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RESEARCHING THE DYNAMICS OF THE AGING PROCESS

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A B S T R A C T

Aging is a complex process that leads to changes in all the systems of the body and all the functions of the person; however, aging develops at different rates in different people, and chronological age is not always consistent with biological age. Studies from the basic biology of aging using laboratory animals - and now extended to human populations - have led to the emergence of theories to explain aging. While there is no single “key” to explain aging, these studies have demonstrated that the rate of aging can be slowed, suggesting that targeting aging will coincidentally slow the appearance and/or reduce the burden of numerous diseases and increase health span (the portion of life spent in good health). Aging is associated with changes in dynamic biological, physiological, environmental, psychological, behavioral, and social processes. Some age-related changes are benign, such as graying hair.

K E Y W O R D S

Geographic regions, basic biology of aging, mechanism of aging, psychological factors, the effects of exercising.

Introduction

The ageing process is the gradual, decreased ability of the body to functions and to heal itself. As our body age, they naturally deteriorate in the late years, many essential functions begin operating at a suboptimal level. To develop new interventions for the prevention, early detection, diagnosis, and treatment of aging-related diseases, disorders, and disabilities, we must first understand their causes and the factors that place people at increased risk for their initiation and progression. NIA-supported researchers are engaged in basic science at all levels of analysis, from molecular to social, to understand the processes of aging and the factors that determine who ages “well” and who is susceptible to age-related disease and disability. Research is also ongoing to identify the interactions among genetic, environmental, lifestyle, behavioral, and social factors and their influence on the initiation and progression of age-related diseases and degenerative conditions. However, aging is the major risk factor for developing many major chronic diseases.

Material and Methods

Furthermore, many diseases appear to accelerate the aging process - which is manifested as declines in functionality and reduced quality of life. One of our challenges is to develop a clearer understanding of the basic biology underlying changes that accompany aging, as distinct from the basic biology underlying disease. Others result in declines in function of the senses and activities of daily life and increased susceptibility to and frequency of disease, frailty, or disability. In fact, advancing age is the major risk factor for a number of chronic diseases in humans. For example, in response to bacterial infections or wounds, inflammation is an essential part of the recovery and healing process. However, low-level chronic inflammation that appears in the absence of clinically diagnosed infection may increase the susceptibility to and rate of progression of age-related pathologies. This process is most visible and obvious in our skin the older we get the thinner our skin becomes. The third part of the ageing process involves the Cellular deco regulation of our national oxidative enzymes such as superoxide dismutase and catalase and glutathione peroxidase, making our antioxidant defense less efficient with age.

