Did you know that exercise enhances ageing brains?

Sedentary, older adults who took aerobic dance classes twice a week showed improvements in brain areas critical for memory and thinking

Exercise can change how crucial portions of our brain communicate as we age, improving aspects of thinking and remembering, according to a fascinating new study of ageing brains and aerobic workouts. The study, which involved older African-Americans, finds that unconnected portions of the brain's memory centre start interacting in complex and healthier new ways after regular exercise, sharpening memory function.

The findings expand our understanding of how moving moulds thinking and also underscore the importance of staying active, whatever our age. The idea that physical activity improves brain health is well established by now. Experiments involving animals and people how exercise increases neurons in the hippocampus, which is essential for memory creation and storage, while also improving thinking skills. In older people, regular physical activity helps slow the usual loss of brain volume, which may help to prevent age-related memory loss and possibly lower the risk of dementia. There have been hints, too, that exercise can alter how far-flung parts of the brain talk among themselves. In a 2016 M.R.I. study, for instance, researchers found that disparate parts of the brain light up at the same time among collegiate runners but less so among sedentary students. This paired brain activity is believed to be a form of communication, allowing parts of the brain to work together and improve thinking skills, despite not sharing a physical connection. In the runners, the synchronized portions related to attention, decision making and working memory, suggesting that running and fitness might have contributed to keener minds.

But those students were young and healthy, facing scant imminent threat of memory loss. Little was known yet about whether and how exercise might alter the communications systems of creakier, older brains and what effects, if any, the rewiring would have on

thinking. So, for the new study, which was published in January in Neurobiology of Learning and Memory, Mark Gluck, a professor of neuroscience at Rutgers University in Newark, N.J., and his colleagues decided to see what happened inside the brains and minds of much older people if they began to work out.

In particular, he wondered about their medial temporal lobes. This portion of the brain contains the hippocampus and is the core of our memory centre. Unfortunately, its inner workings often begin to sputter with age, leading to declines in thinking and memory. But Dr. Gluck suspected that exercise might alter that trajectory. Helpfully, as the director of the Ageing & Brain Health Alliance at Rutgers, he already was leading an ongoing exercise experiment. Working with local churches and community centres, he and his collaborators previously had recruited sedentary, older African-American men and women from the Newark area. The volunteers, most of them in their 60s, visited Dr. Gluck's lab for checks of their health and fitness, along with cognitive testing. A few also agreed to have their brain activity scanned. Some then started working out, while others opted to be a sedentary control group. All shared similar fitness and memory function at the start. The exercise group attended hour-long aerobic dance classes twice a week at a church or community centre for 20 weeks.

Now, Dr. Gluck and his research associate Neha Sinha, along with other colleagues, invited 34 of those volunteers who had completed an earlier brain scan to return for another.

Seventeen of them had been exercising in the meantime; the rest had not. The groups also repeated the cognitive tests. Then the scientists started comparing and quickly noticed subtle differences in how the exercisers' brains operated. Their scans showed more-synchronized activity throughout their medial temporal lobes than among the sedentary group, and this activity was more dynamic. Portions of the exercisers' lobes would light up together and then, within seconds, realign and light up with other sections of the lobe.

Such promiscuous synchronizing indicates a kind of youthful flexibility in the brain, Dr. Gluck says, as if the circuits were smoothly trading dance partners at a ball. The exercisers' brains would "flexibly rearrange their connections," he said, in a way that the sedentary group's brains could not.

Just as important, those changes played out in people's thinking and memories. The exercisers performed better than before on a test of their ability to learn and retain information and apply it logically in new situations. This kind of agile thinking involves the medial temporal lobe, Dr. Gluck says, and tends to decline with age. But the older exercisers scored higher than at the start, and those whose brains displayed the most new interconnections now outperformed the rest. This study involved older African-Americans, though, a group that is underrepresented in health research but may not be representative of all ageing people. **—CNA**

Scientists grow bile duct organoids to repair livers

Bile is made in the liver. It contains a mix of products such as bilirubin, cholesterol, and bile acids and salts. Bile ducts are drainage "pipes" that carry bile from the liver to the
gallbladder and from the gallbladder to the small intestine.

In other words, Bile ducts act as the liver's waste disposal system. Malfunctioning bile ducts are behind a third of adults and 70 percent of children's liver transplantations, with no alternative treatments. There is currently a shortage of liver donors: according to the NHS, the average waiting time for a liver transplant in the UK is 135 days for adults and 73 days for children. This means that only a limited number of patients can benefit from this therapy. Increasing organ availability or providing an alternative to whole organ transplantation could be the solution.

In a study published today in Science, scientists at the University of Cambridge have developed a new approach. Using a technique, they grow bile duct organoids – often referred to as 'mini-organs' in the lab to repair human livers in regenerative medicine first. Their approach could repair damaged organ donor livers so that they can still be used for transplantation. This new approach relies on a recent 'perfusion system' used to maintain donated organs outside the body. Using this technology, scientists demonstrated that it is possible to transplant biliary cells grown in the lab known as cholangiocytes into damaged human livers to repair them. Dr. Fotios Sampaziotis from the Wellcome-MRC Cambridge Stem Cell Institute said, "Given the chronic shortage of donor organs, it's important to look at ways of repairing damaged organs or even provide alternatives to organ transplantation. We've been using organoids for several years to understand biology and disease or their regeneration capacity in small animals. Still, we have always hoped to be able to use them to repair damaged human tissue. Ours is the first study to show, in principle, that this should be possible." Scientists used single-cell RNA sequencing and organoid culture techniques to determine that the duct cells differentiate biliary cells from the gallbladder. The disease usually spares this and could be converted to the bile duct cells usually destroyed in condition (intrahepatic ducts) and vice versa using a bile component known as bile acid. This means that the patient's cells from disease-spared areas could be used to repair destroyed ducts.

