Can we treat cellular aging like a disease for higher impact care?

February 1 2024, by Nicole Ehrhart

Engaging companion dogs in health span clinical trials provides a chance to enhance their well-being and life span, not only for their benefit, but also as a more accurate predictor of the effectiveness of health span. Credit: John Cline

Expected life span for human beings has been extended significantly

over the last century, thanks to medical advancements that have resulted in vaccines to prevent common infectious diseases, improved sanitation practices and better nutrition. However, this longevity revolution comes with a steep price. The exponential rise in rates of Alzheimer's and cardiovascular diseases, cancer, dementia and physical frailty across the globe are by-products of a longer life span. Humankind simply had to start living long enough to experience them.

This phenomenon refers to a foundational concept in aging studies: that while life span has increased, health span—or the number of years we spend living without the burden of chronic disease—has not kept pace. We're living longer, but not necessarily living healthier for longer.

Definitions of aging

From a physiological perspective, aging is the highest risk factor for diseases that are on the rise globally. Put simply, changes in our cells and tissues occur with the passage of time. We call this aging. Older bodies are made up of older cells that are less and less able to repair from the wear and tear of everyday function or damage. Subsequently, when enough unrepaired cells accumulate within an organ or body system, the system fails to work properly. We recognize this dysfunction as a disease.

Modern medicine does what it can to detect and treat diseases of aging, one at a time, as they occur. This involves reacting to the onset of disease, rather than preventing it. Addressing individual diseases in this manner has led to incremental success in the treatment of certain cancers, dementia and cardiovascular diseases, but the underlying biologic processes of aging continue to march on in the background, undeterred from these treatments. In other words, knock one aging disease down and another manifests shortly after. The longer we live, the shorter the timeline between the occurrence of such diseases.

Geroscience

This observation leads to some important questions. If aging is the common thread linking all chronic diseases of older age, could we think of cellular aging itself as a "disease" and therefore "treat" the condition of aging? If so, could we reverse or slow the accumulation of unrepaired damage within our cells, and thereby halt the decline in function that ultimately leads to disease?

These questions have led to the formation of geroscience as an interdisciplinary field of study that seeks to translate knowledge gained from aging research to prevent, minimize or reverse detrimental age-related changes and functional decline in older individuals.

Until very recently, too little was known about how the cellular aging process happens to address these questions. However, in the last two decades, aging research has led to a deep understanding of the fundamental processes that drive cellular aging and how those changes ultimately lead to disease. As a result, it is now possible to significantly slow the rate of aging in other species, resulting in significant life span and health span improvements.

The impact of this scientific progress is mind-boggling. Rather than treating one disease at a time as it occurs, we could potentially slow down the process of aging and lower the risk of all fatal and disabling diseases of aging at once.

The dawn of age-modifying therapeutics that extend human health into old age is on the horizon. However, the road map to bringing such treatments to humans is exceedingly challenging.

Obstacles to advancement

Chief among these challenges is that the Food and Drug Administration does not recognize aging as a treatable condition. The FDA approval pathway only considers the effect of a new therapeutic on specific individual diseases. There is no current pathway for approval of therapeutics that target aging itself, even though such interventions are possible. Scientists and policymakers are now encouraging the FDA to reconsider its definition of aging and develop pathways to allow for age-reversing medications to be tested and approved for humans.

However, even if such regulatory reform takes place, there is a second major challenge. Any clinical trial testing for improved health span in humans will take multiple decades to complete. The expense associated with such a lengthy trial is enormous, and the return on investment would not be realized for a long time, thus disincentivizing investment by both big pharma companies and federal funding sources.

Thus, the direction forward must also include a way to study aging on an accelerated timeline, which brings us to the topic of model organisms in research. Laboratory mice—the most common species involved in testing the safety and effectiveness of a drug prior to human clinical testing—are astoundingly poor models of human aging. They live in highly controlled environments, eat identical diets and are genetic twins of one another. This is a far cry from humans, who are genetically diverse and have a myriad of social, economic, environmental and lifestyle behaviors that influence their health outcomes. Consequently, a mouse-to-man approach for new drugs has historically been unsuccessful.

Primates, our closest genetic relatives, are an alternative model in which to study age reversal drugs, but primates also have long lives, and when in a laboratory environment, they are not subject to the same variations in environment, exposures and habits as human populations.

However, there is another promising approach: a species that lives among us, shares our environments, lifestyle habits and social structures. They develop the same diseases of aging as humans, are genetically diverse and have access to well-established heath care systems and interventions, yet they age much more rapidly than humans. Enter the companion dog.

Man's best friend

Pet dogs have co-evolved with humans and represent a unique animal population that could be a powerful bridge to accelerating the development and approval of age reversal drugs in humans. There are millions of companion dogs in the United States, and the quality of veterinary care has paralleled human medical care, such that there is a large population of dogs living to old age and developing diseases of aging naturally, just as humans do.

The development of well-designed clinical trials to show health span extension in family dogs would need to include all the ethical and safety considerations of human clinical trials. Studies such as these are conducted while the pet continues to live out their daily life in their home with their family—while the medical team conducting the trial carefully ensures that their health and well-being are maintained. Pet owners can choose if they wish to voluntarily enroll their companion dogs in a study and participate in citizen science, collaborating with trained researchers to share observations, thereby co-creating and contributing to scientific outcomes.

Engaging companion dogs in health span clinical trials provides a chance to enhance their well-being and life span, not only for their benefit, but also as a more accurate predictor of the effectiveness of health span-extending drugs in human populations. Given the identical nature of most age-related diseases between dogs and humans, and the shorter

canine life span, the overall effect would be the acceleration of meaningful health span extension therapies for humans that our best friends get to benefit from too. In my role as director of CSU's Center for Healthy Aging, this is exactly what we're doing.

The Center unites and facilitates interdisciplinary research teams across CSU's colleges and programs to address the grand challenge of global aging. While our work spans many disciplines from the behavioral sciences to engineering, my personal passion and focus is to find ways to bridge the gap between discovery in geroscience and meaningful health span interventions that will impact how we, and the creatures we share our world with, can live our best lives.

Provided by Colorado State University

Citation: Can we treat cellular aging like a disease for higher impact care? (2024, February 1) retrieved 28 April 2024 from https://medicalxpress.com/news/2024-02-cellular-aging-disease-higher-impact.html