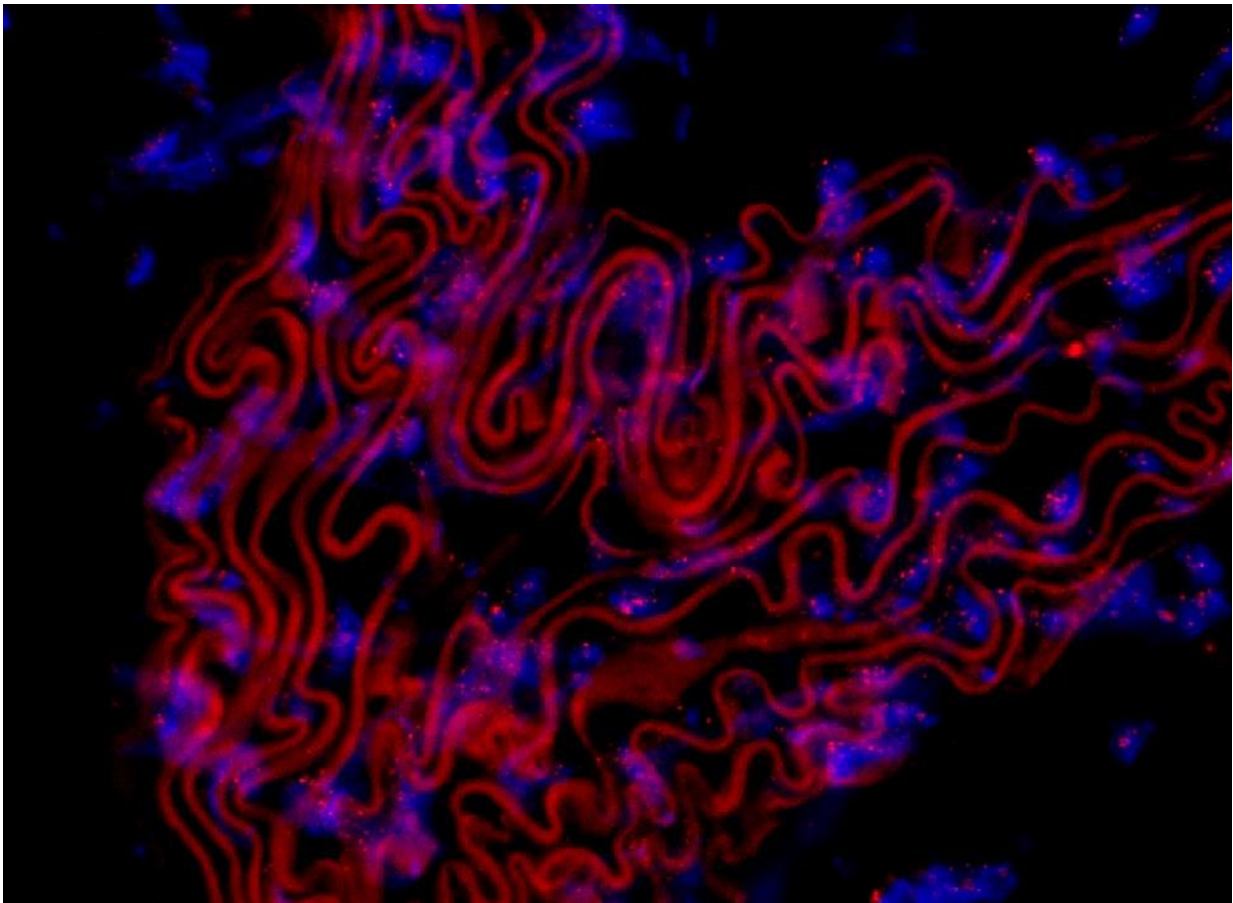


Endurance but not resistance training has anti-aging effects

November 27 2018



Microscopic image of thin sections of a thoracic mouse aorta exposed to a fluorescent probe to stain telomeres. Nuclei of cells are stained blue and telomeres are shown by red dots within nuclei. The fluorescence intensity correlates with telomere length. Red curved lines are from elastin auto-fluorescence. Credit: PD Dr. Christian Werner, University Clinic of the Saarland, Homburg, Germany, and the *European Heart Journal*.

Researchers have discovered evidence that endurance exercise, such as running, swimming, cross-country skiing and cycling, will help you age better than resistance exercise, which involves strength training with weights.

