

Aging and Health - A system biology perspective

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Interdisciplinary topics in gerontology, vol. 40

S. Karger AG, Basel, Switzerland

ISBN: 978-3-318-02729-7

Pages 194 pp + XII; Figures: 36;

Color figures: 8; Tables: 9; CHF 180,00

We have been recently told by The United Nations Population Division (an international institute that carries out two-yearly assessment of population age-structure, available at: <http://www.un.org/en/development/desa/population/theme/ageing/index.shtml>) that the demographic structure of the world populations will drastically change by 2050: *The rapid ageing of the world population is one of the major global demographic trends, driven by the reduction of fertility and mortality. The Population Division monitors the global, regional and national trends in ageing and its major socio-economic implications... in most regions and countries of the world the population aged 60 or more is growing faster than younger adults and children, and this has important consequences for the family, the labor market, and public programs directed to different generational groups.* The most recent survey carried on in the year 2013 is forecasting some of the projection trends about the demographic structure of the world populations (trends that encompass the years 2050 and for some forecasts the year 2100). The survey can be downloaded at: <http://www.un.org/en/development/desa/population/publications/pdf/ageing/WorldPopulationAgeing2013.pdf>).

The data presented are impressive and I think useful to read one of the sections: *The number of older persons is growing very fast. At the root of the process of population ageing is the exceptionally rapid increase in the number of older persons, a consequence of the high birth rates of the early and middle portions of the twentieth century and the increasing proportions of people reaching old age. The num-*

ber of older persons is 841 million in 2013, which is four times higher than the 202 million that lived in 1950. The older population will almost triple by 2050, when it is expected to surpass the two billion mark...The trend in the number of older persons in the world is dominated by the fast growth of the older population in the less developed regions, where the size of the older population is 554 million in 2013, which is five times greater than in 1950 (108 million). The number of older people in these regions will further triple by 2050 to attain 1.6 billion. The speed of change in the more developed regions has been impressive too, but significantly slower than in the less developed regions. The older population of the more developed regions tripled between 1950 and 2013, from 94 million to 287 million, and it will increase further in coming decades, reaching 417 million in 2050.

We will become a world of senescent people, obviously with the concomitant emergence of diseases and age-related dysfunctions, since aging is a major risk factor for chronic diseases: actually, in epidemiology and demography, most rates, such as incidence, prevalence, mortality, are strongly age-dependent, with risks rising (e.g., chronic diseases) or declining (e.g., measles) with age. In part this is biological (e.g., immunity acquisition), and in part it reflects the hazards of cumulative exposure, as is the case for many forms of cancer. Thus, the readers will immediately understand while a *new knowledge on biological aging within a systems biology framework* is a welcome study enriching the *Interdisciplinary Topics in Gerontology* series (edited by Tamas Fulop) and published by Karger AG (Basel). In something like twelve pages of introduction the two editors are tracing an historical perspective of the *system biology* discipline summarizing for the benefit of a broad spectrum of readers the content of each of the thirteen chapters. This fact helps to fully understand one of their pursued objectives: to highlight that the multifaced phenomenon of aging can be profitably understood (by students, researchers as well as professionals dealing

with public health) and managed (by professionals dealing with the public policy of aging societies) only within this scientific framework. Beginning chapters introduce to the network systems analysis, something necessary to fully appreciate the multifaced aging phenomenon in its basic (i.e., eco-evo-developmental aspects) and applied (i.e., social and medical aspects) relevance.

Later on we are facing some theoretical biological questions like the meaning of aging for all of the biological systems, which are the theories that can account for this phenomenon. Contrasting theories, some telling us that aging is not supposed to be evolved by Darwinian processes like natural selection (being a post-reproductive phenomenon) while others invoke precisely natural selection to explain the fixation of aging. Very interesting are those chapters that explain epigenetics, biological clocks, circadian cycles and many other universal phenomena (in animals and plants) to study aging in animal models and how much of this knowledge we can translate to human medicine, just think to the unresolved question among gerontologists if aging is a programmed or non-programmed phenomenon. Other chapters deal with the quantitative methods we handle to characterize the state of aging, the immunosenescence, the pharmacological interventions to slow aging and the gut microbiota contribution to the well being (a very hot topic for the nutrigenomics). Quite interesting, the last two chapters highlight the rooms we can experience for the development of interventions to delay or reverse the features of aging. That is to say, in other words, that we still have to continue to study this fascinating phenomenon!

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