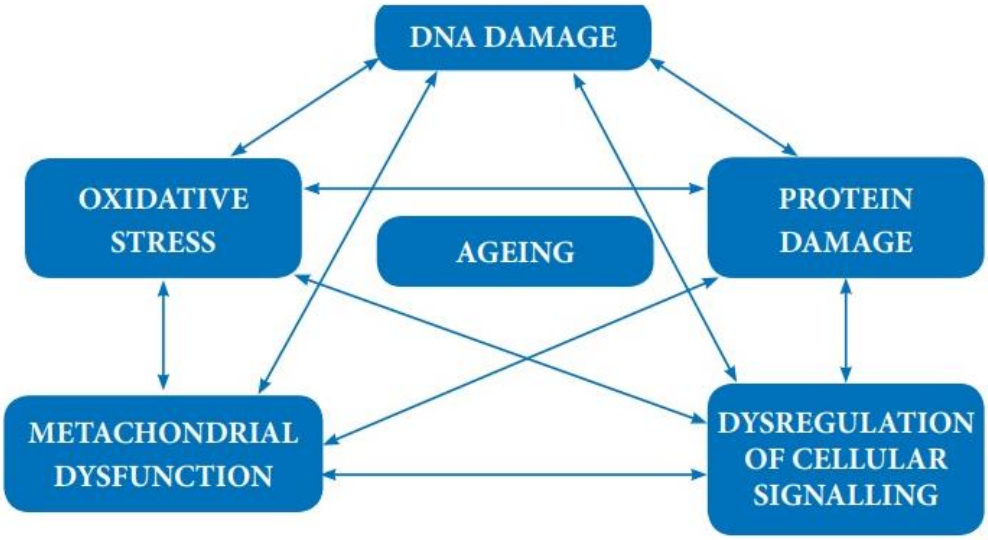

Figure 1. Mechanism of Ageing

Behavioral and psychological factors - for example, physical activity, smoking and other health behaviors, cognitive and social engagement, personality, and psychosocial stress - play a critical role in health across the lifespan. Studies have shown that up to 50% of preventable deaths in the U.S. can be attributed to adverse health behaviors such as smoking as well as unhealthy diet that result in obesity. Social factors, such as social relationships and socioeconomic circumstances, have a similarly important impact on health and well-being. We hypothesize that with the same facilities, coaching and training advice, average swimmers, for example, would produce maximum times appropriate to their abilities and that the profile of decreasing performance as a result of age would be the same as that produced by better physically endowed athletes. Aside from hypothetical elite genes there are other related issues that need to be addressed. Firstly, do people engage in exercise because they have a genetic predisposition to respond to exercise, and secondly, do about 80% of people choose inactivity because they cannot respond to exercise? Unsurprisingly, in a cross-sectional study of non-competitive men and women cyclists (albeit again self-selected) it was found that all the

physiological systems showed the expected effects of high levels of physical activity. This concept is demonstrated as the solid green curve in Figure 2.

