Can Understanding Aging Lead to Measures to Increase Longevity?

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Health launched a Depression Awareness, Recognition, and Treatment Program aimed at informing the public that depression is a common, serious, treatable illness (Regier et al., 1988). The program was designed to run for ten years, and it was to be accompanied by the training of professional personnel to meet the anticipated increase in demand for services. Early information could be obtained from this experience that would facilitate the planning and execution of a rigorous intervention study that could pay rich dividends.

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References
distinguishes it from the Handbook of Physiology: Section 11, Aging. There are, however, chapters in the Timiras book that deal with the theories of aging, degenerative changes in cells, and oxidants and antioxidants. These chapters amount to short reviews intended to inform a broad range of biologists on the latest in molecular and cellular aging. The book closes with a chapter called “An Agenda for Healthful Aging,” which provides ideas on wellness and health promotion in the elderly, rehabilitation, and the possibility of life extension through future discoveries made by research into the basic biology of aging. Physiological Basis of Aging and Geriatrics, 2nd edition certainly meets its goal of providing the established facts on physiologic aging for a broad audience of biologists. For a more in-depth understanding of the aging process and its implications for continued health in old age, the Handbook of Physiology provides excellent coverage.

While aging is discussed from many viewpoints, at the level of molecular, cellular, and organ systems, in all of the books reviewed in the essay, Robin Holliday’s Understanding Ageing deserves special emphasis. Holliday’s central message, that the deterioration and diseases of old age are a direct consequence of the evolutionary design of higher organisms, deserves special emphasis. The anatomical and physiological features in most animals are simply incompatible with indefinite survival. The author argues that aging is due to the eventual breakdown in maintenance of various organ systems. This breakdown in maintenance is an inevitable consequence of the evolved anatomical and physiological makeup of the organisms.

Many theories of aging are discussed but Holliday concludes that these theories refer in one way or another to the failure of maintenance at the biochemical and physiological level. To understand aging, we need to consider the changes at the molecular level, which in turn leads to understanding cellular senescence, and finally to understanding tissue and organ system aging. The mechanisms involved in maintenance of organ, tissue, and cell function are discussed by Holliday relative to homeostatic mechanisms, which are stated to be basically organized to maintain the integrity of cell function. The events that may explain cellular aging are related for the most part to regulated programmed aging and to a second possibility of a multi-hit process involving random defects that may accumulate during cell division. These are transmitted to the next generation, so they gradually accumulate.

A major theme of Holliday’s monograph is that aging is probably not due to a single mechanism or gene, but is a larger phenomenon. A single mechanism or biological clock does not direct the aging process. This approach to understanding aging is well documented in numerous articles in the gerontological literature, and it is the feeling of these reviewers that the essence of aging is referable to the multiplicity of factors. The concept that this breakdown of homeostatic mechanisms may have its origin at the molecular and cellular level is appropriate. However, it is equally important to consider that for the changes at these levels to be designated as fundamental to the aging process, their role in the breakdown of homeostatic systems must be documented. The Holliday monograph emphasizes, and the reviewers concur, that there is probably not one single gene that determines the senescent phenotype and that there are many genes that relate in some way to the maintenance mechanisms and their ultimate decline.

An important area covered in the monograph by Holliday is the relationship of pathology to aging. The author appears to believe that pathology should be considered part of the aging process rather than a separate phenomenon. This is a major issue in gerontology. Whether pathology and aging are two separate processes and how they relate to each other is still important questions to resolve. While Holliday addresses this issue, no resolution emerges from his consideration. Nevertheless, it is helpful to continue to focus on this issue. Without this kind of understanding, attempts or efforts to modify the aging process may not be fruitful.

Another important issue considered in this monograph is that animals must survive long enough to produce adequate numbers of offspring. This kind of conceptual approach to aging has been cited before, but in the context of an overall consideration of understanding aging, this reiteration seems inappropriate.

Influences which may modify the aging process are also noted by Holliday. In order for one to have a meaningful approach to understanding modulators of the aging process, more fundamental research into the aging process is required. Holliday’s statement that “the search for the elixir of life is as fanciful as the transmutation of metals into gold” is somewhat strong, but it certainly captures the status of attempts to prolong longevity in the absence of sufficient fundamental knowledge of the basic process of aging.

We feel that Holliday’s book is a contribution to our understanding of the aging process. It is well documented and footnoted.

Butler’s and Brody’s Delaying the Onset of Late-Life Dysfunction does not concern itself with as many fundamental considerations as Understanding Ageing. But the overall approach in this monograph is similar in terms of explaining aging, namely, that aging is due, at least in part, to the breakdown of physiological homeostatic mechanisms. Numerous examples are cited and discussed, such as the cardiovascular system, the glucocorticoid cascade in the hippocampus, and the plasticity of the nervous system among others. The issue of dysfunction resulting from the basic process of aging and dysfunctions that are caused by disease are considered once again, attributing to the importance of resolving the relationship between aging and disease.

