

# Japanese Super Aging Society and Frailty Syndrome

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## Abstract

In the developed countries including Japan, the average life expectancy is expected to exceed 90 years in the near future. And major causes of death of the super-elderly shift from cancer and cardiac infarction to senility, dementia and pneumonia. These diseases of super-elderly are related to gradual deterioration of both physical and mental abilities to maintain proper condition of daily activities. Several terms have been suggested to describe weaken condition of the super-elderly such as geriatric syndrome, locomotive syndrome, sarcopenia and frailty. Among them, frailty seems to provide an easy-to-understand concept as a word that comprehensively captures both physical and mental deterioration caused by aging. Cycle of frailty causes not only sarcopenia and undernutrition but also decline of life defence mechanism including immune system, homeostasis and surface barrier system. To prevent from the frailty, muscle training, especially resistant muscle training, has been reported as beneficial. Traditional resistance trainings for elderly including Yoga in India, Tai chi, Falun Gong and Qigong in China, may be beneficial since those trainings use abdominal breathing. In Japan, Judo exercises are also tried to prevent the frailty.

## Introduction

Mausner and Kramer described a definition of primary, secondary and tertiary prevention in their famous epidemiology text together with the famous schematic representation of the natural history of the disease [1]. The distinction between primary, secondary and tertiary prevention is useful and applicable to many types of health problems including infectious diseases, cancers and metabolic syndromes, providing the basis for the prevention strategy. However, recent improvements in health care standards in the developed countries including Japan, are entering the stage of how to maintain the health of super-elderly who have no particular illness other than age-appropriate decline both mentally and physically. In them boundary between primary, secondary and tertiary prevention became obscure. The global COVID-19 pandemic revealed a strong dependence of the age on the degree of deterioration in health due to unexpected external factors, although the existence of excessive mortality from influenza or pneumonia among elderlies has been known for a long time (Figure 1).

## Age-dependency of Major Causes of Death

Until several years ago, malignant neoplasm, cardiac diseases and cerebrovascular diseases were the three leading causes of death in Japan. Recently, however, senility and pneumonia exceeded cerebrovascular disease.

Main reason of this change is prolongation of life expectancy and difference in age-dependency among causes of death. Figure 2 shows the proportion of main causes of death and their transition by age group processed from the 2019 vital statistics [2]. Though malignant neoplasm occupies almost half of death in the age group from 65 to 75, it decreases to 8% in the over 95 age group. On the other hand, senility and pneumonia rapidly increase their proportions in the higher age groups. Proportion of cardiac diseases also slightly increase with age, mainly due to increase of chronic heart failure which recently exceed deaths of acute cardiac infarction in Japan. Proportions of cerebrovascular diseases is almost the same in any groups of elderlies.

This transition of causes of death by age groups can be explained by examining the age mortality curve of each cause of death. In Figure 3, the age-specific mortality rate of malignant neoplasm, pneumonia

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and senility are compared. People begin to die of malignant neoplasm early at the age of 40 and gradually increase with age. On the other hand, pneumonia and senility begin to increase at a much later age, but the rate of the increase is faster in pneumonia and much faster in senility, so the mortality rate of malignant neoplasm is exceeded by them before the age of 95. As most people die at the age around the average life expectancy, the shift in average life expectancy from left to right, which has just occurred and is occurring in developed countries including Japan, increases the percentage of highly age-dependent causes of death that increases mortality in the super-elderly.

## Frailty and Highly Age-dependent Causes of Death

These highly age-dependent causes of death, therefore, have risen in the mortality rate ranking in Japan in recent years. What is common to these causes of death is, of course, derived from the decline of the physical function due to aging. The most prominent among them, senility, means failure of the multiple vital organs due to aging. The next prominent cause of death, pneumonia, also related to decline of the multiple life maintaining functions, including immune system, respiration, and swallowing.

Dysphagia causes aspiration pneumonia which takes up about half of the pneumonia in the elderlies. Like chronic heart failure or chronic kidney disease, COPD is primarily caused by a single vital organ malfunction due to aging, although smoking and metabolic syndrome often exist as an underlying state. Accidental death is also known to be highly age dependent. It occurs when neuromuscular function and brain function decline. Among them, fall is directly related physical frailty, and asphyxiation results from decline in breathing and swallowing function. Drowning in a bathtub is also a characteristic cause of death for Japanese elderlies.