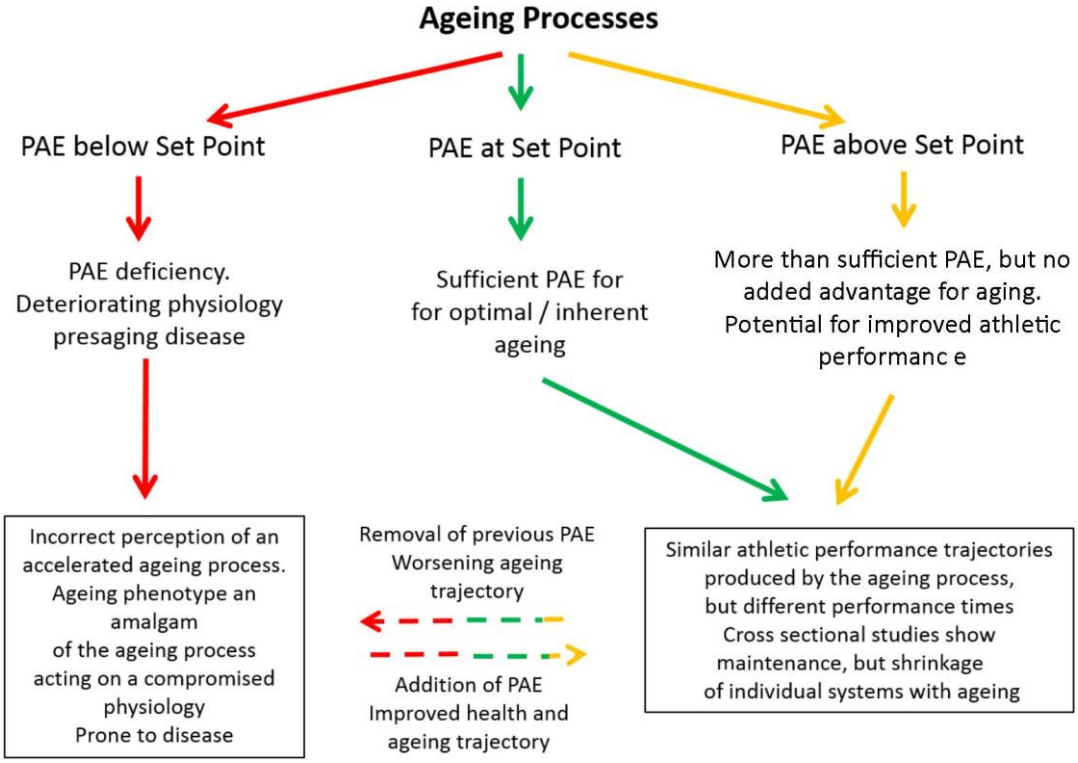

Figure 2. Schematic showing the effects of exercising

The mutual interaction of the aging process and exercise ensures that the functional ability of the diminishing physiological base is kept as efficient as possible. The aging process accomplishes this effect by, as yet, unknown integrating and synchronizing mechanisms. We hypothesize a central location/s for the control of these integrating functions, but more data is necessary and at present our hypothesis is heuristic. There are other hypotheses concerning the control of complex systems. Many of these concern non-biological systems and will not be discussed. For example, subjective feelings of loneliness are known to be a risk factor for serious functional declines and even death, and converging lines of evidence from multiple cross-national epidemiological studies indicate that social isolation is a major risk factor for morbidity and premature mortality. And the relationship between personality - relatively stable individual differences in dispositions to think, feel, and act in particular ways - and aging-related outcomes has been well documented: Conscientiousness is related both to longevity and to the development of AD, and neuroticism is linked to health in both positive and negative ways. A more comprehensive understanding of the causal pathways through which behavior, personality, social relationships, and socioeconomic circumstances are associated with health and well-being outcomes may suggest novel targets for intervention. Furthermore, we now know that behavioral and social factors interact with genetic, molecular, and cellular mechanisms to influence health at older ages.

Methodology

Basic behavioral science is uncovering individual-level psychological, social, and behavioral factors that predict adaptive and healthy aging or confer risk for age-related decline. Evidence suggests that

addressing these factors and their interplay are critical to minimizing disease and achieving full potential and vitality as people age. It appears that aging affects nearly all physiological systems. In order to follow these changes a measure of global physiological function is necessary. Such a measure is maximal athletic performance where many systems must be integrated to be able to perform at their limits. Thus, a change in performance over time (years) reflects the change in global physiological status with aging.

