Heterochronic Parabiosis

Anti-Aging Plasma Exchange

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First Edition
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1. Why Is Anti-Aging Important?

Since thousands of years ago, mankind had begun the pursuit of longevity and hoping to feel and look young forever. However, to the surprise of many, modern medical society did not pay much attention to aging-related problems until the late 20 century.

Two hundred years ago, the average lifespan of humans was only 40 years. At that time, people, in general, could not live long enough to experience the aging processes.

Due to the birth of modern medicine, within the next 100 years, the average lifespan experienced a rapid rise to 55 years, which was further extended by another 25 years to reach the current life expectancy of 80 years old during the past 100 years. If this trend were able to continue, at this speed of 20 to 30 years per 100 years, some scientists project that the human life span will eventually reach the 150 years mark. However, this is unlikely to be the case.

Let us examine the age of death of United States women over the past 85 years. (Figure 1) The x-axis is the age of death, the y-axis is the number of people who died. The line on the left side is the age of death curve in 1933 and the line on the right is the age of

death curve in 2014. From the figure, we can see that in 1933, there were 2 peaks in the curve. The first peak occurs at birth and the other peak occurs between 70 and 90 years of age. On the other hand, there was only one peak of the 2014 age of death curve between 85 and 95. This implies that the largest increase in the average life expectancy over the past 85 years occurs due to the decrease in mortality at birth (mostly due to the advances in obstetrics and neonatal care). If we eliminate the influences of this, the actual extension in average life span was less than 15 years over the last 80 years.

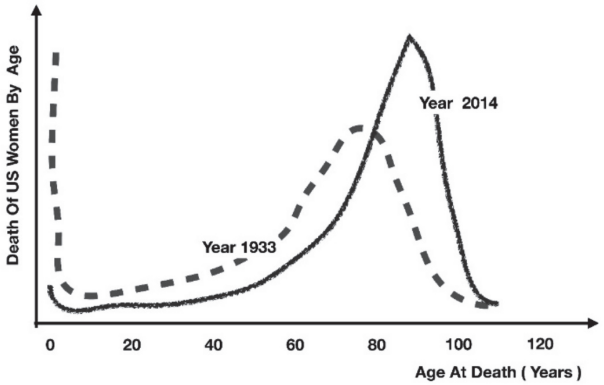

Figure 1: The distribution of death at different ages in the United States in 1933 and 2014. This indicates that the extension of the average lifespan over the last 80 years is mostly due to the decrease of mortality at birth. The average human lifespan seems to converge to the age of 90 to 100 years old. (Source: demogr.mpg.de)

Furthermore, from the changes in the spread of the above age of death curve, we also observe that the distribution of the age of death narrowed significantly over the last 80 years. This seems to imply that most people will eventually die at the same age bracket, e.g., between the age 90 and 100 as the standard of medical care continues to improve in the future; rather than extending to 150 years old as some optimistic scientists might suggest.

Should we be happy about the life extension phenomena?

According to the WHO (World Health Organization), the profile of the disease for the causes of death was very different 100 years ago. At that time (in early 1900), the most prevalent diseases and cause of death were infectious, e.g., pneumonia, influenza, tuberculosis, and gastrointestinal diseases. Over the last century, the profile of causes of death has changed dramatically. Cardiovascular, malignant tumors (e.g., cancers), and chronic obstructive pulmonary disease become the top 3 causes of death in 2018. These changes are mostly due to the advances in three important advances in medicine, namely: anesthesiology, transfusion, and antibiotics.

As people can live to an older age, aging-related diseases also begin to surface. For illustrative purposes, let us take osteoporosis as an example. Assuming the osteoporosis will occur 10 years after menopause which on average occurs at age of 50. When the

average life span is less than 50 years, only a few women can live to experience menopause and there will be very few women who can live to suffer from osteoporosis. When the average life span is between 50 and 60, there will be many people who can live to experience the menopausal symptoms, but still very few will contract the osteoporosis diseases. When the average life span passes 60, every woman will suddenly live to an old age, which allows them to experience both signs and symptoms of menopausal and osteoporosis. As a result, people will have a bone fracture from a fall and will crowd the hospital if the governing agency is not prepared ahead of time.