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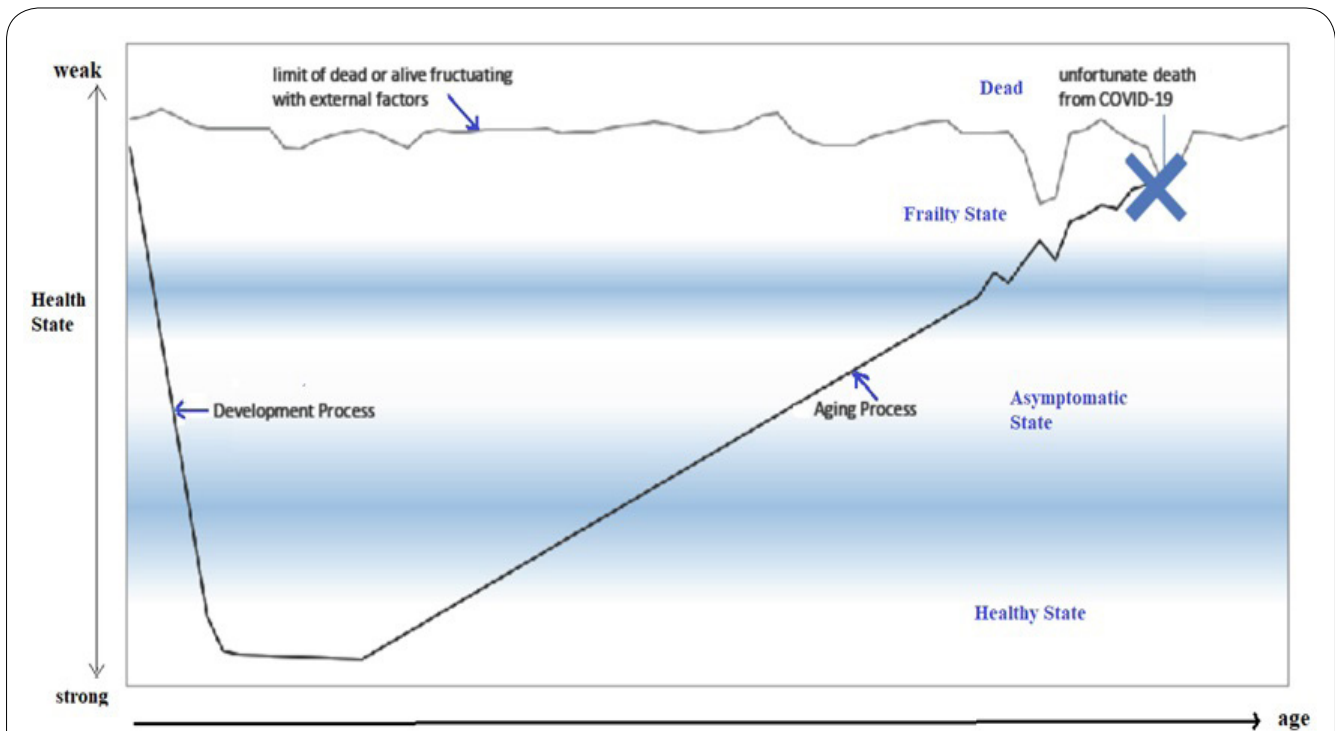


Figure 1: Natural History of Frailty. Humans are the most vulnerable in their infant and old age. It gets stronger as it develops. Between the teens and twenties are the hardest time to die. After that, aging begins, and gradually becomes vulnerable until death. If aging progresses gradually, the boundary between a completely healthy state and an asymptomatic state (but frailty is processing) is unclear. Also the boundary where frailty manifests itself is relatively ambiguous. Death occurs when frailty fails to push back life-threatening event.