In a study published in the *European Heart Journal* today, researchers in Germany looked at the effects of three types of exercise—[endurance training](#), [high intensity interval training](#) and resistance training—on the way cells in the human body age, and they found that [endurance](#) and high intensity training both slowed or even reversed cellular aging, but that resistance training did not.

Our DNA is organised into chromosomes in all the cells in our bodies. At the end of each chromosome is a repetitive DNA sequence, called a telomere, that caps the chromosome and protects its ends from deteriorating. As we grow older, the telomeres shorten and this is an important molecular mechanism for cell aging, which eventually leads to cell death when the telomere are no longer able to protect the chromosomal DNA. The process of telomere shortening is regulated by several proteins. Among them is the [enzyme telomerase](#) that is able to counteract the shortening process and can even add length to the telomeres.

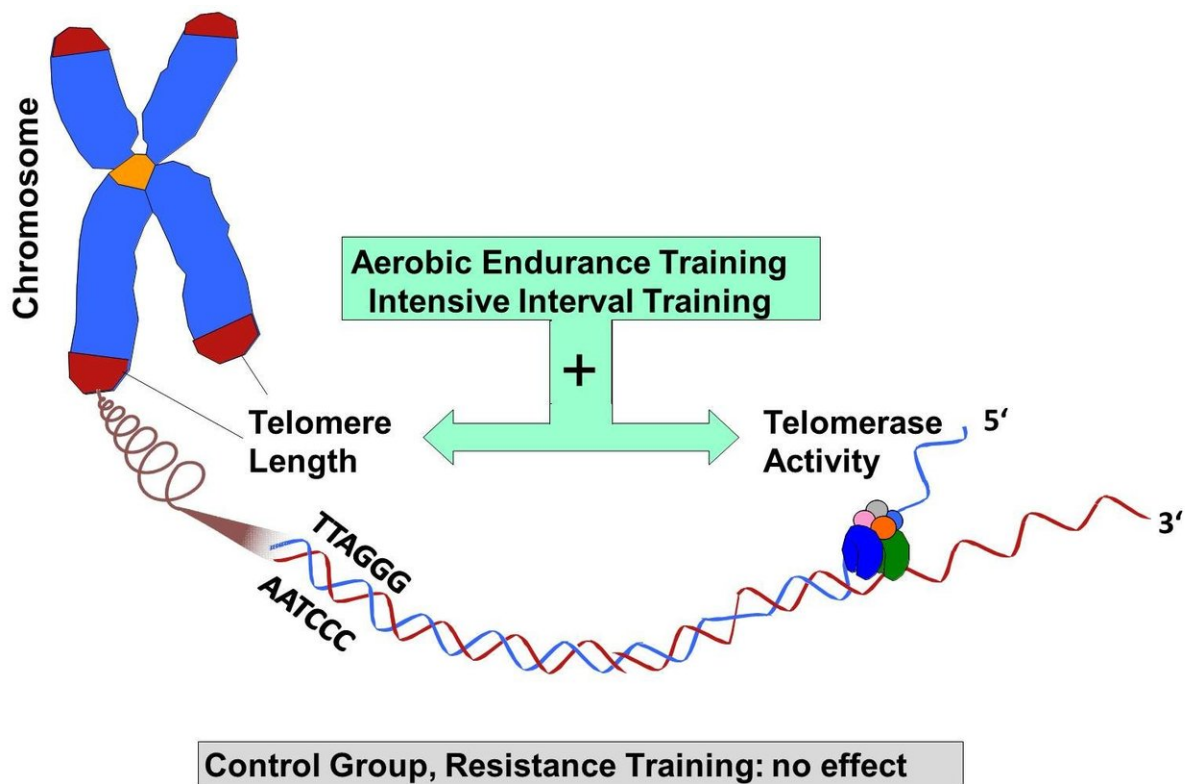
The researchers led by Professor Ulrich Laufs, of Leipzig University, Germany, enrolled 266 young, healthy but previously inactive volunteers and randomised them to six months of endurance training (continuous running), high intensity interval training (warm-up, followed by four bouts of high intensity running alternating with slower running, and then a final cool down of slower running), resistance training (circuit training on eight machines, including back extension, crunch, pulldown, seated rowing, seated leg curl and extension, seated chest press and lying leg

press), or to an unchanged lifestyle (the control group).