The volume, like Holliday’s, emphasizes that programmed aging and stochastic aging are both important to consider in explaining the aging process. Exploration of the differences and how each of these account for the aging process and increase in life expectancy should continue to be a major research emphasis in biological gerontology. For example, the book points out that even though Alzheimer’s disease may be considered to be mainly genetic, it might also be due to epigenetic considerations.

While the books reviewed in this essay consider many systems in which manipulations through interventions might delay the onset of late life dysfunction, specific interventions that might be applied to human aging are relatively few. Indeed, it is clear that considerably more work has to be done regarding the fundamental processes involved in aging and in distinguishing between genetic, epigenetic, programmed, and stochastic aspects of aging before efforts to delay the aging process will be successful. As Holliday suggests, the elixir of life still eludes us.

Considering the overall approach of these volumes, it is clear that the knowledge gained at the molecular and cellular level has to be translated into functional components of the cell, tissue and organ system. Once these building blocks are put together, then it might be possible to design an approach to alter the aging process and increase longevity and the quality of life.

There is much to learn about aging. its origin, its evolu-
EXERCISE AND AGING: OH, WHAT A TANGLED WEB WE MORTALS WEAVE!

Exercise in Older Adults, edited by David R. Lamb, Carl V. Gisolfi, and Ethan Nadel. Cooper Publishing Group, Carmel, IN, 1995, 472 pp., no price listed (cloth).


Robert M. Hutchins, the former president of the University of Chicago and editor of the Great Books, once quipped “When I feel like exercising I always lie down until the feeling passes.” Even Hutchins actually exercised, but what is meant by the term exercise? In any given dictionary, exercise has a wide range of definitions, but in the context of physical dimensions and functional performance, the most attractive definition is “to employ the activity of muscles.” If the definition of muscular activity is accepted literally, its broadest interpretation would include even the act of breathing while lying down. With this interpretation, one cannot live without exercising and the end of exercising signals the cessation of breathing, if not blood flow, and the end of life.

In fairness to Hutchins’ quote, most people would restrict the term physical exercise to muscular activity above the level of resting metabolism while either lying down, sitting, or standing. This has given rise to the concept of resting metabolism being one metabolic unit and the measurement of the energy cost of exercise in metabolic units or METs. METs are useful for assessing the intensity of total body activities, but less so for more restricted tasks such as weight lifting.

The concept of METs is presented clearly and concisely by Bonder & Wagner in Chapter 5, Cardiopulmonary Development, in their book on Functional Performance in Older Adults. Despite the usefulness of the concept of METs as an estimate of intensity, even this concept does little to deal with the enormity of the range of different muscular activities. The tangled web that exercise scientists face is this enormity of the range of all aspects of physical exercise involving tasks, intensities, durations and frequencies. For gerontologists interested in physical activity or muscle mechanics, the web becomes ever more tangled because of the decline after age thirty in muscle strength, power (force times velocity of shortening) and endurance (Faulkner, Brooks, & Zerba, 1995). Particularly for the less active older adult, the interplay between a specific task with fixed biomechanical and biochemical requirements and the declining capability of muscles may limit the performance of even the routine tasks of daily living. This issue is addressed by all three books reviewed in this essay.

Each of the three books is designed to assist specific groups of professionals. The audiences range from geriatricians, psychologists, nurses, physical therapists, and social workers to exercise leaders who work directly with the elderly and attempt to maintain or enhance their physical capabilities. In addition, because each book is based on research on topics presumed to interface with the physical exercise and muscular activity during aging, the books are presented as resource books for gerontologists, kinesiologists, exercise scientists, and biomechanists.

The goal of Waneen Spirduso’s Physical Dimensions of Aging is to prepare health professionals who deal with the elderly to assist older people in maintaining physical, intellectual, and emotional independence as long as they can. Dr. Spirduso cares about the plight of older persons. She wants to provide “an informational base of understanding of the physical dimensions of aging and their impact on the aging individual," present the concept of “biological or functional age, and clarify “the roles of health habits and physical exercise on modifying functional age." This book presents a cohesive and integrated picture of the physical dimensions of aging and, overall, is a readable text with excellent graphics. Spirduso’s point that “aging is an individual experience” is well taken and, for most readers the chapter on individual differences will be interesting and informative.

A chapter on physical development and decline is highly traditional, focusing on height and weight; body composition — particularly fat — and factors affecting bone. The lack of any serious treatment in this chapter of the extensive literature on the 40% loss of muscle mass that occurs between 30 and 80 years of age in both men and women, and the underlying factors, is a serious oversight (see Holloszy, 1995). Cardiovascular and pulmonary function are handled in a traditional manner, but the de-