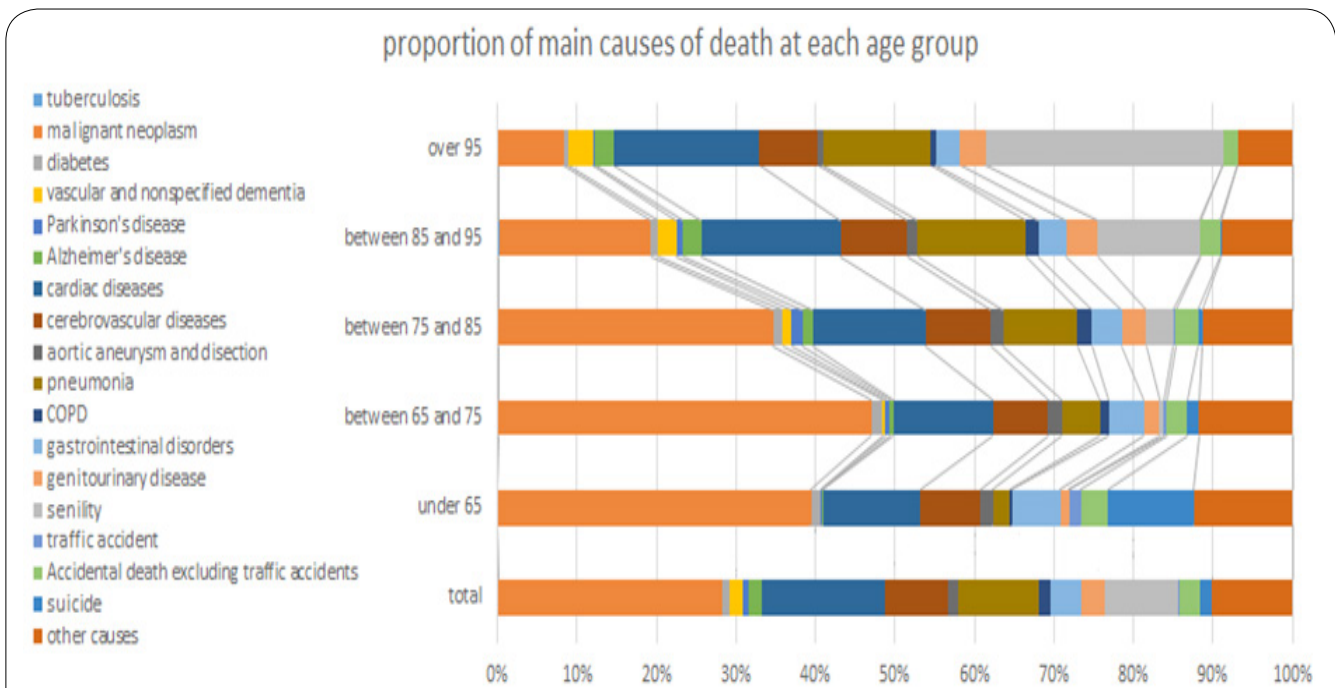
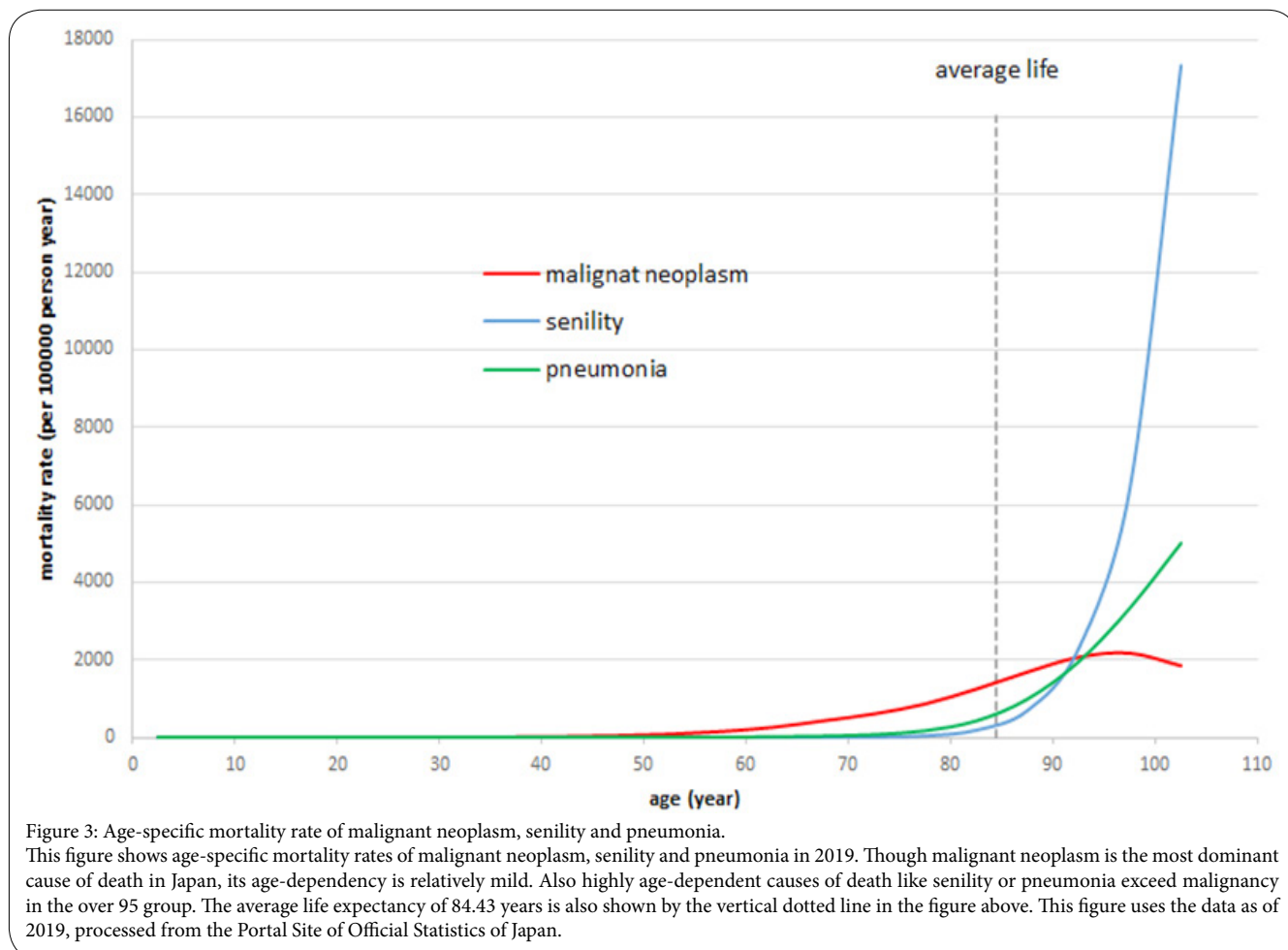