Scientists tested their hypothesis by growing gallbladder cells as organoids in the lab. After grafting these gallbladder organoids into mice, they found that the organoids were indeed able to repair damaged ducts, opening up avenues for regenerative medicine applications in the context of diseases affecting the biliary system. The team used the technique on human donor livers taking advantage of the perfusion system used by researchers based at Addenbrooke's Hospital, part of Cambridge University Hospitals NHS Foundation. They injected the gallbladder organoids into the human liver and showed for the first time that the transplanted organoids repaired the organ's ducts and restored their function. This study, therefore, confirmed that their cell-based therapy could be used to repair damaged livers.

Professor Ludovic Vallier from the Wellcome-MRC Cambridge Stem Cell Institute, joint senior author, said: "This is the first time that we've been able to show that a human liver can be enhanced or repaired using cells grown in the lab. We have further work to do to test the safety and viability of this approach, but hopefully, we will be able to transfer this into the clinic in the coming years." Mr. Kourosh Saeb-Parsy from the Department of Surgery at the University of Cambridge and Cambridge University Hospitals NHS Foundation Trust, joint senior author, added: "This is an important step towards allowing us to use organs previously deemed unsuitable for transplantation. In the future, it could help reduce the pressure on the trans-

Eating processed meat is linked to dementia risk

More men than women were diagnosed with dementia in the study population

The risk of dementia is increasing globally. Its development and progression are associated with both genetic and environmental factors, including diet and lifestyle.

Meat consumption has traditionally been associated with the risk of dementia, but specific amounts and types related to the risk of incident dementia are poorly understood. A new study aimed to explore the connection between consuming meat and the risk of incident dementia. The study conducted by the University of Leeds used data from 500,000 people, discovering that consuming a 25g serving of processed meat a day is associated with a 44% increased risk of developing the disease.

The study also shows that eating some unprocessed red meat, such as beef, pork, or veal, could be protective, as people who consumed 50g a day were 19% less likely to develop dementia. Lead researcher Huifeng Zhang, a Ph.D. student from Leeds' School of Food Science and Nutrition, said, "Our research adds to the growing body of evidence linking processed meat consumption to increased risk of a range of non-transmissible diseases." For this study, scientists analyzed the data provided by UK Biobank. They wanted to determine associations between consuming different types of meat and the risk of developing dementia.

The data was collected in 2006-2010, which includes how often participants consumed different kinds of meat, six options from never to once or

more daily. Among the participants, 2,896 cases of dementia emerged over an average of eight years of follow-up. These people were generally older, more economically deprived, less educated, more likely to smoke, less physically active, more likely to have stroke history and family dementia history, and more likely to be carriers of a highly associated gene associated with dementia. What's more, compared to women, men were more likely to be diagnosed with dementia in the study population.

Some people were three to six times more likely to develop dementia due to well-established genetic factors. Still, the findings suggest the risks from eating processed meat were the same whether or not a person was genetically predisposed to developing the disease. This study is believed to be the first large-scale study of participants over time to examine a link between specific meat types and amounts and the risk of developing the disease. Ms. Zhang said: "Further confirmation is needed, but the direction of effect is linked to current healthy eating guidelines suggesting lower intakes of unprocessed red meat could be beneficial for health."

Professors Janet Cade from Leeds said, "Anything we can do to explore potential risk factors for dementia may help us to reduce rates of this debilitating condition. This analysis is a first step towards understanding whether what we eat could influence

Using AI to detect how humans have adapted to recent diseases

Artificial intelligence can help spot traces of natural selection

In the natural selection process, beneficial gene mutations are preserved from generation to generation until they become dominant in our genomes. The protection against pathogens drives the process.

However, gene mutations that are protective against one pathogen could make people susceptible to new diseases whenever there is a change in the environment. Familial Mediterranean Fever (FMF) is one example of such disease. It is an autoimmune disease that has emerged over the past 20,000 years in southern Europe, the Middle East, and northern Africa. Around 50 percent of the people in the region today carry a gene mutation that makes them more susceptible to the disease.

This prevalence of a seemingly detrimental gene mutation could be the consequence of two distinct kinds of natural selection. One choice is 'incomplete sweep', where the gene mutation for vulnerability is currently being eliminated from the populace. However, it has not yet been destroyed. For this situation, natural selection is ongoing. The other option is 'balancing selection, where some potentially detrimental gene mutations for one condition are preserved in the population because they confer some protection against different diseases. In this case,

the gene for FMF susceptibility has been associated with protection against the bacteria Yersinia pestis, which causes the plague. To determine which version of natural selection is at play in FMF, scientists used advanced AI and large genomic data sets. They trained their algorithm on datasets that have known values to test their ability to spot patterns. Scientists ran their algorithm on the database for the 1000 genomes project, which holds genomic data for 2,504 individuals from 26 populations, including the relevant ones around the Mediterranean.

They discovered that the FMF gene mutations are still prevalent due to ongoing selection; they haven't reached an equilibrium yet, and natural selection is still acting.

Lead researcher Dr. Matteo Fumagalli, from the Department of Life Sciences at Imperial, said: "This is the first tool to test the difference between different types of natural selection, finding signals in the genome that have previously been inaccessible. "Now we have proven that AI can be used to search genomes for subtle patterns of selection, we can use it to investigate further how humans have both adapted to old diseases, like the plague, and relatively new diseases, like FMF." **—Agencies**