From the disease prevalence curve (Figure 2), we can observe that from the adult-onset Type 2 Diabetes to Cardiovascular disease, to neurodegenerative diseases, to cancer and even Covid-19, almost all of the disease incidence increases with age. The incidence of 9 out of the 10 most common diseases in developed countries, i.e., cancer, cardiovascular diseases, pneumonia, cerebrovascular incidence, diabetes, COPD, high blood pressure, nephritis, Chronic renal failure, and Cirrhosis, are in proportion to age.

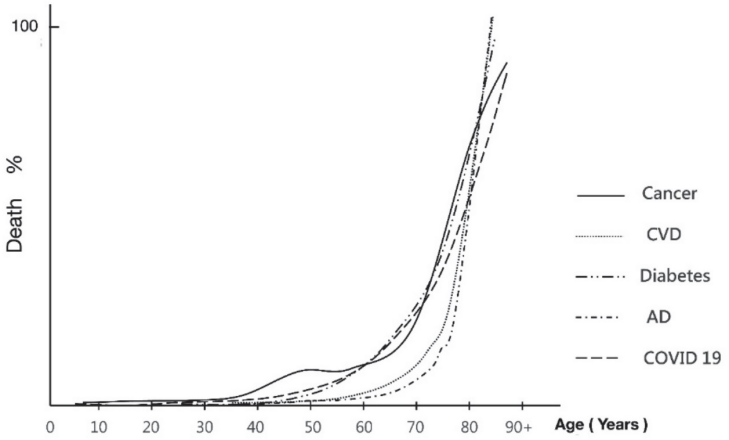

Figure 2. Prevalence of common diseases with age. The probability of contracting cardiovascular diseases, cancer diabetes, neurodegenerative diseases, and Covid-19 increases with age. As the result of increases in life span, they replaced infectious and gastrointestinal diseases to become major causes of death in developed countries,

Most of the citizens over the age of 65 are diagnosed with multiple diseases. According to a recent study in Taiwan (who has a complete medical history of her citizen under the National Health Service program), 50% of the senior were diagnosed with hypertension, 20% with Diabetes, 10% has hepatobiliary problems, and as high as 7% of this population has chronic renal diseases. This data suggests that most of the seniors are literally in the octant state of illness by definition, with further extension in life span, the length of suffering from the diseases also increases (Figure 3). It is estimated that the last 20% of our

natural life span is accompanied by at least one or more chronic diseases and the unhealthy lifespan also increases steadily as the healthy life span increases.

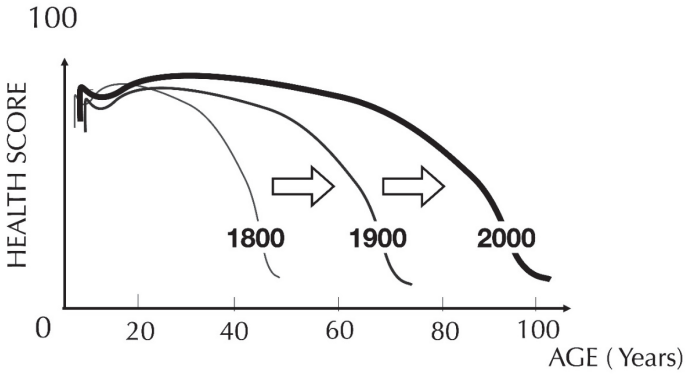

Figure 3. The relation between health and age. Over the last two centuries, the average lifespan of mankind continued to increase steadily. However, at the same time, many aging-related chronic diseases have also become more and more prevalent. This resulted also in increases in unhealthy life span.

In summary, due to the advances in medicine, the human lifespan has almost doubled over the past 200 years. However, this extension comes with the cost of increases in numerous chronic diseases and tremendous social economic burdens to society. Furthermore, it also created a vicious cycle of increases in unhealthy life span. At present, most of the seniors usually are

living with and suffer from a few illnesses and hundreds of thousands of them are handicapped or bedridden, which greatly reduced the happiness that could have been achieved with the life span extension.

The general public and medical society should place a greater interest and effort to promote lifestyles in anti-aging and anti-chronic diseases. In contrary to the use of extreme therapies, e.g., respirators, ECMO (i.e., Extracorporeal Membrane Oxygenator), etc., to extend the unhealthy life span.

The goal of the next generation of medicine should be using preventive medicine or regenerative medicine to slow down or even reverse the effect of age (i.e., the aging processes) exerted in health, to maximize the length of healthspan, and preserve independent life until the very end of life (Figure 4).