Figure 2: Proportion of main causes of death at each age group. In total, malignant neoplasm occupies about 27% of deaths, followed by cardiac diseases of 15%, pneumonia about 10%, senility about 9% and cerebrovascular diseases about 8%. In the age group between 65 and 75, malignant neoplasm reaches 46%, but gradually decreasing in the higher age groups, which only occupies 8% in the over 95 age group. On the other hand, senility and pneumonia increases rapidly from the 65-75 group to the over 95 age group. Cardiac diseases also slightly increase from the 65-75 group to the over 95 age group. As for the over 95 group, senility 29%, cardiac diseases 18% and pneumonia 13% exceeded the rate of malignant neoplasm. This figure uses the data as of 2019, processed from the Portal Site of Official Statistics of Japan.



### Frailty Syndrome and Other Similar Concepts

Many concepts and terms have been proposed that describe the pathological condition of age-related decline in physical function including geriatric syndrome [3], locomotive syndrome [4], disuse syndrome [5] and sarcopenia [6]. Frailty or frailty syndrome is one of them that successfully accepted. Fried and her colleagues proposed a scheme called the Cycle of frailty in explaining the concept of Frail [7]. They regarded that the core problem of frailty is the vicious cycle between weakening of muscle strength and limitation of activities. Weakened musculature called sarcopenia causes limitation of activities, which causes muscle weakening as disuse syndrome. Although sarcopenia itself is not life threatening, undernutrition and bedridden conditions, which is concomitant with sarcopenia, are the major risk factors for pneumonia, especially aspiration pneumonia.

An assessment of frailty includes both mental and physical functions, and many modified methods using pictures for instance are used as well as original assessment provided by Fried et al.

### Measure for Frailty

To get out of the vicious cycle of frailty, muscle training, especially resistance training has been reported as beneficial. In Japan, as a measure to prevent bedridden conditions, local governments have been recommending elderlies to do light exercises such as walking or playing games together. With the establishment of the concept of

frailty in recent years, each local government is actively working on the implementation of frailty prevention classes [8].

As resistance training for elderlies, several ethnic exercise methods have been shown to be effective [9]. Yoga exercise in India is worldly famous. In China, Qigong, Tai chi and Falun Gong are popular. And in Japan, Judo exercises are also tried to prevent frailty [10].

### Competing Interests

The authors declare that they have no competing interests.

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