an abnormal level of beta amyloid, indicative of Alzheimer's, Spreng said. Test results showed that temporal lobes looked the same regardless of amyloid level, but the basal forebrain showed notable degeneration among those seemingly healthy adults with abnormal amyloid levels.

Spreng admits that being able to predict who will get the disease doesn't mean a lot without a protocol to treat and, ultimately, cure the disease. "And it might induce more anxiety," he said. But the more knowledge that can be gained now, he said, the better.

"Future molecular genetics work holds strong promise for developing therapeutic strategies to prevent the spread of pathology at stages of Alzheimer's preceding cognitive decline," Schmitz said. "Our clarification of an earlier point of Alzheimer's propagation is therefore of utmost importance for guiding endeavors to combat this devastating disease."

This work was funded by grants from the National Institutes of Health and the Alzheimer's Association.

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Do Kids Take Years Off Your Life? Giving Birth May Make Cells 'Older'

Women who give birth may be biologically "older" than women who don't, a new study suggests.

By Rachael Rettner, Senior Writer

For the study, the researchers analyzed information from 1,556 U.S. women ages 20 to 44 who took part in a national survey from 1999 to 2002, which involved giving blood samples.

The researchers looked at the genetic material inside the women's cells, specifically the length of their telomeres. These are caps on the

ends of chromosomes that protect the chromosomes from damage. Telomeres naturally shorten as people age, but the structures don't shorten at the same rate in every person. The longer a person's telomeres are, the more times their cells could hypothetically still divide, research has shown. Thus, telomeres are considered a marker of biological age — that is, the age of a person's cells, rather than the individual's chronological age.

Women in the survey who said they'd given birth to at least one child had telomeres that were about 4 percent shorter, on average, than those of women who'd never given birth. The findings held even after the researchers took into account other factors that could affect telomere length, including the women's chronological age, body mass index and smoking habits. These findings suggest that a "history of live birth may be associated with shorter telomeres," the researchers wrote in their abstract, which was presented this week at the meeting of the American Public Health Association in Denver.

The study was not designed to determine the reason behind the link, the researchers said. But one hypothesis is that having children increases stress levels, and high stress has been linked with shorter telomeres, the scientists said.

"It is possible that pregnancy, birth and child-rearing can induce chronic stress, leading to shorter telomere length perhaps through an inflammatory pathway," study researcher Anna Pollack, an assistant professor and environmental and reproductive epidemiologist at George Mason University, in Fairfax, Virginia, told Live Science. However, because the survey was conducted at a single point in time, the researchers cannot determine which came first in the women's lives — giving birth or having shorter telomeres, Pollack said. It's also possible that for some yet-unknown reason, women with shorter telomeres are more likely than women with longer ones to have children, Pollack said.

More studies are needed that follow women over time and measure the length of their telomeres before, during and after pregnancy, she said. "It would be interesting to see how telomere length changes during pregnancy, after birth and during the child-rearing years, and how these changes compare to women who do not have children," Pollack said.

Future studies could also investigate the findings further, by including a measurement of women's levels of cortisol, a hormone linked to stress, said study researcher Kelsey Rivers, an undergraduate student at George Mason University majoring in global and community health, who presented the findings.

Other studies could compare telomere length in women who have given birth with telomere length in those who adopt children, to see if the effect might be linked to parenting or giving birth, Rivers said. The researchers are working on publishing the findings in a peer-reviewed scientific journal.

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Huge lake discovered 15 kilometres under a volcano

Our planet is blue inside and out.

By Andy Coghlan

A massive reservoir of water has been discovered deep beneath a volcano in the Andes, and Earth's interior may be dotted with similar wet pockets lurking below other major volcanoes.

Landscape showing the Uturuncu volcano **Michael Sayles/Alamy Stock Photo**

The unexpected water, which is mixed with partially melted magma, could help to explain why and how eruptions happen.

This water may also be playing a role in the formation of the continental crust we live on, and could be further evidence that our planet has had water circulating in its interior since its formation.

Deep Earth in a lab

Jon Blundy of the University of Bristol, UK, and his colleagues made the discovery while studying a huge "anomaly" 15 kilometres beneath the currently dormant Uturuncu volcano in the Bolivian Andes. The anomaly, called the Altiplano-Puna magma body, slows down seismic waves and conducts electricity, unlike surrounding magma.

Blundy's team took rocks that were spat out by an eruption of Uturuncu 500,000 years ago and mixed them with varying amounts of water before exposing them in the lab to conditions mimicking those in the anomaly. This included pressures 30,000 times as high as atmospheric pressure, and temperatures up to 1500 °C. "We reproduced conditions deep in the Earth in the lab," says Blundy.

They found that at a particular water content, the electrical conductivity exactly matched the value measured in the anomaly. "By weight, we calculated it contains 8 to 10 per cent water," says Blundy.

Staggering amount

The Altiplano-Puna magma body is known to be around half a million cubic kilometres in volume, so the researchers estimate it must contain a similar amount of water to some of the largest freshwater lakes on Earth. "It's probably somewhere between Lake Superior and Lake Huron," says Blundy. "It's a staggeringly large amount."

Other anomalies with similar unexplained conductivity have been discovered beneath other volcanoes, such as those in the Taupo Volcanic Zone in New Zealand, and Mount St Helen's in Washington State, which erupted spectacularly in 1980. It's likely that these are also signs of secret reservoirs.

"This study illuminates a new feature of Earth's deep-water cycle, and reminds us how little we know about the pathway of water through Earth's crust and mantle systems on geologic timescales," says Steve Jacobsen of Northwestern University in Evanston, Illinois, whose team previously discovered a reservoir of water three times the volume of all the oceans 700 kilometres down in the mantle.

Such discoveries add to growing evidence that significant amounts of water exist in Earth's interior, some of which may even have been the source of today's oceans. It could be that the water that makes our planet habitable was present in the dust that coalesced to create Earth, rather than arriving later on ice-rich comets or asteroids.

Beyond our reach

We can forget about extracting the newly found water. "It's dissolved in partially melted rock at 950 to 1000 °C, so it's not accessible," says Blundy. But increased water content in magma may help to explain the composition of continental crust rocks. When magma in the mantle – mainly composed of basalt – rises up into the crust, the water helps to enrich the basalt with silica and deplete it of magnesium, eventually forming rocks like the andesite found beneath the Andes.

"The process in Uturuncu is a microcosm of continental crust formation, and involves much more water than we thought, probably twice as much," says Blundy.

Water is also one of the volatile components dissolved in magma that drive volcanic eruptions, he says. "Dissolved at shallower depths where the pressure is lower, it comes out as bubbles, which end up as an explosive eruption."

In the future, understanding more about how water can trigger eruptions could help volcanologists better interpret seismic activity, perhaps improving predictions. "Our results will hopefully improve our ability to interpret these signals of unrest," says Blundy.

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http://bit.ly/2fdcK2X

Mimicking nature turns sewage into biocrude oil in minutes

Sludge from Metro Vancouver's wastewater treatment plant has been dewatered prior to conversion to biocrude oil at Pacific Northwest National Laboratory

David Szondy

Biofuels are often touted as an alternative to fossil fuels, but many depend on raw materials that would quickly become scarce if production were scaled up. As an alternative to these alternatives, the