The participants who were randomised to the three forms of exercise undertook three 45-minutes sessions a week, and a total of 124 completed the study. The researchers analysed telomere length and [telomerase activity](#) in white blood cells in blood taken from the volunteers at the start of the study, and two to seven days after the final bout of exercise six months later.

Prof Laufs said: "Our main finding is that, compared to the start of the study and the control group, in volunteers who did endurance and high intensity training, telomerase activity and telomere length increased, which are both important for cellular aging, regenerative capacity and thus, healthy aging. Interestingly, resistance training did not exert these effects."

Telomerase activity was increased two- to three-fold and telomere length was increased significantly in the endurance and high intensity training groups compared to the resistance and control groups.



Take home image showing the effects of three types of exercise -- endurance training, high intensity interval training and resistance training -- on the way cells in the human body age, and they found that endurance and high intensity training both slowed or even reversed cellular aging, but that resistance training did not. Credit: Ulrich Laufs, Christian Werner and the *European Heart Journal*

"The study identifies a mechanism by which endurance training—but not resistance training—improves healthy aging. It may help to design future studies on this important topic by using telomere length as indicator of 'biological age' in future intervention studies," said Prof Laufs.

Co-author of the study, Dr. Christian Werner, of Saarland University, Germany, said: "The study has several implications: Our data support the

European Society of Cardiology's current guideline recommendations that [resistance exercise](#) should be complementary to endurance training rather than a substitute. The data identify telomerase activity and telomere length as sensitive ways to measure at cell level the effects of different forms of exercise. Using these measurements to guide training recommendations for individuals may improve both adherence to and efficacy of exercise training programmes in preventing cardiovascular disease."

Previous research has shown that longer telomeres and increased telomerase activity are associated with healthy aging. However, this is the first prospective, randomised controlled study of the effects of different forms of exercise on these two measurements of cellular aging.

Prof Laufs said: "Physical exercise is widely recommended. However, prospective randomised controlled training studies are very rare because they require a great effort and there are no funding sources from industry. The numbers of participants in our study may appear small compared to large drug trials, however, to the best of our knowledge, this is the largest randomised study comparing well defined training modalities with a control group and with a long duration of six months. We hope that our project will stimulate confirmation and further studies in this field."

A possible mechanism that might explain why endurance and high intensity training could increase telomere length and telomerase activity is that these types of exercise affect levels of nitric oxide in the blood vessels, contributing to the changes in the cells.

"From an evolutionary perspective, endurance and [high intensity](#) training may mimic the advantageous travelling and fight or flight behaviour of our ancestors better than strength training," said Dr. Werner.

Limitations of the study include the fact that the number of participants is small, even though it represents the largest study to investigate this in a prospective and randomised controlled way; and the everyday activities of the participants outside the training sessions may have included elements of the other forms of [exercise](#), but this would be likely in all the groups, including the [control group](#).

In an accompanying editorial by Professor Konstantinos Stellos and Professor Ioakim Spyridopoulos, from Newcastle University and Freeman Hospital, Newcastle Upon Tyne, UK, who were not involved in the research, write that so far there has been no evidence that the role played by telomerase to maintain telomere length is implicated in the onset of cardiovascular disease, except maybe for heart failure. Rather, it appears that an acceleration in [telomere](#) shortening may be a sign of increased oxidative stress and a higher turnover of cells, coinciding with diminished telomerase activity. However, telomerase leads to enhanced nitric oxide, decreased oxidative stress, reduced damage to [cells'](#) DNA and reduced cell death, which are all important for delaying the clogging up of arteries with fatty deposits. They conclude that the findings from the study by Dr. Werner and Prof Laufs "clearly underline the advantage of aerobic endurance training compared to resistance [training](#) in cardiovascular ageing".

More information: "Differential effects of endurance, interval and resistance training on telomerase activity and telomere length in a randomized, controlled study ", by Christian Werner et al. *European Heart Journal*. [DOI: 10.1093/eurheartj/ehy585](https://doi.org/10.1093/eurheartj/ehy585)

"Exercise, telomerase activity and cardiovascular disease prevention," by Konstantinos Stellos and Ioakim Spyridopoulos. *European Heart Journal*. [DOI: 10.1093/eurheartj/ehy707](https://doi.org/10.1093/eurheartj/ehy707)

Provided by European Society of Cardiology

Citation: Endurance but not resistance training has anti-aging effects (2018, November 27)
retrieved 3 May 2024 from

<https://medicalxpress.com/news/2018-11-resistance-anti-aging-effects.html>

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