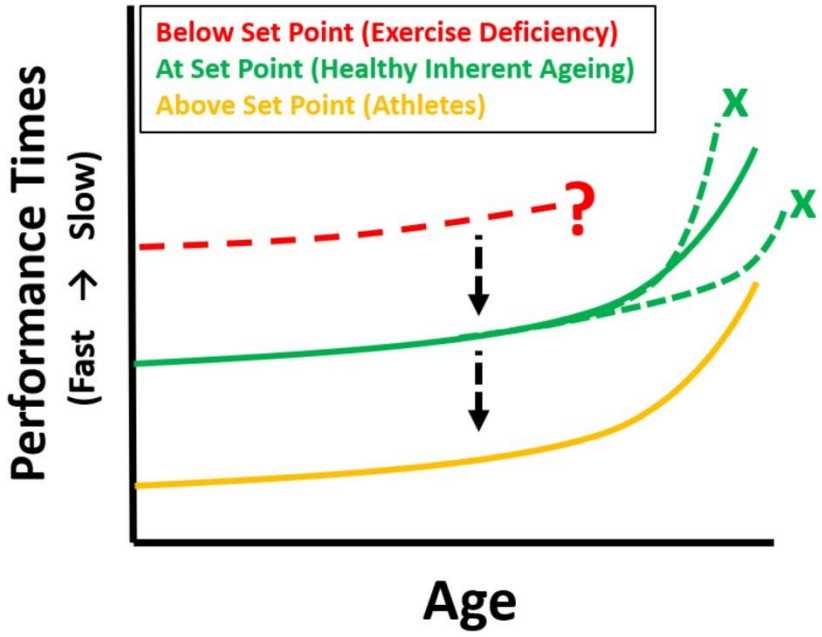

Figure 3. Theoretical longitudinal maximum performance curves

NIA will support and conduct research to verify these linkages and to better understand their underlying mechanisms. Research supported and conducted by NIA is helping to identify lifestyle factors and health behaviors that directly influence physical, cognitive, sensory, and emotional health and risk of disease as people age, such as research linking work and social engagement to cognition. Scientists are developing and refining recommendations for people of all ages regarding optimal diet, use of dietary supplements, mental stimulation, physical exercise, quality sleep, social engagement, stress reduction, and other practices to increase their likelihood of enjoying healthy old age. Still other researchers are looking for better ways to enhance the physical, mental, and social capacities of older adults and to expand opportunities for them to achieve personal goals and contribute to society in meaningful ways. As investigators more precisely identify the psychological, behavioral, and social processes that influence health and quality of life, we will be able to reinforce prevention efforts, enhance symptom management, and conserve function among older adults. Biological aging is a multifactorial process. The molecular hallmarks of aging and organ-specific physiological function are both influenced by genetic, epigenetic, and environmental factors. Metastatic aging may contribute to differential aging in remote tissues through a paracrine mechanism.

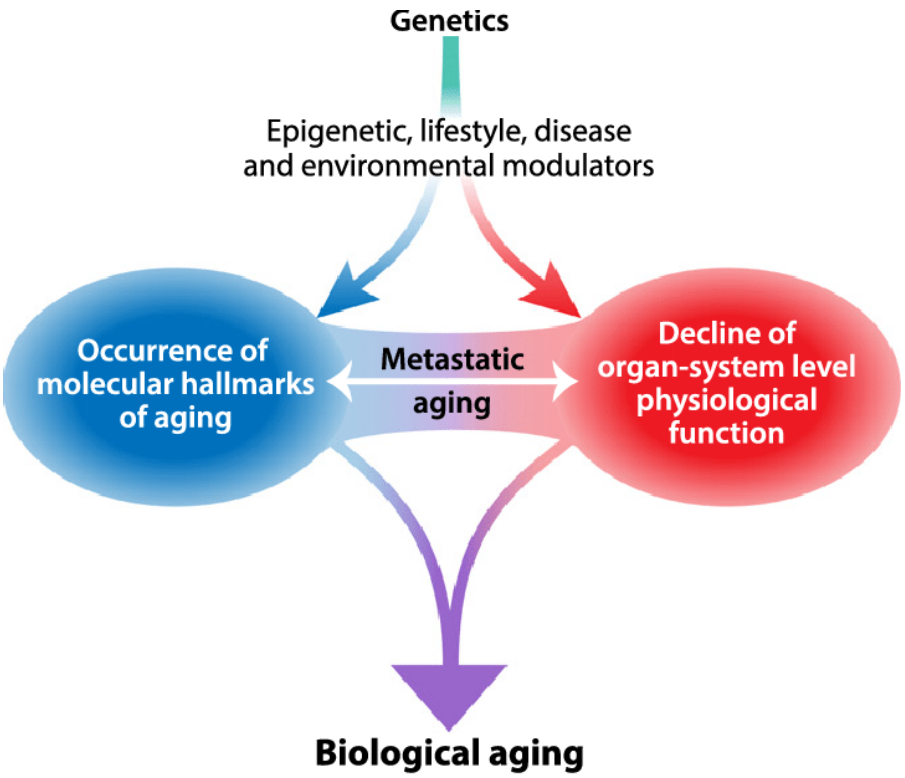

Figure 4. Biological aging is a multifactorial process

Chronic inflammation may also contribute to frailty in ways that are independent of obvious disease. These and newly emerging findings on the basic biology of aging hold great promise for improving health, and NIA is committed to continuing support of this research and translating these discoveries into interventions that support better health. First as we grow older, the number of mistakes incurred by daily Cellular reproduction increases. The body actually create non-functional cells, leading to more rapid deteriorate of the body's functions with advantage age. A large percentage of our cells even though they were present are useless. These non-functional cells sometime interfere with normal cellular process. The second part of the ageing process related to Cellular damage that cause the shortening of DNA. As time passes increased damage to healthy DNA leads to accelerated cell death and our old bodies simply cannot generate cells fast enough to compensate for the loss.

Conclusion

Gerontologists are focused not only on finding the best theory able to explain aging but also on identifying one or more markers, which are able to describe aging processes. These biomarkers are necessary to better define the aging-related pathologies, manage multimorbidity, and improve the quality of life. The aim of this paper is to review the most recent evidence on aging biomarkers and the clusters related to them for personalization of treatments.

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